

**REOPENING THE AMERICAN FRONTIER:
EXPLORING HOW THE OUTER SPACE TREATY
WILL IMPACT AMERICAN COMMERCE
AND SETTLEMENT IN SPACE**

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE, SCIENCE,
AND COMPETITIVENESS

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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MAY 23, 2017
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Printed for the use of the Committee on Commerce, Science, and Transportation



Available online: <http://www.govinfo.gov>

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U.S. GOVERNMENT PUBLISHING OFFICE

29-998 PDF

WASHINGTON : 2018

For sale by the Superintendent of Documents, U.S. Government Publishing Office
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ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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CONTENTS

	Page
Hearing held on May 23, 2017	1
Statement of Senator Cruz	1
Letter dated May 22, 2017 to Hon. John Thune and Hon. Bill Nelson from Christopher Johnson, J.D., LL.M., Space Law Advisor, Secure World Foundation and Ian Christensen, Project Manager, Secure World Foundation	3
Letter dated May 17, 2017 to Senator Ted Cruz, Chairman; and Senator Edward Markey, Ranking Member, and Members of Space, Science, and Competitiveness Subcommittee from Michael J. Listner, Esquire, Space Law & Policy Solutions	7
Letter dated May 22, 2017 to Hon. Ted Cruz and Hon. Edward Markey from Arthur M. Dula, Trustee, and J. Buckner Hightower, Trustee, Heinlein Prize Trust	12
Statement of Senator Markey	2
Statement of Senator Nelson	14
Statement of Senator Peters	46
Statement of Senator Hassan	49

WITNESSES

James E. Dunstan, Founder, Mobius Legal Group, PLLC	14
Prepared statement	16
Laura Montgomery, Attorney and Proprietor, Ground Based Space Matters, LLC	24
Prepared statement	25
Matthew P. Schaefer, Veronica A. Haggart & Charles R. Work Professor of International Trade Law; Co-Director—Space, Cyber and Telecommuni- cations Law Program, University of Nebraska College of Law; and Co- Chair, American Branch of International Law Assoc. Space Law Com- mittee	31
Prepared statement	32
Robert (Bob) Richards, Founder and Chief Executive Officer, Moon Express, Inc.	54
Prepared statement	55
Peter Marquez, Vice President for Global Engagement, Planetary Resources ..	60
Prepared statement	62
Mike Gold, Vice President, Washington Operations and Business Develop- ment, Space Systems Loral	64
Prepared statement	66
Pamela A. Melroy, U.S. Air Force (Retired), and former Astronaut	72
Prepared statement	73

APPENDIX

Letter dated May 24, 2017 to Hon. John Thune and Hon. Bill Nelson from the International Institute of Space Law	85
Letter dated June 5, 2017 to Hon. John Thune and Hon. Bill Nelson from Eric Klein, Lifeboat Foundation	87
Response to written questions submitted by Hon. Bill Nelson to:	
James E. Dunstan	88
Laura Montgomery	95
Matthew P. Schaefer	95
Peter Marquez	96
Mike Gold	97
Pamela A. Melroy	98

**REOPENING THE AMERICAN FRONTIER:
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WILL IMPACT AMERICAN COMMERCE
AND SETTLEMENT IN SPACE**

TUESDAY, MAY 23, 2017

U.S. SENATE,
SUBCOMMITTEE ON SPACE, SCIENCE, AND COMPETITIVENESS,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:31 p.m. in room SR-253, Russell Senate Office Building, Hon. Ted Cruz, Chairman of the Subcommittee, presiding.

Present: Senators Cruz [presiding], Gardner, Nelson, Markey, Peters, and Hassan.

**OPENING STATEMENT OF HON. TED CRUZ,
U.S. SENATOR FROM TEXAS**

Senator CRUZ. Good afternoon. This hearing is called to order.

Fifty years ago, the United States and the Soviet Union were locked in a period of intense international crisis. Two decades of the Cold War had resulted in the Berlin Blockade, the Soviet Union's testing of the atomic bomb, the successful launch of Sputnik, the Cuban Missile Crisis, and the Vietnam war. However, despite the prolonged period of intense international crisis, a remarkable event occurred. The United States and the Soviet Union were able to come together and author the Outer Space Treaty, which was intended to become a foundation for all future activity in outer space.

The main tenets of the treaty include the prohibition of the placement of nuclear weapons and other weapons of mass destruction in space or on a celestial body; the requirement that states are responsible for national space activities, whether carried out by governmental or non-governmental entities; and states that outer space, including the Moon and other celestial bodies, are not subject to national appropriation by claim of sovereignty. Following ratification by the Senate, the United States, the United Kingdom, and the Soviet Union were among 60 nations to sign the Outer Space Treaty, with signing ceremonies in Washington, D.C., London, and Moscow, on January 27, 1967. President Lyndon B. Johnson hailed the signing of the Treaty as, "an inspiring moment in the history of this human race."

However, in the half century that has since passed, many articles of the Treaty haven't been fully tested, as the majority of activities

in space have primarily been carried out by governmental entities. But that could soon change as the United States is poised to lead an explosion in commercial space activity that will see American companies look to land on the surface of the Moon, service satellites, and mine asteroids which may contain platinum and other precious metals valued upwards of trillions of dollars.

While the future appears bright, we cannot afford to become complacent. The United States does not stand alone in this new emerging space race. Just last month, it was announced that China and the European Space Agency are interested in creating an outpost on the Moon.

As activities in space increase, they will undoubtedly pose new challenges as countries and companies compete for resources throughout the universe. We should anticipate that there will be conflicts as countries and private industry race to reach areas of the Moon that hold significant advantages, such as the, “peaks of eternal light” and the lunar sites that may hold vast quantities of water. These sites will provide economic and operational advantages for those who reach them first.

Therefore, it’s incumbent on Congress to use this 50-year anniversary of the Outer Space Treaty to properly determine our actual international obligations, to decide if specific articles in the treaty are self-executing or not, and to ensure that our domestic policy moving forward creates an environment that provides certainty for industry while protecting our national security. Those decisions will be made by this committee, by the Senate as a whole, and by the Congress and the President.

In this committee, this is the second in a series of hearings looking at reopening the American frontier in space. That’s why we’re gathered here today. The testimony that this committee will hear will help pave the way to the future of space exploration and our global competitiveness. Every little boy and every little girl knows the experience of looking up into the night sky, looking to the stars and wondering what’s out there. That’s the mystery, that’s the wonder that is behind this collective endeavor in which we’re engaged.

If this committee can, working together in a bipartisan manner, as it has succeeded in doing for several Congresses now—if we can come together behind a strong national space policy that ensures continued American leadership in space, then I have no doubt that in the not too distant future, those same little boys and little girls will be looking up at the Moon, looking up at Mars, and looking up at Americans walking on the surface of those bodies, perhaps living on the surface of those bodies, exploring new opportunities that the mind can scarcely imagine. That’s what this hearing is all about.

With that, Senator Markey.

**STATEMENT OF HON. EDWARD MARKEY,
U.S. SENATOR FROM MASSACHUSETTS**

Senator MARKEY. Thank you, Mr. Chairman, very much, and thank our witnesses.

This is a very, very forward-looking hearing, because we’re going to be looking at how our policy can support a growing commercial

space industry. We are here today to explore how the Outer Space Treaty impacts commerce, impacts settlement in space, and impacts what may be needed to provide a regulatory framework that grants certainty to businesses and investors and establishes an international understanding of expectations for countries and companies operating in space.

The Outer Space Treaty provides a set of principles for space activities that guides all countries and is an important foundation to build upon to ensure America's interests are preserved in outer space. There are things that were not anticipated or planned for in this treaty when it was negotiated in the late 1960s. The testimony today will explore some of those issues and how U.S. policy might help address some of those concerns.

In particular, Article VI of the Treaty, which gives governments the responsibility for all space activities from their nation, whether undertaken by the government or not, has been an issue. I look forward to hearing the views of our witnesses on what is needed to create effective and efficient policies that will promote the reasonable, rational, safe, and fair use of space. Space policies need to include room for all nations' responsible activities, for small businesses as well as large, and for science and non-profit activities as well as for-profit activities in this new frontier.

The United States continues to be a pioneer in space activities, and our policy should support the continued innovation that has been the key to America's economic success. I look forward to working with this subcommittee and stakeholders to ensure that America continues to be a leader in space.

I look forward to working with you, Mr. Chairman, and leaders like Senator Peters and Senator Hassan to accomplish that goal.

Senator CRUZ. Thank you, Senator Markey.

At the outset, without objection, I want to enter into the hearing record a letter from the Secure World Foundation, a letter from Michael J. Listner of Space Law and Policy Solutions, and a letter from the Heinlein Prize Trust.

[The information referred to follows:]

SECURE WORLD FOUNDATION
May 22, 2017

To: U.S. Senate Committee on Commerce, Science, and Transportation
 Senator JOHN THUNE, Chairman
 Senator BILL NELSON, Ranking Member

CC: U.S. Senate Subcommittee on Space, Science, and Competitiveness
 Senator TED CRUZ, Chairman
 Senator EDWARD MARKEY, Ranking Member

Subject: Letter for the record for the hearing on "Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space"

Mr. Chairman, Ranking Member Nelson, and Members of the Committee,

The Secure World Foundation (SWF) is a non-governmental organization dedicated to ensuring the long-term sustainable use of outer space. We believe that strong, predictable, and coherent governance frameworks which take into account the long-term interest of all stakeholders are fundamental to ensuing sustainability and progress in space activities. As such, SWF has a keen interest in the topics to be discussed at the hearing organized by your Subcommittee on May 23, 2017. We submit the following letter in support of the Subcommittee's deliberations.

1. The United States was the driving force behind the Outer Space Treaty

The U.S. Government was the driving force behind the negotiation and drafting of the 1967 Outer Space Treaty, in large part because it supported U.S. national security interests. At the time, a major U.S. policy objective was to enable the use of satellites to gather intelligence on the Soviet Union, and the principle of “peaceful uses” supported that goal. In May 1966, President Lyndon Johnson instructed Ambassador to the U.N. Arthur J. Goldberg to bring to the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) a draft treaty on space for its expedient negotiation and finalization.¹ Borrowing from previous instruments, the American draft formed the majority of the final text of the Treaty. The Treaty was subsequently sent to the U.N. General Assembly in December 1966 for adoption in U.N. Resolution 2222, and opened for signature in Washington, London, and Moscow. A signing ceremony was held at the White House on January 27, 1967,² where President Johnson commended the Treaty as a step towards the peaceful uses of space.³ At the U.S. Senate Foreign Relations Committee hearings on ratifying the Treaty, Secretary of State Dean Rusk and Ambassador Goldberg testified to the Treaty’s worth as both an arms control measure that protects U.S. national security and ensured private sector access to space.⁴ The Treaty entered into force in October 1967, and the United States serves as one of the Depository Governments for signatures by states becoming party to the Treaty. As 2017 is the fiftieth anniversary of the Outer Space Treaty, the United States can rightly be proud of its international treaty-making effort, which continues to serve as the foundation of the international legal framework for all space activities.

2. Private space activities were ensured, protected through U.S. negotiation

During the negotiations of the Outer Space Treaty, the United States was able to secure the right of the private sector to engage in space activities. The language in the Outer Space Treaty permitting non-governmental private actors to explore and use space is taken from an earlier U.N. Resolution on space, the 1963 Principles Declaration.⁵ In that Resolution’s negotiation phase, a draft submitted by the Soviets would have prohibited all non-governmental private activities in space. The Soviet proposal read “all activities of any kind pertaining to the exploration and use of outer space shall be carried out solely and exclusively by states.”⁶ The American counterproposal offered a compromise which assigned responsibility and liability to a state for launches from its territory and for launches to which it gave assistance or permission.⁷ The Soviets accepted this compromise permitting private non-governmental entities, and three years later this language from the 1963 Principles Declaration made its way unmodified into Article VI of the Outer Space Treaty. In summary, the legality of commercial uses of outer space is a success of American foresight and diplomatic skill.

3. The Outer Space Treaty is part of a permissive, open system

The Outer Space Treaty creates a legal framework that is inherently permissive in its nature. The full title of the Outer Space Treaty is the ‘Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.’ As the title shows, this Treaty is a treaty of principles, rather than an exhaustive and comprehensive delineation of

¹The American Presidency Project, *Lyndon B. Johnson—Statement by the President on the Need for a Treaty Governing Exploration of Celestial Bodies*, 7 May 1966. Available at: <http://www.presidency.ucsb.edu/ws/?pid=27581>.

²British Pathé, *Space Treaty Signed in Washington (1967)*. Available at: <https://youtu.be/086Ygv-4ras> and <https://youtu.be/s80lCpkSzZA>. See also: The LBJ Library, *The President-January 1967*. Available at: <https://youtu.be/gF5OZ7nANTI?t=25m55s>.

³The American Presidency Project, *Lyndon B. Johnson—Remarks at the Signing of the Outer Space Treaty*, 27 Jan. 1967. Available at: <http://www.presidency.ucsb.edu/ws/?pid=28205>.

⁴*Treaty on Outer Space: Hearings Before the S. Comm. on Foreign Relations*, 90th Cong., 7, 27–29 (1967) (Statements of Sec. of State Dean Rusk and Arthur J. Goldberg, Ambassador). Available at: <http://bit.ly/2qyy5fr>.

⁵UN General Assembly Resolution 1962 (XVII), 13 Dec. 1963, *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*, Principle 5. Available at: <http://www.un-documents.net/a18r1962.htm>.

⁶UNITED NATIONS, COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, UNION OF SOVIET SOCIALIST REPUBLICS: DRAFT DECLARATION OF THE BASIC LEGAL PRINCIPLES GOVERNING THE ACTIVITIES OF STATES PERTAINING TO THE EXPLORATION AND USE OF OUTER SPACE, A/AC.105/L.2 (1962) pg. 2, para. 7. Available at: http://www.unoosa.org/pdf/limited/l/AC105_L002E.pdf.

⁷UNITED NATIONS, COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, LETTER DATED 8 DECEMBER 1962 FROM THE REPRESENTATIVE OF THE UNITED STATES OF AMERICA TO THE CHAIRMAN OF THE FIRST COMMITTEE, A/C.1/881, at para. 6. Available at: http://www.unoosa.org/pdf/garecords/A_C1_881E.pdf. See also Michael Gerhard, *Article VI*, in COLOGNE COMMENTARY ON SPACE LAW-VOL. 1, 105 (Hobe, Schmidt-Tedd & Schrogl eds., 2009).

precise rights and obligations in every circumstance,⁸ and it is focused on enabling *use* of outer space.

The Treaty's articles contain a finite body of obligations which serve as limits to the freedom established in Article I. They include the duty to render assistance to foreign astronauts and to return both them and foreign space objects to their launching state (Art. V), the duty to bear international responsibility for all national space activities (Art. VI), the duty to authorize and continually supervise the activities of non-governmental actors (Art. VI), and the duty of international liability to other States Parties to the Treaty for damage from launched space objects (Art. VII). Additionally, articles prohibit the placement of nuclear weapons or other weapons of mass destruction into space or on celestial bodies (Art. IV), the prohibition on space activities causing harmful contamination of celestial bodies and adverse changes in the Earth's environment (Art. IX), and the prohibition on the national appropriation of outer space, including the Moon and other celestial bodies (Art. II). This short list of obligations are the only limits to the freedoms enshrined in Article I.

The Outer Space Treaty is the foundation of subsequent international law on space. The Outer Space Treaty's Article V, protecting astronauts, was expanded and its provisions clarified in the 1968 Astronaut Rescue and Return Agreement. Articles VI and VIII were expanded and clarified in the 1972 Liability Convention. Lastly, Article VIII dealing with registration was expanded and clarified with the 1975 Registration Convention. In 1986 the UN General Assembly adopted a resolution describing Principles Relating to Remote Sensing of the Earth from Space, providing non-binding yet generally accepted guidelines clarifying the relationship of space-based remote sensing activities to international law. This further work was done within COPUOS and led by the United States, and these efforts demonstrate that the Outer Space Treaty is the foundation of a system which is open to expansion, clarification, and modification.

Aside from this short list of finite obligations, the framework established by the Outer Space Treaty is quite permissive. A general presumption in international law is the *lotus principle*, or that "that which is not explicitly prohibited is therefore permitted."⁹ Taking into account that the Outer Space Treaty refrains from directly addressing or regulating various emerging and prospective activities in outer space, applying the *lotus principle* to the gaps in the Treaty demonstrates that the Outer Space Treaty does not clearly restrict any of the commercial activities that so excite and inspire the American space community.

4. The Outer Space Treaty has supported 50 years of commercial activity

Over the last five decades, the Outer Space Treaty has enabled commercial uses of outer space to become a global and multibillion dollar industry. In 2015, worldwide revenues from commercial space products, services, manufacturing, and infrastructure surpassed \$247 billion, according to annual figures compiled by the U.S. Space Foundation.¹⁰ Much of this activity is conducted by U.S. companies and individuals: the United States leads the world in the number of satellites manufactured, and, in 2015, the United States conducted more commercial space launches than any other country.¹¹ Sources of capital that are enabling innovative space start-up activity are concentrated in the United States as well: a 2016 industry report found that 66 percent of the more than 250 identified investors in space start-ups are U.S.-based, while the remaining 34 percent were distributed through 25 different countries.¹²

These commercial uses of outer space have developed—indeed flourished—under domestic law developed in consistency with the system of international space law, of which the Outer Space Treaty is a foundational component. Working under the principles of the Outer Space Treaty, the United States and other governments have developed and implemented domestic legal and regulatory frameworks to enable

⁸See also footnote 4, testimony of Dean Rusk "The treaty is not complete in all possible details. It does not deal with all problems that may develop. But it is responsible to those problems that can be described and forecast today." (pg. 4).

⁹See generally IAN BROWNIE, PRINCIPLES OF PUBLIC INTERNATIONAL LAW 291 (7th ed.) (2008) "Restrictions upon the independence of States cannot be presumed"; HUGH THIRLWAY, THE LAW AND PROCEDURE OF THE INTERNATIONAL COURT OF JUSTICE, Vol. 1, 505 (2016).

¹⁰U.S. Space Foundation, *The Space Report 2016—Overview*. Available at: https://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2016_OVERVIEW.pdf.

¹¹Bill Canis, *Commercial Space Industry Launches a New Phase* (Congressional Research Service Report R44708), Dec. 12, 2016, 2. See also Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation 2016*, Available at: https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2016_Compndium.pdf.

¹²The Tauri Group, *Start-up Space*, 2016.

several categories of commercial activities. It cannot be said that the Outer Space Treaty has hindered the commercial uses of outer space that have developed and expanded so dramatically in the previous decades.

At the moment, the main restrictions on further innovation and commercial development of space come largely from U.S. national law, not the Outer Space Treaty. U.S. export controls on satellites have already caused the U.S. space sector to lose a significant portion of global market share. Several categories of remote sensing and on-orbit activities are heavily restricted, or, in some cases, have historically been off limits for U.S. commercial entities, enabling foreign competitors to leap ahead and establish global markets. And there are several types of commercial space activities planned for the near future that do not clearly fall under any of the existing national licensing authorities. These gaps create uncertainty that gives rise to real-world challenges for start-up companies trying to secure investors and insurers, a phenomenon many new space companies are struggling with.

5. The U.S. has more effective avenues to further encourage commercial space

It would be extremely difficult, and likely counterproductive, for the United States to withdraw from or seek amendment to the Outer Space Treaty. As of 2017, 105 countries have ratified the Outer Space Treaty.¹³ These include all of the historically spacefaring states such as the United States, Russia, China, India, Brazil, Japan, and all the Member States of the European Space Agency (ESA). A further 25 countries have signed the Treaty, which expresses their intention to ratify it in the future, or at least to not take actions contrary to the purposes of the Treaty. Additionally, many of the foundational provisions of the Outer Space Treaty are so well respected that they are considered to have passed into the realm of customary international law.¹⁴

As a consequence of this wide international success, an attempt to amend the Treaty is likely to be extremely difficult, and it is not certain it would advance U.S. interests. First, if the United States officially broaches the subject of amending the Outer Space Treaty, it is likely that other countries would identify issues of their own they would like addressed, not all of which would be aligned with U.S. interests. Moreover, given the diversity of countries that are States Parties to the Outer Space Treaty, reaching the threshold of 53 required to amend the text (via Art. XV) is a serious obstacle.

However, other avenues exist to clarify and define the rights and obligations of states under the broad principles already established by the Outer Space Treaty. The first is through national space law and regulation. Here, the United States has a significant opportunity to take a leadership role in the international community. Historically, other countries have modeled their national policy and regulation on the examples provided by the United States. Thus, how the United States approaches the current issue could have widespread international implications. Additionally, the United States can also shape the interpretation and implementation of the Outer Space Treaty through multilateral initiatives. Over the last few decades, the United States has played a leadership role in establishing international non-binding norms and guidelines regarding satellite broadcasting, space debris mitigation, nuclear power sources for use in space, and the long-term sustainability of space activities. This work is done both within COPUOS and elsewhere. For example, governments have cooperated through the Inter-Agency Space Debris Coordination Committee (IADC) to coordinate discussion of technical and policy matters related to space debris mitigation. This process represents the development of additional clarifications without require amendment to any existing treaty. These multilateral efforts are seen as conducive to the creation of norms and best practices which can receive widespread acceptance and adherence.

6. Conclusion

We strongly believe that continuing to support the Outer Space Treaty and further enhancing U.S. national oversight frameworks will be the best method for pro-

¹³UNITED NATIONS, COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, LEGAL SUB-COMMITTEE, STATUS OF INTERNATIONAL AGREEMENTS RELATING TO ACTIVITIES IN OUTER SPACE AS AT 1 JANUARY 2017, A/AC.105/C.2/2017/CRP.7 (2017). Available at: http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_22017crp/aac_105c_22017crp_7_0.html/AC105_C2_2017_CRP07E.pdf.

¹⁴FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW—A TREATISE 418. See also Adam Mann, *Who's in Charge of Outer Space?*, WALL ST. J., May 19, 2017, quoting Sagi Kfir, General Counsel of Deep Space Industries: "[The Outer Space Treaty] is so fundamental that its principles have become customary international law even for those countries that aren't signatories." Available at: <https://www.wsj.com/articles/whos-in-charge-of-outer-space-1495195097>.

moting commercial development in space. As more countries acquire the capability to engage in commercial space activities, it will be important for U.S. companies to be working inside a predictable international legal framework that can encourage and protect investments. The Outer Space Treaty provides the foundational level of certainty in the international system that commercial space entrepreneurs, businesses, and capital sources require to develop further innovative activities.

Rather than an arduous and unpredictable international amendment process, domestic space law is often the best avenue to address any gaps or needs for further clarity, especially regarding emerging activities in space such as space debris removal, satellite servicing, and celestial resource use. Activities which engender international apprehension might also be pursued on a multilateral basis in the form of new instruments that augment, rather than replace, the Outer Space Treaty. Modification or withdrawal from the Outer Space Treaty leaves, on balance, too many uncertainties in outcome, with little clear actual utility, either political or legal.

The Secure World Foundation would like to once again commend the Subcommittee for focusing on such an important issue, and express our support for U.S. governmental efforts to respond to the needs of the commercial space sector while ensuring a sustainable international governance framework in outer space.

Respectfully,

CHRISTOPHER JOHNSON, J.D., LL.M.,
Space Law Advisor,
Secure World Foundation.

IAN CHRISTENSEN,
Project Manager,
Secure World Foundation.

SPACE LAW & POLICY SOLUTIONS
Rochester, NH

MEMORANDUM

THIS MEMORANDUM AND ITS CONTENTS IS FOR INFORMATIONAL PURPOSES ONLY. OPINIONS ARE THOSE OF THE AUTHOR, AND IT SHOULD NOT BE RELIED UPON AS LEGAL ADVICE, IS NOT LEGALLY PRIVILEGED AND DOES NOT CREATE AN ATTORNEY/CLIENT RELATIONSHIP.

To: Senator Ted Cruz (R–TX), Chairman, Senator Edward J. Markey (D–MA), Ranking Member and Members of Space, Science and Competitiveness Subcommittee

From: Michael J. Listner, Esquire

CC: Senator John Thune (R–SD), Chair, Senate Committee on Commerce, Science, and Transportation

Date: May 17, 2017

Re: The Outer Space Treaty: Implications of Amendment and Withdrawal.

Senator Cruz, Senator Markey and Honorable Members of the Committee,

My name is Michael J. Listner, and I am an attorney licensed to practice law in and before the state and Federal courts of the State of New Hampshire. I am also the Founder and Principal of the legal and policy consultation firm, Space Law and Policy Solutions and the editor of the space law and policy briefing-letter *The Précis*.

This Subcommittee will examine the effect of The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) on free enterprise with regards to both current and future private outer space activities.¹ Implicit in the discussion of the Outer Space Treaty and private outer space activities is the question of amendment or withdrawal.

The question of amending or withdrawing from the Outer Space Treaty is polarizing. The global community hailed the 50th anniversary of the Outer Space Treaty

¹The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, 18 UST 2410, 610 UNTS 205.

being open for signature this past January with the expectation of the accord lasting another fifty years. On the other side, space advocates, especially in the community advocating settlement and exploitation, look to outer space as the new frontier akin to the 1800s and the opening of the West. This special interest sees the Outer Space Treaty as an impediment to settling outer space and alludes to legislation like the Homestead Act of 1862 as the model for the future settlement of outer space.² The *res communis*³ principle of the Outer Space Treaty found in Article I and II precludes a grant of title to land to private individuals similar to the 1862 Act.⁴

Understanding the Rationale for The Outer Space Treaty

The Outer Space Treaty is a culmination of principles with legal rights and obligations interspersed. The Outer Space Treaty is purposely ambiguous and during negotiations the major space powers most notably the United States, reserved the right to interpret those ambiguities broadly. This has been most recently demonstrated with the interpretation of Article I and Article II of the Outer Space Treaty by the United States to permit the extraction and possession of “space resources” by private citizens as enacted in Title 51, Chapter 513 of the United States Code.

The Outer Space Treaty also contains strict prohibitions and legal duties. A prominent prohibition is found in Article IV, which expresses the arms control nature of the Outer Space Treaty and prohibits the placement of nuclear weapons in outer space, including celestial bodies.

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

Article IV also expresses the mandate outer space should be used for peaceful purposes and precludes the placement of military installations in space, including the Moon and other celestial bodies.

*The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.*⁵

The idea behind Article IV is nuclear weapons or other weapons of mass destruction are not permitted and outer space is to be used for peaceful purposes.⁶

²‘Property’ in the strict legal sense is an aggregate of rights which are guaranteed and protected by government. *Fulton Light, Heat & Power Co. v. State*, 65 Misc. 263, 270. The Homestead Act in essence did this by exercising national sovereignty over lands formerly held by Native Americans and guarantying homesteaders possession subject to conditions within the Act. This act of national sovereignty is the antithesis of the *res communis* doctrine and specifically prohibited in Article II of the Outer Space Treaty, which makes analogies of outer space to the Homestead Act inaccurate.

³See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. I & II, 18 UST 2410.

⁴*Res communis* is a concept derived from Roman property law that refers to the light and the air. See Merriam-Webster Dictionary at <https://www.merriam-webster.com/dictionary/res%20communes>. See also, BLACK’S LAW DICTIONARY, Sixth Edition, *res communes*—“In the civil law, things common to all; that is, those things which are used and enjoyed by everyone, even in the single parts, but can never be exclusively acquired as a whole, e.g. light and air.” The idea behind *res communis* in the reference to both the Antarctic Treaty and the Outer Space Treaty is that no sovereign can extend [state] ownership much in the same way no one can extend control over the air or the light. In other words, in the case of outer space and celestial bodies, they belong to no nation. It is notable in regards to usage and passage, the high seas are considered *res communis*.

⁵See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. IV, 18 UST 2410.

⁶Even though Article IV has an express prohibition against the operation of nuclear weapons in outer spaces, the broad nature of the Outer Space Treaty is allowed a potential work-around to that prohibition, which was considered as a lead up to the Strategic Defensive Initiative (SDI) as proposed by President Reagan. In particular, the X-ray laser system proposed by Edward Teller and researched by Project Excalibur would have implicated Article IV as the system would have consisted of a small nuclear device launched aboard an ICBM or SLBM that when detonated in outer space would have channeled a fraction of the energy released into high intensity laser beams that would destroy enemy missiles during their boost phase. The device would be destroyed in the course of detonation and it’s this operation of a nuclear weapon in outer

Another legal obligation/duty is found in Article VI.

*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. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.*⁷

Article VI requires States to bear responsibility for national activities in outer space whether those activities are performed by government or non-government actors. Article VI also includes the mandate for activities of non-government entities to be “authorized” and “continually supervised”.⁸

The Outer Space Treaty was conceptualized in the geopolitical environment after World War II and in the advent of the Cold War with the Soviet Union. In particular the Outer Space Treaty was intended as a hedge against the possibility the Soviet Union would reach the Moon first and make territorial claims with the resultant military and national security implications. This concern and its implications were manifest in Project Horizon, which was a 1959 U.S. Army proposal to establish a lunar outpost. In terms of policy considerations, the Project Horizon proposal extolled the national security implications of establishing a lunar outpost before the Soviet Union reached the Moon.⁹

This was considered a very real possibility with the Soviet success with *Sputnik-1* and territorial claims the Soviet Union made prior to that accomplishment.¹⁰ Even before *Sputnik*, Eisenhower perceived outer space as a potential Pearl Harbor and sought to meld space exploration, disarmament and the creation of international law through his idea of “space for peace” and an environment free from national military rivalries.¹¹ This led to his proposal for a new international treaty [the Outer Space Treaty] that would be modeled after the Antarctic Treaty of 1959¹² in order to prevent a new form of colonial competition in outer space.¹³

The Outer Space Treaty served its Cold War role well. However, the question is begged whether it is relevant in a post-Cold War geopolitical environment and

space, and not the resulting laser beam Article IV technically would have prohibited. However, it could have been argued the devices were purely defensive and were not actually placed in orbit to remain there, but rather they were of a transient nature and only remained in outer space long enough to fulfill their defensive function against incoming enemy missiles. Moreover, because the function of the X-ray laser system would have been defensive and hence non-aggressive, it could be argued its use would have correlated with Article IV’s principle outer space should be used for peaceful purposes. See Maj. John E. Parkenson, Jr., *International Legal Implications of the Strategic Defense Initiative*, 116 MIL. L. REV. 67, 86–89 (Spring 1987).

⁷See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. VI, 18 UST 2410.

⁸The requirement to authorize and continually supervise is a compromise between the United States and the Soviet Union during the negotiations of the Outer Space Treaty. The Soviet Union took the position outer space activities should be limited to government actors while the United States wanted to include non-government actors. The compromise was reached to include non-government actors with the stipulation their activities be authorized and continually supervised in a manner left to the discretion of the State.

⁹See generally, *Project Horizon, Volume I, Summary and Supporting Considerations*, March 21, 1959 [Regarded Unclassified, September 21, 1961], pp. 61–81, available at http://nsarchive.gwu.edu/NSAEBB/NSAEBB479/docs/EBB-Moon01_sm.pdf.

¹⁰Prior to the launch of *Sputnik-1*, the Soviet Union did not limit its sovereignty to the stratosphere and regarded outer space above its territory part of its sovereign control. However, the launch of *Sputnik-1* challenged this claim of sovereignty as *Sputnik* would be clearly violating the “territory” of other nations. The Soviets when confronted with this conundrum tried to explain *Sputnik* had not violated the territory of other nations as it did not pass over the territory of those nations, but rather the territories of other nations passed beneath *Sputnik*. See Delbert R. Terrill, Jr., *The Air Force Role in Developing International Space Law*, Air University Press, May 1999, pp. 27–30.

¹¹*Id.* at pp. 3–9.

¹²See generally, Antarctic Treaty, June 21, 1961, 12 UST 794; 402 UNTS 7.

¹³See generally, Narrative, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), Bureau of Arms Control and Compliance, Department of State, available at <https://www.state.gov/t/isn/5181.htm>.

whether its purpose to prevent geopolitical competition in outer space is impeding development of outer space in particular the development of outer space by the private sector. Certainly, the interpretation of the Outer Space Treaty by the United States to “allow” the harvesting of “space resources” by U.S. citizens by classifying a property interest in space resources as an activity leading to a property interest illustrates the limitations of the Outer Space Treaty with regards to private enterprise.¹⁴ It also represents the limitations of the policy position taken the United States prior to and in response to the Bogota Declaration¹⁵ of 1976.¹⁶ In other words, the Outer Space Treaty is being stretched to permit the extraction and ownership of space resources, but it cannot be stretched to provide commercial operators with the holy grail of title to sections of or celestial bodies in their entirety.

Amendment or Withdrawal From the Outer Space Treaty?

The effect of the Outer Space Treaty on private enterprise and real property rights are at the center of the controversy as to whether to seek amendment or withdraw. Amendment to the Outer Space Treaty is permitted per Article XV:

Any State Party to the Treaty may propose amendments to this Treaty. Amendments shall enter into force for each State Party to the Treaty accepting the amendments upon their acceptance by a majority of the States Parties to the Treaty and thereafter for each remaining State Party to the Treaty on the date of acceptance by it.¹⁷

While many parties to the Treaty express the desire to amend provisions for various reasons from time-to-time, none of the Big Three (United States, Russian Federation and People’s Republic of China) have shown an interest in doing so. Even if amendment was politically palatable, the proposed amendment(s) would have to be approved by a majority of the parties of the Treaty.¹⁸ Yet, when it comes to the holy grail of title to sections of or celestial bodies in their entirety, amendment to the *res communis* principle is politically unviable and would undermine the foundation of the Outer Space Treaty itself.¹⁹ This means amending the Outer Space Tre-

¹⁴In its simplest terms 51 U.S.C §51303 creates a usufruct. A usufruct is a real property interest that can simply be described as the conjoining of the right to “use” property and the right to the “fruits” of that use. In other words, while “use” grants a property interest that allows a private person to use resources belonging to the land of another to support their occupancy on the land, a usufruct allows the person to harvest the fruits of the occupied land and convert it to their own use, *i.e.*, possess, own, transport, use, and sell. However, in the context of international law, “use” and “usufruct” are synonymous and considered an activity that creates a property interest in personal property as opposed to a real property interest that permits an activity, *i.e.*, mining. The recognition of the need to define an usufruct or “use” as an activity and not a real property interest confirms the understanding of the Outer Space Treaty does not permit a real property interest. *Compare*, Louisiana Mineral Code, La. R.S. §31:21, which defines a usufruct for minerals as a “mineral servitude” where “[a] mineral servitude is the right of enjoyment of land belonging to another for the purpose of exploring for and producing minerals and reducing them to possession and ownership.”

¹⁵The Bogota Declaration was an attempt by nations lying on or near the equator to make sovereign territorial claim of corresponding sections of geosynchronous orbital slots reside. Given the unique nature of geosynchronous orbit, the equatorial nations signing the Declaration stipulated because of the unique attributes of geosynchronous orbital slots, they represent a limited natural resource that was better administered by the nations under which the slots reside as opposed to administration by the International Telecommunications Union (ITU). The Declaration was flatly rejected by the major spacefaring nations and non-spacefaring nations alike, and the United States took the opportunity in responding to the Declaration to announce its own policy positions with regards to commercial activities in outer space.

¹⁶The United States has taken the position the “province of all mankind” provisions are compatible with conducting and developing free enterprise and the right to determine how it shares the benefits and results of U.S. space activities. *See* J.I. Gabrynowicz, *the “Province” and “Heritage” of Mankind Reconsidered: A New Beginning*, p. 694, *citing* Christol, C.Q. (1982), *The Modern International Law of Outer Space*, p. 40.

¹⁷Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. XV, 18 UST 2410.

¹⁸In the case of non-interference with space resource extraction, agreement could be made bilaterally between two nations through a non-binding protocol as opposed going through an amendment process. This idea is beyond the scope of this Memorandum but illustrates optional methods of addressing some of the short-comings of the Outer Space Treaty.

¹⁹There is also the matter of the soft-power response to the United States unilaterally seeking to amend the Outer Space Treaty. Geopolitics being what it is, many of the non-developed countries (with encouragement from the Russian Federation and perhaps China) would raise the specter of the United States seeking to leverage its status as a superpower to get what it wants. On the other hand, the government of Luxembourg has suggested amendment to the Outer Space Treaty might be in order to address concerns its legislative body has raised with regards to space resources. Allowing a nation like Luxembourg to broach the topic of amendment with the United States riding its coattails might be a path to amendment. Yet, any amendment Lux-

ty may not be able to solve the fundamental issue of real property rights that is a central interest for private sector development and settlement.²⁰

In order to address the issue of real property rights, it may be necessary to withdraw from the Outer Space Treaty in its entirety. Article XVI provides for withdrawal:

*Any State Party to the Treaty may give notice of its withdrawal from the Treaty one year after its entry into force by written notification to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.*²¹

Withdrawal from the Outer Space Treaty would be no small matter as the geopolitical backlash would be considerable. Such a decision would not be made overnight and would require significant consideration of the potential ramifications not only by the Department of State but other agencies including NASA, the Department of Defense, NOAA, the intelligence community and any agency with duties that relate to outer space activities and international law and relations. Certainly, non-governmental organizations would be queried as to their opinion as would academia and the Senate Foreign Relations Committee.²²

The underlying concern to withdrawal is whether the benefits of withdrawing from the Outer Space Treaty would outweigh the geopolitical and national security implications withdrawal would trigger. If and when the U.S. invoked Article XVI, the withdrawal process would instigate condemnations and implicate the trustworthiness of the United States with geopolitical adversaries like the Russian Federation who would use the announcement to enhance its own soft-power in the United Nations and particularly among the smaller space-faring and the non-space-faring nations.²³ Even more unsettling, withdrawal could also find opposition from traditional geopolitical allies. That being the case, unilateral withdrawal from the Outer Space Treaty would be a politically painful process for the United States to endure.

However, the United States could mitigate some of the political fallout by filling in the legal vacuum during the withdrawal process with customary international law. As part of the withdrawal process, the United States could announce its intention to recognize as custom certain principles and legal obligation in the Outer Space Treaty.²⁴ For example, the United States could agree to recognize Articles III

embourg might propose would still not reach the level of change needed to acquire real property rights.

²⁰A possible amendment that might allay the concerns of private enterprise is the idea of “exclusion zones” around the area of an activity authorized under Article VI. However, since any personnel and space objects performing activities under Article VI are subject to the continuing jurisdiction or Article VIII, there is an argument these exclusion zones would represent “pockets of national appropriation” of a celestial body, which would violate Article II of the Outer Space Treaty. See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. II & art. VIII, 18 UST 2410.

²¹Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, October 10, 1967, art. XVI, 18 UST 2410.

²²Even though the Senate would weigh in on potential withdrawal from the Outer Space Treaty, the final decision would remain with the Executive Branch, especially given the Outer Space Treaty permits withdrawal. That does not preclude the members of the Senate voicing their opposition.

²³It's unclear how the People's Republic of China would respond to an announcement of withdrawal. On the one hand, China could take the opportunity to enhance its soft-power standing in the United Nations and level political rhetoric against the United States. On the other hand, it could take a stance similar to “space resources” and quietly watch while the United States is pummeled with the political fallout and then announce its own withdrawal following the path the United States created without paying the political price.

²⁴Customary international law is defined as international obligations arising from established state practice, as opposed to obligations arising from formal written international treaties. It consists of two components. First, there must be a general and consistent practice of states. This does not mean that the practice must be universally followed; rather, it should reflect wide acceptance among the states particularly involved in the relevant activity. Second, there must be a sense of legal obligation, or *opinio juris sive necessitatis*. In other words, a practice that is generally followed but which states feel legally free to disregard does not contribute to customary law; instead, there must be a sense of legal obligation to the international community. States must follow the practice because they believe it is required by international law, not merely because they think it is a good idea, or politically useful, or otherwise desirable. The definition of customary international law is nuanced because not all states are equal when considering whether a state's practice and *opinio juris sive necessitatis* reaches the level of customary international law. See *United States v. Bellaizac-Hurtado*, 700 F.3d 1245, 1252 (11th Cir. 2012). In the case of the Outer Space Treaty, there is an argument since the provisions of the

Continued

through XII as binding customary international law subject to its own interpretation through state practice. Most critically, the United States would have to address how it intends to replace the *res communis* principle in the Outer Space Treaty in a manner that would draw international consensus, especially seeing as unilateral withdrawal from the Treaty would likely be precipitated on the rationale of providing its citizens greater rights and flexibility in outer space activities and in particular title to sections of celestial bodies or celestial bodies in their entirety.

A decision to withdraw would invite substantial resistance not only from the geopolitical community but from domestic political arena as well most notably from the Senate, especially in the current hyper-partisan political atmosphere. Additionally, academia and other non-governmental organizations that have a vested interest politically and ideologically to maintain the Outer Space Treaty would push back with the media likely creating narrative to provide pressure against a withdrawal effort. Indeed, the deciding factor of a successful withdrawal effort may lie with the political willingness to resist the resulting international and domestic pressure sure to be applied.

Conclusion

Amending or withdrawing from the Outer Space Treaty would not be easy nor should the decision to do so be trivialized. For such a decision to be made, fundamental consideration must be given to whether the status quo of the Outer Space Treaty is relevant to the growing realities of the current geopolitical environment and whether it can be stretched to meet the long-term demands of the private sector while at the same time taking into consideration the national security interests of the United States. The result of a decision to amend or withdraw from the Outer Space Treaty lies in no small part as to whether we look upon the Outer Space Treaty as a tool to meet a pragmatic geopolitical end or revere it as an immutable geopolitical icon.

Respectively submitted,

MICHAEL J. LISTNER.

HEINLEIN PRIZE TRUST
May 22, 2017

Hon. TED CRUZ,
Hon. EDWARD J. MARKEY,
Commerce, Science, and Transportation Committee,
Space, Science, and Competitiveness Subcommittee,
United States Senate,
Washington, DC.

Dear Chairman Cruz and Ranking Member Markey:

The Heinlein Prize Trust honors the memory of renowned American author Robert A. Heinlein and his wife, Virginia, by awarding prizes for the advancement of commercial spaceflight and conducting a variety of educational outreach activities. As its trustees, we write first to thank you for your leadership in passing the Commercial Space Launch Competitiveness Act, which promotes the development of commercial spaceflight in the United States in a manner consistent with Robert Heinlein's vision; and second to address issues related to the Outer Space Treaty which you have raised in recent public comments and your Subcommittee's hearing this month.

We recognize that the Outer Space Treaty was a Faustian compromise with the USSR. It was an attempt to prevent an Evil Empire from gaining an upper hand in the strategically vital realm of outer space, and as a result it left on the bargaining table a wide range of opportunities for the United States. That said, the treaty has proven that it can be the foundation for productive international cooperation to explore and develop outer space—and perhaps more importantly, it has not yet been shown to impede the efforts of the United States or U.S. entities.

Of course, Congress and the Administration must remain vigilant to prevent the Outer Space Treaty—or any international law—from being used in a manner contrary to its original intent so that it binds the United States in ways not accepted by our government at the time it was signed and ratified. When international legal activists attempt to assert that the United States has international responsibility for the activities of nongovernmental actors as a result of the treaty, those argu-

Treaty have been adhered to for nearly half a century they have already entered the realm of custom.

ments should be refuted. Space should not be different from aviation and admiralty in that respect.

To the extent that adjustments are needed, we strongly recommend updating U.S. law rather than reopening the Outer Space Treaty wherever possible. Fortunately, the terms of the Treaty are loose enough that nations can define its application by adopting national laws controlling national activities. The Commercial Space Launch Competitiveness Act's provisions on property rights in space resources—by our estimation, the most sweeping legislative recognition of property rights in human history—is an excellent example.

The Outer Space Treaty has worked well for 50 years. It is accepted by more than 100 nations. Trying to change the Treaty now will create significant risks of delay and confusion. Such risks should be avoided, especially when the option of changes to national law exists.

Thank you again for your leadership on these matters. As Robert and Virginia Heinlein saw so clearly, space is inherently multinational and international. All countries are neighbors sharing an “upper border,” outer space. History teaches us that nations flourish as neighbors when there is liberty and where commerce is managed with minimum regulation within a framework of strong human rights. Space resources are effectively infinite, thus cooperation in their use should benefit all stakeholders much more than competition. The emergence of humanity into the cosmos can be a non-zero sum adventure. All of humanity will win if there is enough ordered liberty.

Sincerely,

ARTHUR M. DULA,
Trustee.

J. BUCKNER HIGHTOWER,
Trustee.

Senator CRUZ. We will now turn to the first of two panels that this committee will hear. The first panel—we have three witnesses. I want to thank each of you for being here today.

Our first witness is Mr. James Dunstan, who is a Senior Adjunct Fellow at Tech Freedom and the founder of Mobius Legal Group. Mr. Dunstan has spent more than 33 years counseling private businesses in all aspects of doing business in outer space and has assisted Federal and state governments with space law issues.

Our second witness is Ms. Laura Montgomery, who is the proprietor of Ground Based Space Matters law offices and publishes *groundbasedspacematters.com*. Ms. Montgomery works on issues of regulatory space law with an emphasis on commercial space transportation, human space flight, and the Outer Space Treaty. Ms. Montgomery has spent over two decades with the Federal Aviation Administration's Office of the Chief Counsel, where she represented the FAA at the United Nations Legal Subcommittee of the Committee on Peaceful Uses of Outer Space.

Our third witness is Mr. Matthew Schaefer, who is the Veronica A. Haggart and Charles R. Work Professor of International Trade Law and Co-Director of the Space, Cyber, and Telecommunications Law Program at the University of Nebraska College of Law. Mr. Schaefer has taught international law, international business, and foreign relations-related courses since 1995 and has directed the Space and Cyber Law Program since its creation in 2006. Mr. Schaefer is also Co-Chair of the American Branch of the International Law Association's Space Law Committee, and I would like to note that Mr. Schaefer previously served as the Director in the International Economic Affairs Office of the National Security Council at the White House in 1999.

Before we hear testimony from the witnesses, I want to welcome and recognize the Ranking Member of the Full Committee, Senator Nelson, who has a long and enduring issue on the topic of space.

**STATEMENT OF HON. BILL NELSON,
U.S. SENATOR FROM FLORIDA**

Senator NELSON. Well, I am very, very pleased that we have made the progress that we've made. The commercial space sector has been truly outstanding in the accomplishments, and that's exactly what was intended as we started some 7 years ago this dual track, where we had a commercial space program that was going on with regard to astronauts; a commercial space program going to and from the International Space Station; and, simultaneously, we have the NASA program to go out and explore the cosmos.

And, of course, people don't realize it, but it's right here. Within the next year and a half, both commercial rockets with crew will launch, as will the largest rocket ever, the SLS, with its spacecraft, Orion, on top. So, indeed, Mr. Chairman, what's going to happen is the American people are going to really get engaged again.

I want to add a word of caution, however, because the budget that was just submitted by the President just today—it would cut a half a billion dollars from NASA. There are some positive elements, like full funding for the commercial crew, and some not-so-positive elements, such as the cuts to Earth science, to education, and to exploration. But the spending plan simply does not go far enough for NASA or for various space centers, including our space center, the Kennedy Center in Florida.

As we have all said in the past, we're going to work together on both sides of the aisle, and NASA is not partisan. NASA is non-partisan. We're going to work together to make sure the agency gets what it needs so that we can keep building this momentum. And, Mr. Chairman, we're going to Mars.

Senator CRUZ. Amen and Hallelujah.

With that, Mr. Dunstan, you may start us off.

**STATEMENT OF JAMES E. DUNSTAN, FOUNDER,
MOBIUS LEGAL GROUP, PLLC**

Mr. DUNSTAN. Chairman Cruz, Ranking Members Markey and Nelson, and members of the Subcommittee, thank you for the opportunity to testify here today. I am truly an orphan of Apollo. As children, my generation watched the Apollo astronauts walk on the Moon. We were promised that if we studied hard and ate our vegetables, we too could go into space. Unfortunately, that didn't happen.

I was in law school when the space shuttle started to fly. Again, we were promised flights every 2 weeks and that we'd be able to fly experiments for as little as \$10,000. None of that happened, either. At its peak, the shuttle flew only nine times in 1985, and any hope of conducting affordable commercial activities aboard the shuttle died with the *Challenger*.

But space commerce has taken off anyway on private vehicles. The industry now nears \$350 billion annually in revenue, mostly in commercial satellite services, and we're seeing the dawn of a radical new generation of launch vehicles, with fly back first boost-

ers, and fly back second stages just over the horizon. Launch costs may fall by an order of magnitude.

Startups have raised real financing to do everything from on-orbit servicing to asteroid mining. For these companies, once esoteric provisions of the Outer Space Treaty could create real business risks. It's time for Congress finally to address the relationship between government and private sector under Article VI of the Outer Space Treaty, something I assumed we would have tackled imminently when I graduated from law school almost 35 years ago.

Article VI makes each country responsible and liable for the activities of its citizens and companies in space. The Treaty also leaves up to each country to decide how to authorize and supervise private activities. In other words, Article VI is not self-executing in governing private citizens. Just consider the Supreme Court case in *Medellin v. Texas*, which Chairman Cruz argued as the Solicitor General for Texas. Quoting Federalist Number 33, the court said that whether a Treaty is self-executing means, "comparing laws that individuals are bound to observe as the supreme law of the land versus a mere Treaty dependent on the good faith of the parties." Article VI falls into this latter category. Thus, even failing to adopt any regulation at all would not violate the Outer Space Treaty, because there is the backstop of the national liability for private citizen activities.

Federal law already authorizes Americans to operate in outer space. Americans have inalienable rights to life, liberty, and the pursuit of happiness, as the Declaration of Independence puts it. The Tenth Amendment made this principle binding constitutional law—the powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the States respectively, or to the people. In short, absent a constitutionally consistent law prohibiting innovative space activities, Americans are already authorized to pursue those activities. In other words, that which is not forbidden is permitted.

We do have laws and regulations, plenty of them, that govern the activities of private citizens in space. Space entrepreneurs need permission from multiple government agencies. This includes the FAA AST for launch, FCC, NOAA, NASA, and the DoD. Entities conducting launches have to answer to both state and local authorities, everything from assessing environmental impact of launches to obtaining permits to transport their vehicles across state and county lines.

The problem isn't a regulatory vacuum, but a patchwork of cumbersome, burdensome, and sometimes inconsistent regulations. Congress should clean up this mess at the same time that it addresses how to govern innovative space uses not clearly governed by existing rules.

Precisely because the United States Constitution promises me that I can go to outer space, and precisely because Article VI is not self-executing, Congress is in a unique position internationally to show the world that we recognize our liability under Article VI and our obligation to ensure that our private citizens abide by the self-executing provisions of the OST, no nuclear weapons in space, no military bases on the Moon or celestial bodies, and no appropriation of a celestial body.

The United States can thus lead internationally by adopting a sensible and non-burdensome regulatory regime to ensure treaty compliance. This would put the rest of the world on notice that countries that would offer flags of convenience for outer space activities cannot dodge their liability obligations. This would also promote the goal of Article I, the peaceful exploration and use of outer space, while protecting U.S. assets, both public and private, from irresponsible foreign companies.

There is also nothing to be gained right now from reopening the current Treaty regime. Once the United States demonstrates a light-touch regime consistent with treaty requirements can work, then reopening the treaties might make sense. But doing so now would allow countries that aren't friendly to the United States or American capitalism to layer on costly regulatory burdens that the United States would have to reject as we rejected similar provisions of the Moon Treaty.

My written testimony, co-authored by Berin Szóka, President of TechFreedom, explores in greater depth the United States' responsibilities under Article VI.

Thank you again for the opportunity to testify, and I look forward to answering your questions.

[The prepared statement of Mr. Dunstan follows:]

PREPARED STATEMENT OF JAMES E. DUNSTAN & BERIN SZOKA

Congress took the first (and long-overdue) step toward recognizing the rights of private citizens to explore and use the resources of outer space in the Commercial Space Launch Competitiveness Act of 2015 (CSLCA). The next challenge is for Congress to address the so-called “regulatory gap” for innovative space activities beyond today's established satellite and launch industries—such as asteroid and lunar mining, on-orbit repair and construction, and private space habitats. This implicates Article VI of the Outer Space Treaty (“OST”), which requires that nations “authorize” and “continually supervise” the activities of their citizens in outer space to ensure compliance with overall treaty obligations. This does *not* mean, however, that the United States must either (a) re-open the Treaty for negotiation or (b) pass legislation to regulate private activities in space. This is because:

- The “authorization” and “supervision” components of Article VI are subsidiary to the overall structure of Article VI, which places both the responsibility and liability for treaty violations and damages for space activities on the Nation itself. A failure to either authorize or continually supervise the activities of private nationals merely increases the risk that a country might be liable for damages;
- Article VI is not “self-executing,” meaning that the authorization and supervision language is not the “law of the land” in the United States, absent domestic legislation implementing Article VI. The case of *Medellin v. Texas* makes a clear distinction between treaty provisions that, by their language and nature, become the “law of the land” in the U.S., and those treaty provisions that require domestic implementation to have the force of law;
- The Tenth Amendment (echoing the Declaration of Independence) provide the required “authorization” component of Article VI for Americans;
- Congress has the discretion, as a matter of both international and American constitutional law, to decide how to implement its Article VI responsibility to provide “ongoing supervision” for private American actors in space;
- There are plenty of supervisory regulations in place already, many of which are overlapping, cumbersome, and inconsistent;
- The best way to protect American interests is for Congress to enact a regulatory framework that takes the lightest touch possible in order to satisfy our Treaty obligations while also protecting both public and private American assets—by setting precedent for other nations to follow in adopting their own domestic leg-

isolation that will ensure that foreign private companies also act responsibly in space; and

- Reopening the international space law treaty regime would, at least prior to the U.S. establishing its own domestic regulatory regime (and perhaps also demonstrating that such a regime can work), no doubt look much like the burdensome provisions of the Moon Treaty, which the U.S. has previously rejected.

Congress must also streamline and harmonize the patchwork regulatory regime put into place in the 1980s and 1990s on the assumption that there would be only a dozen or so commercial flights a year that would carry no more than 20 payloads to space.

Congress' next steps after adoption of the CSLCA will chart the course for space development for the next century. We call the attention of the Committee to nine themes:

1. The So-called “Regulatory Gap” and Article VI of the OST

This hearing is focused on the impact of the Outer Space Treaty on private activities in space. In Section 108 of the CSLCA, Congress directed the White House to identify any regulatory gaps and suggest ways of closing those gaps to ensure compliance with U.S. obligations under the OST. The White House responded in April, 2016, with its analysis that correctly noted that currently no Federal agency regulates such “innovative space activities” such as asteroid mining and commercial lunar landings.¹ The White House suggested a “Mission Authorization” approach, with the FAA/AST taking the lead role in an inter-agency review of applications for missions that don't squarely fall into the regulatory jurisdiction of any current agency (FAA/AST for launches, FCC for frequency, NOAA for remote sensing, NASA for NASA-backed payloads and DoD for DoD payloads).

The White House report notes, correctly, that some planned missions involve activity that is not currently regulated and then concludes, incorrectly, that the U.S. is not meeting its obligations under Article VI. But Article VI does not, in and of itself, require any specific form of authorization and supervision—or that, in the absence of such, non-governmental activities are prohibited. Consider Article VI in its entirety:

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. *The activities of non-governmental entities in outer space*, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.

Thus, Article VI places the responsibility and liability for breach of the clear prohibitions contained in the OST on the launching state. These prohibitive provisions are:

1. No placing of nuclear weapons or weapons of mass destruction in outer space (Article IV);
2. No establishing military bases on the Moon or other celestial bodies (Article IV);
3. Space and celestial bodies are not subject to claims of appropriation by means of use or occupation (Article II);
4. Avoiding harmful contamination (Article IX); and
5. Avoiding harmful interference (Article IX).

There is a strong argument that the last two prohibitions are not self-executing (see discussion below), but for the sake of this argument, we assume that they are.

¹The OSTP report is available at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_-4-16_final.pdf (last checked, May 18, 2017).

2. Article VI Allows Congress to Choose How to Authorize and Supervise the Activities of American Companies

While Article VI requires each nation to “authorize” and “continually supervise” the activities of its citizens, the extent of such oversight only extends to compliance with the *self-executing* Treaty provisions (*i.e.*, that its citizens don’t place a WMD in space, make a real property claim on a Celestial Body, or attempt to construct a military base). Article VI says that countries must assure that “activities are carried out in conformity with the provisions set forth in the present Treaty.”

How a country chooses to assure that its citizens do not violate these provisions is completely up to that country. Since Articles VI and VII (making countries liable for damages that are caused by their own activities or those of their nationals) place liability for any activities of citizens clearly upon the launching state, the amount of supervision a country wishes to place is, in terms of treaty interpretation, completely up to the country, depending upon the risk the country wishes to assume. Countries fearing that the activities of their citizens could result in international liability may choose to heavily “supervise” (through highly proscriptive *ex ante* regulation) the space activities of their citizens—up to, and including, prohibiting private space activities entirely. But countries that conclude that the benefits of innovative space activities outweigh the liability risks may consider a lighter “regulatory touch,” all the way to becoming a “flag of convenience” with no supervision whatsoever. A lack of supervision is not, in and of itself, a violation of international law; it merely raises the chances that a non-governmental activity might run afoul of the OST prohibitions and that the country responsible be held liable for consequential damages because that country’s citizens seek to engage in a behavior that is a *per se* violation of the OST, or creates a probability that those activities will interfere with the activities of another space activity resulting in harm (*e.g.*, orbital collision or frequency interference). Congress now has the opportunity to decide where on that continuum of regulation it wishes to place the United States.

3. Article VI is Not Self-Executing

In legal terms, this means that Article VI is not self-executing: it requires domestic legislation in order to be enforceable in U.S. courts. *Medellin v. Texas*, 552 U.S. 491 (2008). The distinction between a treaty provision that represents an international commitment versus a treaty provision that sets forth specific international law that becomes the “law of the land” is a cornerstone of U.S. constitutional law and was discussed in the Federalist Papers, No. 33, “comparing laws that individuals are ‘bound to observe’ as ‘the supreme law of the land’ with ‘a mere treaty, dependent on the good faith of the parties.’” *Medellin*, 552 U.S. at 499. While there are clear prohibitions contained in the Outer Space Treaty which are self-executing, the remaining provisions of the OST are aspirational and advisory, leaving the specific implementation of those concepts up to individual nations. Like the legal issue (consular notification rights of criminal defendants) in the convention at issue in *Medellin* (the Vienna Convention on Consular Relations), the Article VI falls into this latter category of non-self-executing provisions of the OST.

4. The United States has already Authorized Innovative Space Activities

The White House Section 108 Report also ignores the fact that in the United States, innovative outer space activities are already authorized. That authorization predates the space era by nearly 200 years. As Americans, we declared in 1776 that “[w]e hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.” The Tenth Amendment to the U.S. Constitution carries through this concept when it states that “[t]he powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the States respectively, or to the people.” In short, absent a constitutionally consistent law prohibiting “innovative space activities,” Americans are authorized to pursue those activities. In other words, that which is not forbidden is permitted.

5. Adopting a Complete Laissez-Faire “Flag of Convenience” Regime Would Clearly Not Be in the Interests of the United States

As noted above, because Articles VI and VII of the OST ultimately place liability on the launching state, how the U.S. chooses to “continually supervise” the activities of its citizens in space is a matter of risk assessment. Nonetheless, strong policy reasons (besides the potential liability of the U.S. Government, and therefore, the U.S. taxpayer) exist as to why the United States should not abdicate all regulatory authority over the activities of its citizens in space. On two of the Treaty’s five principal requirements—the three bright-line rules—the foreign policy interests of the

United States should be rather obvious: We absolutely do not want China or Russia or any other power (1) placing nuclear weapons or weapons of mass destruction in outer space (Article IV), (2) establishing military bases on the Moon or other celestial bodies (Article IV), or (3) placing an object on a strategic place and then claiming an absolute, permanent property right on that place (rather than a non-interference zone around ongoing activity). We cannot insist through diplomatic consultation that China or Russia screen their companies' (including state-controlled enterprises) planned missions to ensure compliance with these prohibitions without having a clear mechanism for doing the same ourselves.

Nor can we, without our own system of appropriation "supervision," protect the rights of American public and private actors under the other two principal requirements of Article VI:

1. Avoiding harmful contamination (Article IX); and
2. Avoiding harmful interference (Article IX).

It is not difficult to see how American companies and government actors (both NASA and military/intelligence) could suffer at the hands of foreign companies that push the envelope on these two principles to elevate them into a quasi-claim of appropriation—nor why American companies and government actors would benefit from establishing both more specific standards and dispute resolution mechanisms on all three counts. While relying on international treaty making to tackle these highly fact and science-specific problems, the U.S. can continue to lead the way. The U.S. has done so on technical committees such as the Inter-Agency Space Debris Coordination Committee (IADC), which helped develop the orbital debris mitigation standards that were first adopted by the United States, and are now quickly becoming customary international law. Congress should task NASA and other expert agencies to develop technical standards on use, collocation of multiple bases or other uses (*e.g.*, robotic mining or telescopes) on a celestial body, and ways to mitigate interference among multiple users, such as between two groups extracting minerals in adjacent areas or between a mining operation (which produces dust) and a telescope (which might be subject to interference from dust). Such standards could help to avoid disputes in the first place, just as coordination minimizes disputes among spectrum users, while also providing standards for resolving disputes when they do happen.

Ultimately, such standards—and the adjudicatory mechanisms through which technical standards evolve into legal standards, and change over time—will be of greatest benefit to American companies (and government actors) when they address not only disputes with other American entities, but also with foreign entities. While it is theoretically possible to have two systems operating side by side—one for interactions among U.S. parties and one for interactions among U.S. and foreign parties—the difficulty inherent in such separate systems, and the advantages of having, to the greatest extent possible, a harmonized system for both, would be considerable.

One thing is certain: whatever the United States does will set precedent for the rest of the world, as we did with the issue of orbital debris mitigation. For these reasons, the U.S. should continue to lead the international community in exploring and adopting standards for non-interference as well as the other prohibitions contained in the OST—if for no other reason than to set the precedent in the international community that the clear prohibitions contained in the OST must be enforced by all nations on all citizens of the world. In other words, ensuring *some* effective scrutiny over U.S. companies' activities will, to the extent that other nations follow suit, protect U.S. actors, both public and private alike, from irresponsible foreign actors.

Rather than merely hoping that other countries will follow our lead, the United States should give other countries an incentive to enact domestic legislation that offers equivalent protections to that of the U.S.—especially in the standards and mechanisms for resolving interference disputes between U.S. parties and parties of that country. There is already a directly applicable model for this in the U.S. Code. The Deep Seabed Mineral Resources Act of 1979 was passed as an alternative to the socialist and impractical resource appropriation provisions of the Law of the Sea Treaty, as it was then drafted (and under discussion). Rather than negotiate a new treaty, the U.S. law simply and elegantly allows the recognition of exclusive mining claims issued by other countries that will also recognize U.S. claims through "compatible" legislation.² This model could easily be incorporated into U.S. law, avoiding

²30 U.S.C. § 1428.

the need for negotiating revisions to the Outer Space Treaty or even a new multilateral framework such as a convention.

6. Amending the OST or Entering New Treaty Negotiations at this Time is Not in the Interest of the United States

Precisely because the “authorization” and “supervision” provisions of Article VI are aspirational and not self-executing, and because the U.S. Constitution gives Congress the ability to craft domestic legislation that implements Article VI in a way that is both consistent with the core provisions of the OST and Congress’ desire to promote rather than stifle free enterprise in space, Congress should *not* suggest to the Administration or the State Department that the U.S. should begin discussions in the international community about amending the OST or augmenting Article VI with a new treaty (such as was done to flesh out the liability provisions of OST Article VII into the 1972 Liability Convention). The result of such efforts would inevitably be a treaty that the United States would not be able to ratify, because it would either (a) contain specific regulatory provisions akin to those adopted in the Moon Treaty that would be antithetical to U.S. economic interests, or (b) provide international lawyers a way to close the “Medellin loophole” by specifically stating that the requirement that countries supervise and authorize the activities of their citizens is self-executing—by adopting language specifying what that regulatory regime must look like.

Either way, the United States would lose the flexibility it now enjoys, which provides it with a unique opportunity to establish domestic law in the United States that is both consistent with Article VI, yet still provides U.S. citizens with a light regulatory approach that encourages innovation and investment in new outer space activities. Most of all, that flexibility means that U.S. policymakers can design a regime that will heavily influence what other countries do, and the concomitant evolution of international law through new conventions (such as those on registration, liability, rescue and return) or through customary international law.

In short, nothing good can come from diving down the “rabbit hole” of treaty (re)making at this stage. In the future, after the U.S. has shown its world leadership by establishing a domestic regulatory approach that encourages private sector advancement into space while protecting the core values of the OST, then the U.S. will be able to negotiate a future treaty from a position of strength, as by that time U.S. entrepreneurs will already have established themselves as the “first movers” in a huge new economic arena and U.S. domestic law will have shown itself to work, not just for American companies, but also for foreign companies that interact with American companies in space, or that choose to launch out of the U.S. to take advantage of American domestic space law.

7. Understanding the Depth and Breadth of Current Space Regulation

At a recent House hearing,³ most of the questions asked of the panelists involved issues of space traffic management and orbital debris. It was frustrating that the expert panel did not forcefully respond that *every scenario raised in questions is already covered by multiple agencies and multiple sets of regulations.*

1. If one launches a payload into LEO, FAA/AST regulations require full information about orbital parameters, and the launching party must demonstrate that its orbital choice will not conflict with other users (14 C.F.R. § 415.35), as well as demonstrate that it has complied with orbital debris mitigation standards for “safeing” upper stages and disposal at payload end of life (14 C.F.R. § 417.129).
2. The FCC has similar, yet separately enforced, regulations for anyone seeking a license to communicate with a vehicle or payload (47 C.F.R. § 25.114(d)(14)).⁴

³“Regulating Space: Innovation, Liberty, and International Obligations,” March 8, 2017.

⁴Examples abound of how the current space regulations are rooted in the 1980s. The FCC assumes that all satellite are multi-million dollar payloads that take many years to build and launch. See *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, FCC 15-167, 30 FCC Red 14713, 14736 (December 17, 2015) (“*Satellite Services Rules Update Order*”). The FCC rules further require the procurement of multi-million dollar bonds (to minimize the warehousing of orbital slots), 47 C.F.R. § 25.165. The application fees for satellites are extremely high (See *Amendment of the Schedule of Application Fees Set Forth in Sections 1.1102 through 1.1109 of the Commission’s Rules, Order*, GEN Docket No. 86-285, 29 FCC Red 3276, 3276, ¶ 2 (2014) (\$129,645.00 application fee per GEO satellite, \$446,500.00 application fee per non-GEO (“NGSO”) satellite or constellation). Each year satellite operators also have to pay a regulatory fee to the FCC of \$138,475.00 for GEO satellites, and \$141,950.00 for NGSO satellite or constellations. Current processing times for remote sensing licenses from NOAA are more than a year. Further, the regulations adopted even as late as 2006 anticipated the placement of a few very large satellites (*e.g.*, LandSat and its progeny), and require NOAA to physically

3. NOAA, likewise, has rules for those seeking a license for remote sensing of the Earth (15 C.F.R. Part 960, Appendix 1: C).
4. NASA also has orbital debris and other orbital restrictions (vis-à-vis the ISS) that must be satisfied for any NASA-sponsored mission (NASA-STD-8719.14A (74 pages), which puts into effect NASA Procedural Requirement 8715.6, and includes reference to NASA-Handbook (NASA-HDBK) 8719.14).

So if a company is using a U.S. commercial vehicle to launch a remote sensing satellite that will download data to Earth and is somehow supported by a NASA contract, it must demonstrate compliance with the orbital interference and debris rules of *four separate Federal agencies*.⁵ Worse yet, if any of those agencies determines that the debris mitigation statement is insufficient, the company would have to amend its statement to all four agencies, triggering another round of bureaucratic review and (potentially), a near-endless series of reviews and revisions to each of its requests for authorization. This back-and-forth will become significantly more problematic with higher launch volumes.

The problem, then, is not a “regulatory gap” for current space activities, but rather a patchwork regulatory system that is complex, non-transparent, and extremely expensive to navigate. Before we start overlaying a whole new “Mission Authorization” regulatory regime on innovative space activities, we must first streamline the existing regime to reduce cost, redundancy, and most of all, opaqueness, where bureaucrats can still pick winners and losers with impunity. Cleaning up a bloated regulatory regime will provide far more clarity to the space industry than the establishment of an entirely new “black box” into which one drops applications, and crosses fingers that it won’t be vetoed, without explanation, by one of several unaccountable agencies. Ideally, Congress should clean up the mess of current Federal licensing at the same time that it implements any new regime to address its Article VI responsibilities.

8. The “Mission Authorization” Approach Proposed by the Obama Administration is a Continuation of a “Black Box” Policy of the Federal Government Picking Winners and Losers

Is there an optimal domestic regulatory regime for regulating “innovative space activities?” If there is, it certainly is *not* the “Mission Authorization” regime set forth in the White House Report under Section 108. Under OSTP’s “Mission Authorization” approach, an inter-agency review process would be established for initial authorization. As proposed, the process lacks any transparency. There is no requirement governing application processing times, no standards against which approval or disapproval are measured, no requirement for a full (or written) explanation of reasons for denial, and no appeals process. In short, the proposed review process looks uncannily like the State Department’s International Traffic in Arms Regulations (ITAR) regime. That process has been abused by different governmental agencies countless times since it was imposed, resulting in the near death of the United States satellite building industry. It appears that, under the Administration’s Mission Authorization proposal, as in the ITAR, powerful governmental players on the inter-agency review team would each have an independent veto on an authorization request. Most likely, the applicant would never find out who “blackballed” the mission, or why.

If a regulatory regime is adopted for mission authorizations that mirrors, or even remotely resembles, the ITAR regime, Congress will have failed to execute our Treaty obligations in a way that promotes the “exploration and use” of space—the overarching goal of the Treaty (Article II)—and commercial entities will flee the United States to jurisdictions that treat their citizens in a fairer manner, just as satellite manufacturers fled the U.S. To avoid repeating the mistakes of the ITAR regime, Congress must ensure that:

- 1) The lead agency in the inter-agency process must have the *clout to push back against other agencies* seeking to thwart private enterprise for their own reasons, which may have little to do with U.S. national interests—and, indeed,

visit the downlink sites on an annual basis to ensure that they are operated properly. See http://www.nesdis.noaa.gov/CRSRA/files/noaa_commercial_remote_sensing_regulatory_affairs_06302015.pdf. This NOAA presentation noted that between 1996 and 2010, a total of 26 licenses were issued (less than two per year). As of October 1, 2010, there were a total of six (6) remote sensing satellites in orbit. Between 2010 and 2015, 46 licenses were issued (8 per year). As of June, 2015, 11 applications were in process and 22 other entities informed that they were required to apply for licenses. There are now over 100 remote sensing satellites on orbit.

⁵ The DOD has its own set of regulations for military launches.

may actively frustrate them (such as by strangling American industry). FAA/AST, as currently constituted, clearly lacks such clout.

- 2) *Clear processing guidelines* must keep agencies from blackballing projects on a whim. This will take a significant amount of expertise that is lacking even within FAA/AST. While that office has engineers capable of analyzing launch and reentry risks, it is ill-equipped to analyze, for example, whether Company B can mine an asteroid after Company A has already received authorization for such activities, or to determine how close Company B can land to Company A's lander on the Moon. In short, "non-interference" analyses will need to be conducted, which FAA/ATS does not have the expertise to do. Agencies that do have that expertise might have also an interest in conducting similar missions, giving them perverse incentives that could call into question the integrity of their analyses.
- 3) The *process must be transparent*. Applicants must be able to find out where in the process they are, what agencies might have questions about the mission, and when a decision will be rendered.
- 4) Any denial must come with a *fully reasoned decision*, so that rejected registrants know what they must do to amend their registration before resubmitting it. The ability to reject registrations without such explanations will effectively convert a mission registration regime into a mission authorization regime by giving unchecked discretion—veto rights, in fact—to, potentially, each of the reviewing agencies.
- 5) There must be an *appeal process*, whereby an applicant can challenge that decision in court. In short, the Administrative Procedures Act must apply to this process, rather than the "black box" that characterizes the ITAR process.

While it is theoretically possible to write legislation that would cover all of these "sins," we have no doubt but that bureaucrats, attempting to protect their own "turf," could find other ways of denying or slowing down a private sector company's attempt to conduct innovative space activities that might compete with a government program that is seeking billions of dollars of the Federal budget. The statement at the Hearing that "national security interests will always trump commercial interests" gives us pause as to whether any regime with a "veto power" will actually promote commercial innovative uses of space.

9. A "Mission Registration" Approach Will Spur Investment in the Space Economy While Still Allowing the U.S. to Prohibit Activities That Violate the OST or Articulated U.S. National Security Interests

Instead of "Mission Authorization," we propose a minimal "Mission Registration" approach. The essential difference is where the presumption lies.

We suggest allowing any U.S. entity planning to conduct a mission to register with a government entity, and provide full disclosure of the mission scenario. They would also have to demonstrate that the mission would not violate any of the OST prohibitions outlined above and defined more specifically in the enabling legislation. They would also demonstrate that the mission complies with orbital debris and space traffic management requirements through either reference to an FAA/AST, FCC, NOAA, or NASA authorization/approval, or through a separate demonstration if none of those regime apply (which is highly unlikely).

An interagency review would be conducted under a strict shot-clock of 120 days; after that time, the mission would be deemed authorized, unless the lead agency issued an appealable order, consistent with the Administrative Procedure Act's "arbitrary and capricious" standard, clearly identifying the grounds on which the registration was denied. In other words, self-certification of compliance with the statute would provide a *presumption of compliance*—a kind of safe harbor—but that presumption could, of course, be rebutted by the agency or any private party (domestic or, ideally, foreign as well) seeking to oppose the proposed mission as inconsistent with the Treaty.

A registrant would be under an obligation to keep the registering agency upraised of any changes to the mission, and the lead agency could in the future, if it later deemed that the mission might violate the OST prohibitions or other U.S. policy concerns, seek a court injunction to revoke the registration, with the burden of proof or revocation resting with the government agency.⁶

⁶We believe that any revocation would need to be done at the court level to assure an independent review of the revocation process. Allowing an agency to revoke the authorization subject to court appeal by the applicant would unfairly place the burden of proceeding and burden of proof with the private entity, and not on the government agency, where it belongs.

In order to meet U.S. obligations under OST Article IX not to authorize missions that might cause harmful interference to the activities of other “State Parties” or that might cause harmful contamination of space or celestial bodies (which, again, could be involve harm to future users, who may not yet be present to defend their interests in the kind of adversarial process that could work for harmful interference claims), we propose that the lead agency issue a Public Notice indicating that the application for registration has been filed and general information about mission type (*e.g.*, on-orbit satellite servicing, asteroid mining, etc.).⁷ Another country (but not a foreign national) at that point could seek consultation with the United States if it believed that a mission might violate Article IX. The statute should be written such that other countries could not abuse the consultation process by objecting to each registration as a way of either slowing down U.S. interests, or gaining valuable proprietary information concerning the nature of the mission, or the technology involved.

The practical problem with the U.S. taking the “high road” of notifying the world community in advance of planned missions, however, is that it might prompt other nations to create “paper missions”⁸ to stake out coveted locations in the solar system. A country, for example, could authorize a mission to land near Shackleton crater on the Moon and then claim a large non-interference zone around the landing site that would effectively preclude other operations nearby. Such a claim would likely violate Article II’s prohibition on territorial appropriation, both because it is not based on actual, ongoing use, but future, hypothetical use. Nonetheless, to avoid tying up American companies in dilatory international consultations under Article VI, any “prior notice” regime should come with strict milestones to demonstrate to the international community that such authorizations are legitimate. In that way, the United States can demand similar regimes from foreign governments in order to acknowledge any Article IX non-interference rights of their citizens. Again, this kind of coordination should be central to the concept of reciprocal, interlocking legislation proposed above in the model of the Deep Seabed Hard Mineral Resources Act.

A private party would be left with the ability to seek an injunction against another party it believed might cause harmful interference to its activities using traditional common law tort theories. As much as any particular private U.S. company might like to have the weight of the U.S. Government behind it to enforce its rights to a particular mission, such a heavy-handed approach (empowering the government to pick winners and losers) would be costly for the government to engage in, and simply not necessary given the well-established field of tort law. At most, Congress could consider requiring arbitration or other alternative dispute resolution platform in the statute for all cases arising under a Mission Registration regime. Ideally, the same common law developed between U.S. parties should be applicable in disputes between U.S. and foreign parties. For the concept of interlocking, reciprocal domestic legislation to work, the U.S. common law must be firmly grounded in Article IX’s prohibition against harmful interference, while also taking care not to violate Article II’s prohibition on territorial appropriation.

This is, of course, only the beginning of the issues that will ultimately need to be addressed to ensure that American law provides a sound foundation for American activities in space of all kind: governmental, business and scientific/not-for-profit. Congress will also have to address difficult questions, especially around harmful contamination and spectrum usage. But not all these issues need to be addressed now, at this hearing, or in legislation that Congress might pass this year.

We look forward to assisting explore these additional questions in the future, and look forward to being of assistance to your committee in any way we can.

Respectfully,

James E. Dunstan, Senior Adjunct Fellow, TechFreedom⁹

⁷ A fuller registration of the payload would be made prior to launch consistent with the obligations of the Registration Convention.

⁸ The International Telecommunication Union (ITU) and state regulatory bodies such as the FCC have long dealt with attempts to warehouse valuable orbital locations (especially within the geostationary orbit), through the filing of “paper satellite” applications—applications to provide service by entities clearly technically or financially unable to launch a satellite within the timeframes specified in those applications. This has led, on the U.S. side, to the implementation of very strict construction and launch milestones.

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Berin Szóka, President, TechFreedom¹⁰

Senator CRUZ. Thank you, Mr. Dunstan.
Ms. Montgomery.

STATEMENT OF LAURA MONTGOMERY, ATTORNEY AND PROPRIETOR, GROUND BASED SPACE MATTERS, LLC

Ms. MONTGOMERY. Thank you. Chairman Cruz, Ranking Member Markey, and members of the Subcommittee, thank you for inviting me to address the role the Outer Space Treaty may play in the regulatory responsibilities of the United States.

This country has the opportunity to interpret the Treaty in two ways: as conducive to private activity, or so that it creates barriers. A close reading of the text shows that the Treaty actually allows a lighter regulatory hand than many claim, both in terms of the authorization and supervision provisions of Article VI and the harmful contamination provisions of Article IX. If the United States pursues an interpretation that closely aligns with the text, there may be no need to seek changes.

I respectfully recommend that the United States understand that it need not regulate new commercial space activities, such as lunar habitats, mining, or lunar beer brewing, for the wrong reason, namely, the belief that Article VI makes the United States regulate either any particular activity or all activities of United States citizens in outer space. A misunderstanding of the treaty looms as possible regulatory drag, because many, including agencies in the Executive Branch, claim Article VI prohibits operations in outer space unless the government authorizes and supervises those activities.

The U.S. Government should not interpret this as forbidding unauthorized private space activity for three reasons. First, the Treaty does not forbid private operators from operating in outer space. Second, it does not say that either all or any particular activity must be authorized, leaving decisions regarding what activities require regulation to the member states. If Article VI truly meant that all activities had to be overseen, where would oversight stop? Life is full of activities, from brushing one's teeth to playing a musical instrument, which take place now with neither Federal authorization nor Federal supervision. Just because those activities take place in outer space does not have to mean that they should suddenly require oversight.

And, finally, Article VI is not, under U.S. law, self-executing, which means that it does not create an obligation or a prohibition on the private sector unless and until Congress says it does. So concerns over regulatory risks are artificial and may be set aside. Because Article VI is not self-executing, it is not enforceable Federal law until Congress acts.

Just as the Supreme Court said in *Medellin v. Texas*, when the court did not let the President enforce a ruling of the International Court of Justice against the states because Congress had yet to act, Article VI's call for oversight requires legislation with all its attendant policy choices. Accordingly, regulatory agencies should not attempt to enforce this treaty provision by either denying licenses

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or payload authorizations or by attempting to regulate that which they have no jurisdiction over. Nor should Congress pass a law so broadly worded as to encompass all activities that could take place in outer space. The Supreme Court, in criminal and First Amendment cases, says that laws should be drafted so that persons of ordinary intelligence can tell what is forbidden and what is required, and that would be a good model to follow here if Congress takes that path.

Article IX of the Treaty offers another source of concern, but it doesn't have to. Article IX provides that states' parties to the treaty shall avoid harmful contamination of outer space and adverse changes in the environment of Earth. This provision does not, in other words, apply to private actors. The United States is thus not legally obligated to impose this requirement on the private sector.

Even if Congress were to decide that private activity had progressed to the point where harmful contamination had become a concern, Congress would have policy decisions to make, including whether current government guidelines should stand in the way of human settlement in outer space and on the Moon and other planets. Because the harmful contamination provision is neither applicable nor self-executing, regulatory agencies should not attempt to enforce it until and unless Congress directs them to do so.

In order to put to bed the regulatory uncertainty arising out of any misunderstandings of the treaty, Congress could take a number of approaches. The most certain and long-lasting, however, and the one that would reduce the opportunities for confusion, misunderstanding, and regulatory overreach would be for Congress to prohibit any regulatory agency from denying a U.S. entity the ability to operate on the basis of inapplicable or non-self-executing provisions of the Outer Space Treaty, including Articles VI and IX.

Thank you for the opportunity to testify today.

[The prepared statement of Ms. Montgomery follows:]

PREPARED STATEMENT OF LAURA MONTGOMERY, GROUND BASED SPACE MATTERS

Chairman Cruz, Ranking Member Markey, Chairman Thune, Ranking Member Nelson, and Members of the Subcommittee, thank you for inviting me to participate in this important discussion and to address the role the Outer Space Treaty should play in the regulatory responsibilities of the United States. This country has the opportunity to interpret the Outer Space Treaty in two ways: as conducive to private activity or so that it creates barriers. A close reading of the text shows that the treaty actually allows a lighter regulatory hand than many claim, both in terms of the authorization and supervision requirements of Article VI and in terms of the harmful contamination provisions of Article IX.

As someone who hopes to see people beyond Low Earth Orbit again in my lifetime, and who hopes to see commercial space operations other than launches, reentries, and communications satellites, I respectfully recommend that the United States not regulate new, commercial space activities such as lunar habitats, mining, satellite servicing, or lunar beer brewing for the wrong reason: the belief that Article VI makes the United States regulate either any particular activity or all activities of U.S. citizens in outer space. Regulations already cost American industry, the economy, and the ultimate consumer upwards of four trillion dollars, according to recent research from the Mercatus Center,¹ so we should think carefully before creating more drag on the space sector.

A misunderstanding of the Outer Space Treaty looms as possible regulatory drag because many, including agencies in the Executive Branch, claim Article VI of the

¹ Bentley Coffey, Patrick McLaughlin, and Pietro Peretto, "The Cumulative Cost of Regulations" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2016).

treaty prohibits operations in outer space unless the government authorizes and supervises—which I’ll refer to as “oversees” or “regulates”—those activities. Although Article VI states that “[t]he activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty,” the U.S. Government should not interpret this as forbidding unauthorized, private space activity for three reasons. The treaty does not forbid private operators from operating in outer space. It does not say that either all or any particular activity must be authorized, leaving decisions regarding what activities require regulation to the member states. And, finally, Article VI is not, under U.S. law, self-executing, which means that it does not create an obligation or a prohibition on the private sector unless Congress says it does.

I will also address Article IX of the Outer Space Treaty and its admonition that States Parties to the treaty avoid harmful contamination of outer space and adverse changes in the environment of Earth. This provision does not, on its face, apply to private actors. It is thus not an obligation on the United States to impose this requirement on the private sector. Even if Congress were to decide that private activity has progressed to the point where contamination has become a concern, Congress would have a number of policy decisions to make, including whether current views on harmful contamination, which might keep space a scientific preserve, should stand in the way of human activity in outer space. Because the harmful contamination provision is neither applicable nor self-executing, the regulatory agencies should not attempt to enforce it until and unless Congress directs them to do so legislatively.

In order to put to bed the regulatory uncertainty arising out of any misunderstandings, Congress could take a number of different approaches. The most certain and long-lasting approach, however, and the one that would reduce the opportunities for confusion, misunderstanding, and regulatory overreach, would be for Congress to prohibit any regulatory agency from denying a U.S. entity the ability to operate in outer space on the basis of inapplicable or non-self-executing provisions of the Outer Space Treaty, including Articles VI and IX.

I. The Treaty Does Not Forbid Private Space Activity, but Leaves it to Each Country to Decide What Activities to Regulate and How to Regulate Them

Article VI of the Outer Space Treaty states:

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. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.

The United States itself is in compliance with Article VI because the treaty leaves the decisions about how to comply with its rather ambiguous terms to each country. By its own terms, Article VI legally does not and cannot prohibit space operations by the commercial sector. Instead Article VI leaves it to each country to decide which particular activities require regulation, how that regulation will be carried out, and with how much supervision. Accordingly, if Congress hasn’t said that a certain activity, such as lunar harp playing, requires authorization and continuing supervision then lunar harp playing does not.

Article VI contains three relevant ambiguous terms that the drafters have left to the different countries to define as they see fit. The terms are “authorization,” “continuing supervision,” and “activities.”

A. Authorization

Article VI says that a country must authorize its nationals’ activities. Each country has its own processes and terminology for how it authorizes something. The United States alone authorizes regulated activities by certificate, certification, approval, license, registration, waiver, or exemption. In the United States, Congress determines the nature of the authorization.

B. Continuing supervision

The signatories to the treaty are supposed to require continuing supervision of their nationals. “Continuing supervision” is a matter of frequency. Some agencies conduct annual inspections. Others oversee regulated activities on a daily basis. Some only show up after an accident. The frequency may not be the same, but the

supervision may still be called continuous. The nature of the supervision may differ from country to country but all, regardless of frequency, could comply with Article VI's call for continuing supervision.

C. Activities

Finally, and most importantly, the treaty leaves it to each country to decide what activities require supervision and authorization. The treaty does not say *all* activities require oversight. It does not say *which* particular activity requires oversight. Rather, it leaves to each country's policy makers the decision as to where to draw the line. And draw lines they must, so as not to waste resources, unduly burden the industry, or cause confusion. For the United States, the entity that makes those determinations is the U.S. Congress, and the regulatory agencies should wait for Congress to act.

Article VI is structured so that a country need not expend resources regulating frivolous, mundane, or non-hazardous activities. Each country may itself decide what activities require authorization and supervision. Thus, if our decision makers haven't decided that a particular activity needs authorization, that activity does not. If Article VI truly meant that all activities had to be overseen, where would oversight stop? Life is full of activities, from brushing one's teeth to playing a musical instrument, which take place now without either Federal authorization or continuing Federal supervision. Just because those activities take place in outer space does not mean they should suddenly require oversight.

As a matter of past practice, Congress has always identified what activity it wanted regulated, and it has done so with the proper level of specificity that due process considerations of notice and transparency require. Congress required the Federal Communications Commission to license satellite transmissions. It required the Department of Transportation (DOT) to license the launch of launch vehicles. Later, it required DOT and the Federal Aviation Administration (FAA) to license the reentry of reentry vehicles as well. Congress also mandated that the seemingly benign activity of taking pictures of Earth—"remote sensing"—requires regulation, too. The point is, each time Congress determined that something required oversight, whether for reasons of safety, national security, or interference, it identified the activity in question, and it did so with sufficient clarity that persons of ordinary intelligence could tell what was forbidden and what was required.

As a matter of policy, Congress may determine that there are good reasons to expend government resources and taxpayer dollars on a particular activity. Hypothetically, Congress could say that robotic mining of rocks in space really far away does not require regulation because no one lives on that rock, it has no visitors, and no one will get hurt by it. Or, it could say that bringing all those platinum group minerals back to Earth at once will wreak havoc on the economy and then set up an agency to oversee pricing. Even if Congress ignored asteroid mining, it might forbid the reentry of anything large enough to make a crater the size of the Yucatan. There are a number of considerations that may lead to legislation and regulatory oversight. But they are not in Article VI.

Just as there are serious activities that someone may say require oversight, there are a host of other activities that don't. One hears no lamentations over the lack of authorization of space tourists. Yet space tourists exist now. Lunar habitats and space mining do not.

In short, Article VI leaves at least three decisions to each country that signed the Outer Space Treaty: What form should an authorization to take? How frequent must the continuing supervision be? And, what activities require any authorization at all? If Congress doesn't think playing the harp in space requires authorization, then it doesn't, the U.S. is still in compliance with Article VI, and the Executive Branch should not attempt to stop the "unauthorized" harpist.

II. Article VI is not Self-Executing

If a treaty promises, implicitly or explicitly, that the signatories shall enact legislation to implement the treaty, it necessarily requires additional action by another branch of the government than the Executive. In the United States, that other branch is the U.S. Congress, and Article VI's call for supervision and authorization requires the kind of policy decisions that are made by our Congress.

As the Supreme Court noted in *Medellin v Texas* in 2008, "not all international law obligations automatically constitute binding Federal law enforceable in United States courts." As far back as the early 19th century, in a case called *Neilson v. Foster* in which the Court considered a treaty with language similar to that used in Article VI, the Supreme Court said that Congress had to first enact legislation before it could enforce the treaty because the text of the treaty required additional legislative action. With its space legislation, Congress has acted consistently with

the Supreme Court's holdings. When Congress decides that an activity requires regulation, it will pass a law, and has done so for launch, reentry, remote sensing from space, and satellite communications.

Because Article VI is not self-executing and thus not enforceable Federal law, until Congress acts, regulatory agencies should not treat Article VI as a barrier that applies to commercial actors or claim that it prohibits all or any particular private activity. Indeed, given the close textual analysis that the Supreme Court typically applies to treaties, Article VI's potential obligation on the government does not, even on its own terms, constitute a prohibition on the private sector.

III. Paths Forward

Purely as a legal matter, Article VI should not create a barrier to private activity. However, should there be concerns that this view is not shared by agencies of the Executive Branch, Congress has legislative options at its disposal.

A. *Legislation Could Clarify that the Executive Branch May Not Prohibit a U.S. National from Conducting an Activity in Space Unless Congress Requires that Activity's Authorization and Continuing Supervision*

Legislation could clarify that regulatory agencies may not prohibit a U.S. national from conducting an activity in space unless Congress required Federal oversight. This would not be legally necessary, strictly speaking, because this proposal merely reflects current law. However, since the issue of what Article VI means has created legal and regulatory uncertainty, Congress could lay that uncertainty to rest with a directive to regulatory agencies to abstain from using the lack of Federal oversight of a particular activity as a reason to deny a payload review, a launch or reentry license, or authorization for satellite transmissions or remote sensing.

There are clear advantages to this path. It would, of course, create certainty, which is helpful to industry's quest for innovation and investment. It would be long-lasting. Most importantly, this path would ensure that before Congress required Federal oversight of another activity in space, it would first determine whether a real need existed for that oversight.

B. *Let us Not Regulate Everyone for Everything Everywhere in Space*

Congress should not require the authorization and supervision of "all" private activities in outer space by private U.S. nationals. The Supreme Court, in criminal and First Amendment cases, has stated that laws should be drafted so that persons of ordinary intelligence can tell what is forbidden and what is required. Should Congress decide to require regulation, it should avoid the proposals that would require Federal oversight of "all space activities." Language like that could entrap people engaged in perfectly benign activities. They might reasonably believe that something they do all the time on Earth was not a "space activity" or "operation of a space object" subject to regulation. What is forbidden or required should be clear and the government must provide adequate notice of what has to be authorized.

Many activities in space shouldn't require regulation, just as many activities we engage in on the ground don't. Just as there are hazardous activities that may require oversight, there are a host of other activities that don't. People will engage in activities that might endanger themselves, their customers, or their neighbors, but they will also perform more ordinary acts. A musician may decide to play the harp on the Moon. The Internet tells us that a student group plans a little lunar brewing of beer in the interests of science. Rather than enacting overly broad legislation that transfers all of its legislative powers to a regulatory agency, Congress could take the more measured and transparent approach of deciding which activities require oversight while acknowledging that not all of them do.

Indeed, without the clarity of identifying the activities that require oversight, such a transfer of legislative power would only prolong any regulatory uncertainty as industry faced the possibility of having to obtain permission for every little activity proposed. The impact of regulation on the private sector is real.

Typically, if an agency receives a very broad grant of authority the agency will eventually construe that authority to its maximum limits. Were Congress to require authorization and supervision of all activities by U.S. entities in outer space, the incentives on and responsibilities of regulators—such as making sure they don't miss anything, making sure they don't allow something dangerous to happen, and making sure they know what's going on—mean that the agencies will attempt to oversee more than just those activities that are hazardous to others or pose national security concerns. After all, an agency can't figure out if these threats exist unless it finds out all—from the trivial to the hazardous—that an operator plans. Inquiries will be made.

The regulatory process balances a host of competing interests, including transparency, fairness, legal sufficiency, and safety. Unfortunately, these necessary con-

siderations sacrifice efficiency and flexibility. As a society, we consider that sacrifice worth it when an activity jeopardizes other people. When an activity doesn't, we must ask if the constraints serve a useful purpose. If Congress were to decide, as it has in the past with respect to launch, reentry, remote sensing, and satellite communications, that another space activity required regulation, it should identify that activity specifically. Space bakeries, on account of the threats posed by their ovens, might require governmental oversight if there were other people nearby. Robotic mining of asteroids millions of miles from human habitation might not. Congress should not, however, interpret Article VI to require the regulation of everything.

C. The FAA's Payload Review: Opportunity or Threat?

Does the FAA's statutory payload review authority allow the FAA to provide a positive payload determination to an entity not otherwise supervised by the Federal Government? Yes, it does. This answer may not, however, be consistent with the view of everyone in the Executive Branch because of Article VI's call for authorization and supervision.

When conducting a payload review, the FAA must do so consistent with public health and safety, safety of property, national security, and foreign policy interests. Thus we see that the FAA's foreign policy authority allows the FAA to make its own determinations on foreign policy. Its governing statute, the Commercial Space Launch Act, requires the FAA to consult with the State Department on a matter affecting foreign policy. The FAA has implemented this requirement² in its regulations to state that it consults with the Department of State on foreign policy issues for its payload reviews.

Under the better and more legally sound interpretation of its authority, the FAA could use its foreign policy powers to encourage, facilitate and promote the space industry. For example, were a prospective lunar harpist to seek a payload determination from the FAA, the FAA would engage in its normal practice of inter-agency consultation. The U.S. Department of State might raise concerns with respect to the fact that Congress has not passed legislation to regulate harp playing despite Article VI's proviso that all States Parties to the treaty authorize and continuously supervise the acts of their nationals in outer space. With its own foreign policy authority, independent of that of the State Department, the FAA could determine that because Article VI is not self-executing, until Congress acts, the U.S. has not determined that playing the harp constitutes the type of activity requiring oversight under the treaty. Having satisfied its consultation obligations, the FAA could then issue a favorable payload determination.

Conversely, relying on its foreign policy authority, the FAA could worry that other countries might raise issues about Article VI oversight of a lunar harpist and contemplate denying the harpist's requested payload determination. Such a determination would, as noted, run afoul of the fact that Congress has not determined that lunar harp playing is the kind of activity that requires Federal oversight. The FAA must make any policy determinations in accordance with U.S. law, and a non-self-executing treaty is not, as noted by the Supreme Court's *Medellin* opinion, binding Federal law. To treat it as such would raise the question of whether the FAA was usurping Congress's legislative role.

Lunar harp playing is a vaguely ludicrous example of an activity that could take place extraterrestrially, but it makes the point that the Outer Space Treaty left the determinations of what requires authorization and continuing supervision to each signatory nation. If Congress hasn't decided that lunar harpists or miners require oversight for their respective activities, they don't and the regulatory agencies should not attempt to stop these activities. The treaty does not say which activities must be regulated, and in the United States that determination lies with Congress. For the FAA to say that it had the ability to make such determinations about a non-self-executing treaty would be to say that it, rather than the legislative branch, could make the legislative determination.

Accordingly, because of the FAA's foreign policy authority muddying the waters over the FAA's responsibilities, the FAA's payload review creates regulatory uncertainty for industry, and likely merits closer Congressional scrutiny and possible revision.

D. Most Provisions of the Outer Space Treaty only Apply to Governmental Activity in Space

The bulk of the Outer Space Treaty's requirements apply to "States Parties," and the United States should not interpret those provisions as applying to private ac-

²The FAA could change its regulations so that it only consulted on isolated questions rather than for each payload given how 51 U.S.C. § 50918 phrases the requirement.

tors. For example, Article IV says that “States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, . . .” If Congress wanted to make sure that this prohibition applied to private parties, Congress might consider implementing legislation.

Another provision that calls out for Congressional clarification—as well as a multitude of policy determinations—is whether the harmful contaminations provisions (often referred to as the “planetary protection” provisions) of Article IX apply to commercial operations. Article IX states, in relevant part, that:

States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose.

Some, including regulatory agencies, claim that Article VI’s provision that States Parties to the treaty assure “that national activities are carried out in conformity with the provisions set forth in the present Treaty” means that commercial actors must abide today, even absent legislation, by each provision in the treaty, even the provisions that only apply to governments.

The first reason to question the applicability of the “planetary protection” provision is that the treaty itself limits this requirement, like many others, to “States Parties.” States Parties are governments. When the drafters of the treaty intended a particular provision to apply to non-governmental entities they said so. For example, Article IX contains another provision that does apply to non-governmental entities, namely, the requirement for a State Party to consult if it “or its nationals” might interfere with others in outer space.

Secondly, even if it applied, Article IX’s planetary protection provision is not self-executing. It requires the legislative branch to make numerous policy judgments, such as whether the goals of space science or space settlement should preempt one another or may be pursued together. According to NASA’s website,³ “planetary protection” is the term “given to the practice of protecting solar system bodies (*i.e.*, planets, moons, comets, and asteroids) from contamination by Earth life, and protecting Earth from possible life forms that may be returned from other solar system bodies.” NASA is being a good steward with this approach, but the approach is not conducive to human settlement. If Congress were to legislate regarding Article IX’s goal of avoiding harmful contamination, Congress should make it clear that human beings are not a contaminant. If Congress settled that question, anything with equivalent or less biological baggage than a human being should not be required to undergo the expensive sterilization protocols now employed for government missions.

We must keep in mind, however, that the United States did not agree to apply the harmful contamination provision to commercial operators. Accordingly, until Congress acts, we may hope that the new administration will not attempt to treat the harmful contamination provision as binding Federal law for commercial operators. Just as in *Medellin* where a President could not unilaterally impose a treaty obligation on the states, regulatory agencies should not attempt to impose treaty obligations on the private sector without Congressional action. The United States could also take this opportunity to clarify its own interpretation of this provision as applying only to governmental operations in space, not to the operations of private actors.

Conclusion

In closing, I wish to say that Congress, in deciding whether to regulate a particular activity in space, should follow its usual decision-making process for deciding whether an activity requires regulation. Can the activity hurt other people? Could it have health effects? Are there national security concerns? Are there other, less burdensome solutions than Federal regulation? Is it too soon to regulate? Congress has placed a moratorium on the regulation of human space flight for safety purposes. Does the same logic apply to lunar harpists? To lunar miners?

What the United States does not need to do is to regulate purely for the sake of regulation, which is what the misunderstandings over the role of Article VI in U.S. law may lead to. Nor, unless Congress sees domestic policy reasons for doing so, does the United States have an international obligation to impose the harmful contamination provisions on the private sector.

³ Office of Planetary Protection, <https://planetaryprotection.nasa.gov/overview> (last checked May 18, 2017).

Thank you for the opportunity to testify before you today. I look forward to working with you on these issues in the future.

Senator CRUZ. Thank you, Ms. Montgomery.
Mr. Schaefer.

**STATEMENT OF MATTHEW P. SCHAEFER,
VERONICA A. HAGGART & CHARLES R. WORK PROFESSOR
OF INTERNATIONAL TRADE LAW; CO-DIRECTOR—SPACE,
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SPACE LAW COMMITTEE**

Mr. SCHAEFER. Chairman Cruz, Ranking Member Markey, members of the Subcommittee, it's an honor and pleasure to be here today for this very timely hearing.

It is timely because of the Outer Space Treaty's (OST) 50th anniversary, all the innovative and important new space activities of U.S. businesses—many of whose representatives are actually in the audience today—and given the fact the U.S. has a current authorization gap for new space activities, things like asteroid mining, lunar landers, on-orbit satellite servicing, lunar research facilities and laboratories. This authorization gap creates a problem in two ways. First, it creates uncertainty for industry. That doesn't help investment. That doesn't help business cases. Second, as activities go forward, it may create compliance problems with U.S. international obligations, which also can create problems, as I'll elaborate on a bit further.

The U.S. has agreed to a set of treaty interpretation rules internationally that are expressed in the Vienna Convention on the Law of Treaties. The primary rule in that document is that we interpret treaties according to the ordinary meaning of the terms of the treaty in their context and in light of object and purpose. It's very clear that Article VI of the OST calls on the U.S. and other parties to the OST to authorize and supervise commercial space activities in order to assure their compliance with the OST. It further makes parties internationally responsible for non-governmental activities in outer space. This Article VI obligation seems to strike fear into some people, and it shouldn't.

OST obligations are very minimally burdensome and quite flexible in how they can be interpreted. It's a basic set of principles, a few minimally burdensome rules, which, by the way, help advantage U.S. companies as well. If we don't respect our obligations under Article VI of the OST to create an authorization and supervision regime, we're going to face consequences. Our industry will face consequences. Foreign retaliation is possible and a lot of space businesses are global in nature. They depend on global partners, customers, and investors to make out their business case. When the U.S. Government doesn't respect its international treaty obligations, foreign governments can retaliate; take away markets, take away customers; take away foreign partners—and foreign investors can shy away.

Second, when a U.S. company is a first mover up in outer space, other countries will not respect these basic, minimal norms when it comes to how they will interact with that first moving U.S. com-

pany. Both of those impacts of treaty non-compliance would create uncertainty for U.S. space companies.

On the self-executing nature of the OST, we could debate that endlessly. The U.S. Senate has done an excellent job since the U.S. Supreme Court's 2008 *Medellin* case, making very clear which articles of treaties are self-executing and non-self-executing. For older treaties, we're trying to glean U.S. political branch intent on the issue of self-execution from treaty text and less explicit domestic materials.

But the important point is even if the OST Article VI is non-self-executing, the international obligation remains. If we do not comply with it, we will face the consequences I just laid out. Further, the Congress has directed, when it comes to launch licenses and payload reviews, the Department of Transportation to take into account our international obligations.

What is creating the authorization gap is not a failure of Congress to direct the Administration to comply with our international obligations. Rather, what creates the regulatory gap is the legislative history to the 1998 amendments to the Commercial Space Launch Act that indicate that Congress was not intending to grant on-orbit authority to the Executive Branch.

The U.S. Congress did an excellent job in the Space Resource Exploration and Utilization Act of 2015 by highlighting our international obligations when they laid out that there can be property rights in extracted resources, a long-standing U.S. interpretation of the OST. That continuity internationally creates certainty internationally and also helped the U.S. lessen vocal international opposition to the law. That's the page out of the playbook that should be adopted when we establish an on-orbit authorization regime.

In short, there's no need to terminate the OST. There's no need to amend it. There's no reason to stray from our agreed-upon treaty interpretation rules. There's no reason to ignore the plain meaning of Article VI, and there's certainly not a need to pay attention to certain OST obligations and reject others. We can have an OST-compliant regime that meets the spirit of permissionless innovation, something that led to the growth and success of the Internet economy, and I'd be happy to share further ideas on that in the question and answer session.

Thank you very much.

[The prepared statement of Mr. Schaefer follows:]

PREPARED STATEMENT OF MATTHEW P. SCHAEFER, VERONICA A. HAGGART & CHARLES R. WORK PROFESSOR OF INTERNATIONAL TRADE LAW; CO-DIRECTOR—SPACE, CYBER AND TELECOMMUNICATIONS LAW PROGRAM, UNIVERSITY OF NEBRASKA COLLEGE OF LAW; AND CO-CHAIR, AMERICAN BRANCH OF INTERNATIONAL LAW ASSOC. SPACE LAW COMMITTEE

Mr. Chairman and Members of the Subcommittee, it is an honor and a pleasure to be here today to share my views on today's hearing topic: "Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space."

This hearing is especially timely. The Outer Space Treaty (OST), or more formally the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, is celebrating its 50th Anniversary this year. Commercial space business plans and activities are increasing rapidly, including plans for new on-orbit activities going beyond traditional remote sensing and communications satellites, such as asteroid mining, lunar or on-orbit research facilities and hotels, and on-orbit satellite servicing. And, at the

same time, the U.S. Government currently suffers from an on-orbit authorization gap for new activities that go beyond remote sensing and communications—two activities with current licensing regimes administered by NOAA and the FCC, respectively. The authorization gap for new on-orbit activities creates uncertainty for U.S. commercial space businesses and investors, and as activities proceed, may also create compliance problems with U.S. international obligations under the OST. The Executive Branch was able to handle the Moon Express situation under existing authorities given the limited nature of its activities, but authorization of more elaborate activities is likely to require new authorities. In any event, it is in the U.S. national interest and the interest of the U.S. commercial space industry to have a certain and predictable process for authorization established that complies with U.S. international obligations.

The U.S. commercial space industry can flourish under the existing OST. Indeed, the U.S. can establish a licensing or authorization regime for new on-orbit space activities that complies with the OST and still meets the spirit of permissionless innovation, a concept many credit with the growth and success of the Internet economy. I refer the committee to my article *The Contours of Permissionless Innovation in the Outer Space Domain* forthcoming in Vol. 39 of the University of Pennsylvania Journal of International Law (Fall 2017) for a detailed examination of these issues. The article is available publicly now on the Social Science Research Network (SSRN) at <http://ssrn.com/abstract=2942526>. Today, I wish to highlight important findings from that article but also push further into some of the international and domestic dynamics involved in the today's hearing topic.

Permissionless innovation is rarely, if ever, pure in the sense of the complete absence of government regulation altogether. Instead, the core of a permissionless innovation framework is a default presumption in favor of permission with limited constraints.¹ The OST has very minimal constraints on private space activities—and those minimal constraints can actually help protect U.S. commercial industry from harmful actions of other nations and actors. In short, there is a basic compatibility between a flourishing and competitive commercial space industry here in the United States and U.S. compliance with our obligations in the OST.

There is no need for the United States to withdraw from or even seek amendment to the OST. There is no need for the United States to abandon long-established and long-agreed upon treaty interpretation rules when interpreting the OST. There is no need to ignore the plain language of Art. VI of the OST—a provision that requires “authorization” and “supervision” of the activities of a country's commercial space actors in order to “assure” their conformity with the provisions of the OST. There is no need to only pay attention to certain OST obligations and ignore others. Undertaking any of the above listed actions will actually undermine U.S. commercial space industry prospects.

The U.S. commercial space industry—including segments involved in new on-orbit activities—relies on global markets for their business case. Partners, investors and customers from abroad are often necessary to the business case.

If the United States does not take the minimal steps necessary to comply with OST Art. VI, U.S. companies engaged in these activities may face foreign retaliation in the form of denying access to customers or partners, and investors from abroad may shy away as well. The United States will also not be able to credibly insist that foreign governments when conducting their space activities not harmfully interfere with U.S. commercial activities. This diminished credibility would put at risk the large and often long-term investments U.S. commercial space companies undertake. If the Congress tasks the Executive Branch with protecting U.S. commercial space actors from foreign interference, it must also task the Executive Branch with considering harmful interference an applicant might cause not only to pre-existing U.S. Government operations or other pre-existing U.S. commercial operations, but also harmful interference that might be caused to pre-existing foreign activities.

The United States can and should maintain the continuity of the OST and U.S. leadership in outer space matters. Congress can and should create a certain and predictable domestic authorization framework for new on-orbit commercial space activities that complies with the OST² and comports with the spirit of permissionless innovation. The continuity maintained internationally and the (hopefully) soon created predictability and certainty within a U.S. domestic authorization process will yield large benefits to the U.S. commercial space industry. If such a path is followed, the risk of retaliation by foreign governments for failure to abide by the OST and

¹See ADAM THIERER, PERMISSIONLESS INNOVATION: THE CONTINUING CASE FOR COMPREHENSIVE TECHNOLOGICAL FREEDOM (2016).

²In accord with Statement of Dennis J. Burnett, Hearing of House Science Committee Space Subcommittee, March 8, 2017, pp. 8–9.

the risk of any last minute stoppage by the Executive Branch of a new on-orbit activity for reasons of international obligation compliance or national security will be greatly reduced or eliminated altogether. Investors in these new space industries will have legal certainty that should help stimulate investment and growth in these industries.

What the Congress provided for in the Space Resource Exploration and Utilization Act of 2015 (within Public Law 114–90) is a perfect example of maintaining consistency internationally while creating greater certainty and predictability domestically in a fashion that respects U.S. international obligations and dampens negative foreign reactions. The act in Section 402 provides the following:

A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, *including the international obligations of the United States.*³(emphasis added).

These provisions of U.S. law are fully consistent with at least 35 years of long-standing U.S. policy and legal interpretations dating back to 1979–1980 in statements by Secretary of State Vance and State Department Legal Advisor Owen.⁴

The reference to international obligations in the U.S. statute envisions compliance with Art. VI of the OST and thus provides a further justification for Congress to move forward and fill the existing regulatory gap for new on-orbit activities. Just as importantly Congress included a statement in the law in Section 403 that states:

It is the sense of Congress that by the enactment of this Act, the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body.⁵

This statement acknowledges U.S. obligations under the OST Art. II and helps dampen any negative reaction to the codification of long-standing U.S. interpretations of OST regarding property rights in extracted resources.

The important lesson from the Space Resource Exploration and Utilization Act of 2015 is it matters not just what Congress says in a law but how it says it. Congress can provide for consistency internationally while simultaneously creating certainty and predictability domestically—all to the benefit of U.S. commercial space interests. Referencing international obligations and paying heed to the non-sovereignty obligation in Art. II makes many more countries willing to hop on board or at least not overtly object to the long-standing (and correct) U.S. interpretation that Art. II does not prohibit property rights in extracted resources. Some countries, of course, will continue to oppose the U.S. interpretation for reasons of perceived national interest but that group is smaller and less vocal than would be the case had Congress not mentioned and respected U.S. international obligations in the statutory language of the Space Resource and Utilization Act of 2015.

Imagine if instead the United States took the radical step of withdrawing from the Outer Space Treaty because some countries disagree with the U.S. interpretation regarding Art. II as it relates to ownership rights in extracted resources. Initially, the question would arise whether withdrawing from the OST would actually

³ Available at <https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf>

⁴ See Letter from Secretary of State Vance to Sen. Church, Chairman of Senate Foreign Relations Committee, Nov. 28, 1979, *reprinted in* Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Senate Committee on Commerce, Science and Transportation, August 1980, at p. 313 (stating that the Moon Treaty provides no moratorium on exploitation of space resources, that Art. II of the Outer Space Treaty’s ban on appropriation only applies to resources in place, and that the Outer Space Treaty and Moon Agreement would allow for ownership of extracted space resources); *See also* Testimony of State Dept. Legal Advisor Owen in Hearings Before the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science, and Transportation on Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (96th Cong., July 29 & 31, 1980)(both oral and written testimony) at p. 2–19 (“American companies will have a continuing legal right to exploit the Moon’s resources. . . .”; “. . . once [resources] have been extracted from the Moon, ownership can be asserted at that point. . . .”; “exploitation [can] go forward and that one can own what one can remove from the surface or subsurface of a celestial body . . . the negotiating history [of the Moon Agreement] makes it very clear that that was contemplated by the parties.”; “The United States took the position from the outset that such exploitation should be permitted, that such ownership after extraction should be permitted. And that . . . is an authoritative interpretation. . . .”; “. . . we have insisted that even after such a regime is established [an international one under the Moon Treaty], the right of unilateral exploitation will continue to be available to those States which choose not to participate in such a regime.”)

⁵ Available at <https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf>

eliminate the non-sovereignty obligation in any event since many believe the obligation to now apply as a matter of customary international law as well as treaty law. Terminating the treaty obligation would not terminate the customary international law obligation. But setting that issue aside, U.S. termination of the OST would likely prompt other major space powers to withdraw from the OST, and thereby allow any other nation arriving first to the celestial body after the treaty terminations to declare sovereignty over vast swaths of the celestial body, setting up a show down with later arriving U.S. commercial interests. That is not the legal consistency, predictability and certainty that U.S. space interests deserve. Moving forward to the drafting and creation of a U.S. authorization regime for new on-orbit activities, there is similarly a large downside to changing or ignoring long-standing treaty interpretation methods or ignoring some OST provisions altogether.

As described and summarized in the abstract to my *Permissionless Innovation* article forthcoming in the University of Pennsylvania Journal of International Law:

A permissionless innovation regulatory model . . . is being explored for adoption in the outer space domain, given the amount of innovation by commercial entities in that sector. However, translation of the model to outer space is complex because permissionless innovation is contextual, and the outer space domain differs from the cyber domain in important respects: First, international obligations require the U.S. Government to authorize and supervise commercial space activities. Second, national security concerns are potentially raised by even every day, non-illicit space activities. Third, space business investors actually demand enhanced regulatory certainty given the risk and often long-time horizons of their investments.

New on-orbit space activities . . . currently fall within a regulatory gap—the Executive Branch lacks express Congressional delegation to regulate such activities. This situation may appear to be a victory for proponents of a nearly pure or unadulterated version of permissionless innovation. Indeed, to protect the status quo, permissionless innovation advocates are ignoring long-established and agreed upon rules of treaty interpretation to argue the U.S. Government is not under an obligation to authorize and supervise U.S. commercial space companies' activities.

The irony is that the current gap actually undermines the benefits of permissionless innovation. The Executive Branch faces a Hobbesian choice of following Congressional intent and standing aside as new on-orbit activities are engaged in or complying with international obligations and addressing potential national security concerns by continuing to leverage existing authorities in an attempt to control new on-orbit activities. U.S. commercial space businesses—the innovators—are left in a similarly difficult situation: facing a risk of foreign government retaliation in event of U.S. Government non-compliance with international obligations or being forced to engage in costly and time-consuming litigation if the U.S. Government blocks their proposed activity by stretching existing authorities. Fortunately, the U.S. Congress can enact a solution that fills the gap—one that provides compliance with international obligations, protects national security, and affords regulatory certainty for U.S. space businesses while at the same time ensuring that permissionless innovation thinking and *esprit de corps* controls the interagency approval process, including a default presumption in favor of approval.⁶

A Closer Look at Article VI of the OST and Obligations in the OST that Might Minimally Impact U.S. Commercial Actors and Simultaneously Help Protect U.S. Commercial Space Businesses

OST Art. VI provides the following:

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. The activities of non-governmental entities in outer space, including the moon and other celestial bodies,

⁶ See Matthew P. Schaefer, *The Contours of Permissionless Innovation in the Outer Space Domain*, forthcoming in Vol. 39 Univ. of Pennsylvania Journal of International Law (Fall 2017), available currently at <http://ssrn.com/abstract=2942526>

shall require *authorization and continuing supervision* by the appropriate State Party to the Treaty. . . .⁷ (emphasis added).

The first sentence providing that States Parties bear international responsibility for their non-governmental (commercial) entities' activities is quite unique in international law. Normally, a government is not responsible for purely private conduct in the absence of a strong link such as the government exercising direction or effective control over the private activity. This provision was part of the trade-off in the negotiation of the OST in which the original Soviet proposal was to ban private actors from space altogether. The OST clearly allows for and anticipates commercial space activity but makes State Parties internationally responsible for such activity. The last clause of the first sentence of OST Art. VI also provides that States Parties must assure that national activities (including those by its commercial actors) are carried out in conformity with the OST. The second sentence then requires the appropriate State Party to undertake "authorization and continuing supervision" of its non-governmental (commercial) space activities.

Well-established and long-agreed to treaty interpretation rules are codified in the Vienna Convention on the Law of Treaties (VCLT), Articles 31 and 32.⁸ Although the United States is not a party to the VCLT, it has long recognized that it considers itself bound to many of its provisions, including the treaty interpretation rules, as a matter of customary international law.⁹ VCLT Art. 31(1) provides the following primary rule of treaty interpretation:

A treaty shall be interpreted in good faith in accordance with *the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose*.¹⁰ (emphasis added).

Thus, when interpreting what authorization and continuing supervision requires within OST Art. VI, the VCLT mandates looking to the ordinary meaning of those terms in their context and in light of their object and purpose. As written in my *Permissionless Innovation* article:

The ordinary meaning of authorize is "give official permission or approval to," or "to give official permission for something to happen."¹¹ The ordinary meaning of supervision is to "monitor," and the ordinary meaning of continuing is "occurring in a cyclical or repetitious pattern."¹² In short, authorize and continuing supervision require some process to "give official permission or approval to," and "monitor" in some "cyclical or repetitious pattern" with at least one purpose of such process to "assure" that commercial actors are complying with OST obligations.¹³

The first sentence of Article VI provides the context to the authorization and continuing supervision obligation. States parties are to authorize and supervise to "assure" conformity by their commercial actors with provisions of the OST. All of this only mandates very light-touch regulation because OST obligations applied to commercial actors are far from onerous as will be displayed below. It is important to realize that those same obligations help to some extent protect U.S. commercial space actors from injurious foreign actions.

The fact that Art. VI is argued to be non-self-executing by many does not change the situation. Whether a treaty is self-executing is an issue of whether the treaty automatically enters the U.S. domestic legal system.¹⁴ The Executive Branch in the prior Administration proposed a Mission Authorization Framework to implement Art. VI. If the Executive Branch believed that Art. VI was self-executing, then it would already maintain domestic authority to authorize on-orbit activities, at least to ensure their compliance with the OST, unless the legislative history to the 1998

⁷ Available at <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html>

⁸ See Vienna Convention on Law of Treaties [hereinafter VCLT], Arts. 31–32, available at <https://treaties.un.org/doc/publication/unt/volume%201155/volume-1155-i-18232-english.pdf>

⁹ See, e.g., <https://www.state.gov/s/l/treaty/faqs/70139.htm>

¹⁰ See VCLT, *supra* note 8.

¹¹ See MACMILLAN DICTIONARY, <http://www.macmillandictionary.com/us/dictionary/american/authorize> (last accessed Feb. 24, 2017).

¹² See BUSINESS DICTIONARY, <http://www.businessdictionary.com/definition/continuing.html> (last accessed Feb. 24, 2017).

¹³ See Schaefer, *supra* note 6.

¹⁴ See *Medellin v. United States*, 552 U.S. 491, 505, fn. 2 (2008) ("The label "self-executing" has on occasion been used to convey different meanings. What we mean by "self-executing" is that the treaty has automatic domestic effect as Federal law upon ratification. Conversely, a "non-self-executing" treaty does not by itself give rise to domestically enforceable Federal law. Whether such a treaty has domestic effect depends upon implementing legislation passed by Congress.").

space launch amendments indicating Congress did not wish to grant on-orbit authority¹⁵ to the Executive Branch overrode that pre-existing authority.

It is no surprise that there is some debate over whether OST Art. VI or other OST obligations are self-executing. The Senate and other political branches do an excellent job since the Supreme Court's 2008 decision in *Medellin*,¹⁶ and even beginning in the decade or two prior to that decision, in expressing their intent on the issue of self-execution in domestic documents connected with treaties, such as in declarations included in Senate Resolutions of Advice and Consent.¹⁷ For many older treaties, such as the OST, Senate and political branch intent is often not so clear in domestic documents concerning the treaty, and that allows room for debate on the topic. But the key point today is that the international obligation created by Art. VI remains regardless of whether it is self-executing and failure to abide by it will risk foreign retaliation undermining the business case of U.S. commercial space companies and risk foreign space activities interfering with U.S. commercial operations.

Congress is in position to implement U.S. obligations under Art. VI by passing legislation creating an authorization framework for new on-orbit activities that "assures" compliance by U.S. commercial space companies with OST provisions. Passing implementing legislation also allows Congress to craft an authorization regime that comports with the spirit of permissionless innovation and mandates that Executive Branch take into account a limited number of other factors beyond OST compliance, such as national security/harmful interference with pre-existing U.S. Government and harmful interference with existing U.S. commercial space assets.

Congress has actually directed the Department of Transportation (DOT) in consultation with other agencies to take account foreign policy when granting launch licenses and conducting payload reviews.¹⁸ In fact, Congress was even more specific in directing the DOT to ". . . carry out this chapter *consistent with an obligation the United States Government assumes in a treaty, convention, or agreement in force between the Government and the government of a foreign country. . . .*"¹⁹ (emphasis added). This Congressional directive allows the Executive Branch in its regulations regarding launch licenses and payload reviews to take account of U.S. international obligations (whether self-executing or not). Congress has directed by legislation the DOT do so. What is creating the regulatory gap and potential future compliance problems with the OST is the legislative history to the 1998 amendments to the U.S. commercial space launch act in which Congress indicated it was not granting *on-orbit authority* to the DOT, rather only adding reentry authority to existing launch authority.

If one goes through the OST to see what obligations implicate commercial actors, one is left with essentially the following checklist²⁰:

- (1) Does the applicant's planned activity claim surface or sub-surface rights on a celestial body or prevent free access to all areas of a celestial body, keeping in mind legitimate rights to be free from harmful interference and legitimate rights to extracted resources? (OST Arts. I, II & IX)
- (2) Does the applicant's planned activity cause potentially harmful interference with foreign space activities? (OST Art. IX)
- (3) Does the applicant's planned activity risk harmful contamination of a celestial body with Earthly matter? (OST Art. IX)
- (4) Is the applicant willing to allow visits, *based on reciprocity*, to its stations and equipment with maximum precautions and conditions to ensure safety and no interference with their operations? (OST Art. XII)
- (5) Is the applicant respecting ownership rights of a foreign operator's space object? (OST Art. VIII)

¹⁵ See H.R. REP. NO. 105-347 (1997).

¹⁶ See *Medellin*, 552 U.S. 491 (2008).

¹⁷ See, e.g., Sen. Ex. Rep. 110-12 (Senate Foreign Relations Committee "included a proposed declaration that states that [the] treaty is self-executing. This declaration is consistent with statements made in the Letters of Submittal from the Secretary of State to the President on each of these instrument and with the historical practice of the committee in approving extradition treaties. Such a statement, while generally included in the documents associated with treaties submitted to the Senate by the Executive Branch and in committee reports, has not generally been included in Resolutions of advice and consent. The committee, however, proposes making such a declaration in the Resolution of advice and consent in light of the recent Supreme Court decision, *Medellin v. Texas*, 128 S.Ct. 1346 (2008), which has highlighted the utility of a clear statement regarding the self-executing nature of treaty provisions).

¹⁸ See 51 U.S.C. 50905(b).

¹⁹ See 51 U.S.C. 50919(e).

²⁰ This checklist is drawn from Schaefer, *supra* note 6.

One might add as a sixth factor that the applicant is willing to take possible steps to assist astronauts in distress should a need arise, although this is likely to be impossible in most circumstances. The fourth factor is also unlikely to arise in most instances because only a few countries would have the capabilities to even consider a visit, and those countries are unlikely to utilize their limited resources to attempt to visit another country's commercial stations or equipment, particularly when that visitation right is limited by reciprocity, as well as the ability to limit visits for safety and non-interference reasons, and also bounded by budgetary constraints. Moreover, the ordinary meaning of the term visit means something of short duration and that is not extensive or intrusive. Further, an examination of the context and object and purpose of the provision may very well indicate that it was intended to allow verification of arms control provisions of the OST, thus obviating the need for visits to U.S. commercial stations and equipment.

The above list of factors to take into account in ensuring OST compliance is not onerous, particularly when one realizes there is significant flexibility in how to define various terms such as potentially harmful interference and harmful contamination. Moreover, the obligation in Article IX regarding potentially harmful interference is only an obligation to consult in advance but does not prohibit proceeding with the activity. The U.S. commercial space industry will benefit if the U.S. Government is able to engage in consultations with foreign governments if a planned activity by a foreign government might cause potentially harmful interference with U.S. commercial activities.

The U.S. Government can even have industry involved in setting the standards that define terms such as harmful interference and harmful contamination provided such definitions do not stray from the ordinary meaning of those terms. For example, some worry that COSPARs planetary protection standards developed in a scientific era of space will necessarily apply to U.S. commercial actors and that those standards will impose undue costs and burden on commercial actors. This concern, however, is unjustified²¹:

. . . for a number of reasons [COSPARs] standards, created and followed in a science-inspired coalition of governments and scientists, do not create a floor for what constitutes harmful contamination under the OST. The U.S. Government recognizes that COSPARs standards do not constitute "subsequent practice establishing the agreement of the parties" under the Vienna Convention on Law of Treaties interpretation rules and thus the U.S. Government need not follow these standards in authorizing on-orbit activities. Instead, the U.S. Government has the flexibility to set its own planetary protection standards in a commercial environment or follow industry set standards. Congress recently has promoted industry standards over safety matters by requiring periodic reports from the FAA in consultation with industry on such matters every 30 months.²² Congress could similarly push the FAA to promote industry standards on matters related to ensuring compliance with OST obligations by private parties—specifically non-interference and harmful contamination (planetary protection) standards.

To meet the continuing supervision obligation, the U.S. Congress can simply require licensees to report material changes to operations or business plans as they occur and, in any event, provide a report to the authorizing agency once per year on activities. As the largest user of space, the United States has a significant national interest in maintaining and observing the basic, minimally burdensome rules found in the OST and thus maintaining the credibility and ability to pressure other nations to play by the same basic, minimally burdensome rules.

Failing to Fill the On-Orbit Authorization Gap Not Only Risks Non-Compliance with the OST but Also Creates Regulatory Uncertainty and National Security Risks for Commercial Space Actors

COMSTAC has called for a clear, transparent and predictable framework for authorizing and supervising new on-orbit activities. The industry panel later today will provide an opportunity to hear directly from industry on this matter, but certainty and predictability assist industry in obtaining investment and making efficient use of their resources. Investors are willing to take risk on the success of a technology, but regulatory uncertainty risk they are not particularly keen on assessing or undertaking.

Additionally, there will need to be some acknowledgement of national security concerns (at least to protect important U.S. Government space assets) in any on-

²¹ See Schaefer, *supra* note 6.

²² See U.S. Commercial Space Launch Competitiveness Act of 2015, Public Law No. 114-90, § 111(5).

orbit authorization framework created by Congress. Otherwise, the Executive Branch will always be tempted, even if it requires stretching current authorities, to prevent activities that might cause damage to important national space assets. This is one of the risks created by the current regulatory gap for on-orbit activities, a risk of a last minute blocking of a particular commercial activity. Former Deputy Assistant Secretary of Defense for Space Policy Doug Lovero’s testimony in early March 2017²³ before the House Science Committee’s Space Subcommittee highlighted that the damage caused by accidents in space is not limited in time or geography given the physics of space. He also noted an occasion where were it not for the voluntary accommodation of a commercial space company to modify its plans, the U.S. Government would likely have taken action to prevent or block the commercial company’s plans from moving forward due to the risk of damage to an important U.S. Government space asset.

Guiding Principles and Concepts for an On-Orbit Authorization Regime that Meets OST Article VI Obligations and Comports with the Spirit of Permissionless Innovation

I would like to offer eight principles for consideration by this Subcommittee and by the Congress as a whole to help ensure the spirit of permissionless innovation pervades the OST-compliant authorization regime it should create for new on-orbit activities²⁴:

1. Creating a Default Presumption in Favor of Approval

A default presumption in favor of approval is at the core of permissionless innovation thinking and should be a feature in any on-orbit licensing regime Congress adopts.

2. Limiting the Factors that Can be Considered by the Executive Branch in Making Determinations

Factors for the Executive Branch to consider in authorizing new on orbit activities can be limited to compliance with international obligations, U.S. national security interests (or at least protection of U.S. government space assets), measures to limit space debris, and ensuring the proposed activity does “not result in harmful interference with [already] approved and operating [U.S.] payloads and associated activities.”²⁵ The latter factor is necessary to protect U.S. commercial first movers from interference from U.S. commercial second-movers. Compliance with international obligations only deals with interference between U.S. companies and foreign entities.

There is some concern over abuse of non-interference rights or what may be termed “space squatting.” For example, envision a scenario of a company rushing a comparatively low-cost asset to a particularly valuable area of the Moon in order to attempt to cordon off an area through creation of a non-interference right. Congress can direct the Executive Branch to look at interference rights in this context with particular caution. Harmful interference is not defined in the OST nor in current domestic legislative proposals so there is flexibility to account for this scenario both internationally and domestically. As elaborated later in this testimony, this is one reason the Executive Branch armed with the ability to account for the economic, technical and diplomatic issues surrounding such scenarios should make these determinations, rather than creating a right of action in U.S. courts for adjudication. This is also another reason that companies should report material changes in operation to the licensing agency as part of that agency’s continuing supervision obligation. License conditions can also be utilized by the agency to prevent any attempted “space squatting.” It is also important to note that the OST Art. II by prohibiting property rights in the surface or sub-surface of celestial bodies but allowing property rights in extracted resources with a limited non-interference rights for operations actually achieves in broad brush strokes a balance that seeks to avoid “space squatting” possibilities, particularly when one recalls that harmful interference is not defined and in any event really only triggers an advance consultation obligation. In the international context, as cases arise, the U.S. government will be able to address situations of this kind in bilateral negotiations with the relevant country—no major multilateral agreement is need or even wise at this stage.

²³ See Statement of Doug Lovero, Hearing of House Science Committee Space Subcommittee, March 8, 2017, at pp. 7–9.

²⁴ These eight factors are drawn and slightly modified from with shortened analysis from Schaefer, *supra* note 6.

²⁵ See American Space Renaissance Act, HR 4945, §309(a)(2)(C)(ii). One could also consider a factor that ensures space artifacts are not harmed, such as Tranquility Base, the location on Moon where Neil Armstrong’s footprints still reside and other similar artifacts. This additional factor would only implicate activities on the Moon in any event.

3. *Enhancing the Default Presumption by Explicitly Declaring U.S. Leadership in Specific New Activities being Contemplated is in the National Security Interest of the United States*

It is hard to contest that it is in the U.S. national security interest to have U.S. companies be the first to engage in new on-orbit activities, such as asteroid or lunar mining and to establish private research labs or hotels in-orbit or on the Moon. Congress can acknowledge and confirm this expressly in the statute to limit national security grounds for denying applications. While on-orbit satellite servicing is a bit more sensitive, it is far better to have U.S. companies be leaders than followers in this industry segment as well.

4. *Granting Lead Interagency Status to An Agency Directed to Promote Industry (& That Has Experience In Licensing and Inter-Agency Coordination)*

If an agency with promotion authority of the industry is given a lead role in an interagency process, then it can help ensure that the benefits of an activity are fully considered as well as potential foreign competition that might seek to benefit from less stringent authorization processes abroad. Additionally, if an agency that has experience in licensing is given the authority this will help reduce transaction costs and avoid possible duplication in processes. For example, the FAA-AST has both promotion authority and experience in licensing and inter-agency coordination in commercial space matters and is likely the best candidate to be the lead agency for reviewing new on-orbit space activities. If such authority is given to another agency, duplication may be created as FAA-AST will still conduct a payload review, separately or as part of a launch license. Given the State Department's lead role in treaty interpretation and international consultations on space matters, and DOD's knowledge of critical national security space assets, it is important that on-orbit licensing remain an interagency process. Simply adding an on-orbit component to the existing payload review, along with the other suggestions made in these eight principles, may be the least costly and least disruptive solution to solving the on-orbit authorization gap.

5. *Establish Deadlines with Executive Branch Notification and Reporting Requirements to Congress*

In order to spur timely authorization decisions, the Congress can place significant notification and reporting requirements on the Executive Branch in any delegation of on-orbit authority to the Executive Branch.

6. *Consider Establishing an Ombuds as Well as Possible Appeal Avenues to the President or Vice-President in Cases of Denial*

I argued in my *Permissionless Innovation* article for consideration of two possible ideas to provide an avenue for a company to seek to overturn a denial of authorization and/or speed along delayed decision-making²⁶:

Congress might . . . consider creating an ombuds²⁷ with a top security clearance that is able to intervene in cases in which decisions are delayed or rationales for decisions are not fully explained (or cannot be explained due to lack of proper security clearances by applicant company officials). Executive ombuds take complaints regarding agency action and have been created by statute on numerous occasions by the Congress. In fact, there are so many ombuds that a coalition of Federal ombuds has been created.²⁸ Congress can also add an appeal to a higher authority, such as a Vice-President-led Space Council. . . or the President, in situations in which the ombuds working with the interagency process and the company has not reached satisfactory resolution.

7. *Limit Chances for Regulatory Arbitrage and "Flags of Convenience" to Help Ensure Innovation Occurs in United States*

If the Congress limits the factors the Executive Branch may consider in authorizing new on-orbit activities to compliance with international obligations, national security (including protection of U.S. government space assets), mitigation of space debris, and non-interference with other existing U.S. space operators, it is quite unlikely that any regulatory arbitrage or "flag of convenience" situation will arise in which companies move abroad to take advantage of weaker licensing requirements. However, the regulatory uncertainty caused by the gap currently existing due to the lack of an authorization regime for on-orbit activities also risks driving commercial

²⁶ See Schaefer, *supra* note 6.

²⁷ See, e.g., COALITION OF FED. OMBUDSMAN, <http://federalombuds.ed.gov/federalombuds/index.html> (last accessed Feb. 24, 2017).

²⁸ See *id.*

space business overseas as companies potentially look for countries willing to provide a license and certainty for investors. As a further assurance against regulatory arbitrage, the Congress might, if deemed necessary, require the interagency process led by the FAA-AST to consider in its decision making the global nature of the industry and the goal of not placing U.S. commercial space entities at a competitive disadvantage compared to the regulatory frameworks and authorization processes adopted by foreign countries.

8. *Have U.S. Government Both Encourage and Give Substantial Deference to Industry Standards*

Private standards-setting bodies and self-regulating organizations cannot in themselves be alternatives to an authorize and supervise framework consistent with OST Art. VI because Art. VI requires the government to be the one authorizing and supervising. However, as discussed earlier, there is no prohibition on the U.S. government deferring to industry-set standards and standards of self-regulating organizations (*e.g.*, for what constitutes harmful interference or harmful contamination) in determining whether to authorize an activity.²⁹

Two Approaches that Should be Avoided in Authorizing On-Orbit Activities

Finally, I would like to recommend that Congress avoid two approaches in its drafting and construction of an on-orbit authorization regime³⁰:

1. *Avoid Listing Specific Activities that Require Authorization or Giving Blanket Statutory Authorizations to Certain Activities*

Constitutional Due Process and non-delegation principles do not require the Congress to list specific activities that require authorization.³¹ Policy reasons also argue against specific listing of activities that require authorization as it is hard to predict which activities will come to market first and non-listed activities will continue to fall in a regulatory gap with all its downsides.³² Blanket authorization for certain activities will also be difficult as it is often hard to say in advance with no context which activities by their very nature will comply with OST obligations because it often depends on how the activity is conducted. To take an example, lunar beer brewing is unlikely to cause any problems in terms of OST compliance or national security but it truly depends on how the activity is carried out—if the beer brewer plans to land its facility on-top of or just meters from an existing lunar facility of a foreign country this would raise concerns of harmful interference or if the lunar brewer was planning to use without permission another countries space rover present on the moon to distribute its product to lunar dwellers this would raise concerns of failure to respect ownership interests of foreign space objects. Carve outs for minor or modest or earthly-type activities by humans aboard stations could certainly be explored. For example, it is hard to envision the daily human activity (*e.g.*, brushing teeth) within a space object or facility raising OST or national security concerns or interference concerns with a another space object and thus that could be a carve out.

2. *Avoid Relying on the Common Law of Torts or a Newly Created Federal Statutory Cause of Action for Unreasonable Interference*

The court system will be ill-suited to define the specifics of what harmful or unreasonable interference is in the context of outer space activities whether it is between two U.S. companies or a U.S. company and foreign company. The Executive Branch in consultation with industry (in the cases involving two U.S. companies) or in consultation with foreign governments (in the case of a U.S. company and foreign company's activity potentially clashing) will be the best form of cooperation to work out what is harmful interference as cases arise and to take into account the economic, technology, and diplomatic considerations such issues raise.

It has been an honor and a pleasure to be before this Subcommittee and I look forward to answering your questions.

Senator CRUZ. Thank you, Mr. Schaefer. Thank you to each of the witnesses.

There are a number of important issues that have been raised by this testimony. I want to start with the question of Article VI and the extent to which Article VI and the OST is self-executing.

²⁹ See Schaefer, *supra* note 6.

³⁰ See *id.*

³¹ See *id.*

³² See *id.*

And for those following this hearing who are not necessarily living in the minutia of treaty law, the notion of self-executing is a fairly straightforward notion. It is a question of whether treaty language is in and of itself binding domestic law that has force of law on private citizens within the United States that is enforceable judicially and that binds the government. If a treaty is not self-executing, Mr. Schaefer is right. That doesn't mean the treaty has no force. It means its force is diplomatic and political in nature, that there is an international obligation, but it is not binding and enforceable law in United States courts.

If I understand the testimony of the panel correctly, the first two witnesses, Mr. Dunstan and Ms. Montgomery, both testified that Article VI of the treaty is not self-executing, in your judgment. And, Mr. Schaefer, if I heard you correctly, you were a bit more agnostic on whether it was self-executing or not, although, at a minimum, you didn't testify affirmatively that it was self-executing. Is that a fair assessment of the testimony?

Mr. SCHAEFER. We can take as a given that the OST is non-self-executing. Again, I think people can come to different conclusions. That's one of the reasons why the *Medellin* case itself was a six-three opinion of the Supreme Court, right? But set that aside. Let's even accept the view that OST Article VI is non-self-executing. All it means is the Executive Branch doesn't have current domestic authority to look at OST obligations for new on-orbit activities. But, again, the international obligation remains. If the U.S. doesn't do that, we will suffer international consequences.

The Administration almost implicitly admitted it's non-self-executing because they asked the Congress to enact legislation. I should add even if it's self-executing, it still wouldn't matter because there would be a great need for the Congress to enact an authorization regime anyway. We don't want to just look at OST compliance, these minimally burdensome rules of the OST when authorizing an activity. We also want to look and see whether an applicant is interfering with an existing U.S. licensee's activities. We want to look and see whether an applicant is interfering with an existing U.S. Government activity, particularly a critical national security asset.

So there are a number of factors Congress would want to have an Executive Branch agency look at anyway. There's a need to act separate and aside from this question of self-execution or non-self-execution.

Senator CRUZ. And I would note, going even a little bit further than you did, that I think the Executive certainly has the authority to recognize international law obligations and to make discretionary decisions consistent with those obligations, even if a particular treaty is not self-executing. What the Executive cannot do is violate United States law. *Medellin v. Texas*, which each of the witnesses has discussed, is a case I know very well because I argued and won the case on behalf of the state of Texas. So I spent many, many hundreds of hours deeply immersed in *Medellin v. Texas*.

It is interesting in the discussion here, in that each of the witnesses also, if I understood you correctly—none of you are advocating reopening the Outer Space Treaty for renegotiation, and all

three of you are arguing that consistent with the treaty language, it is possible to have a light-touch regulatory regime. Or, I think, Mr. Schaefer, you used the permissionless regulatory regime.

Is that accurate, and if so, should Congress legislate a framework for commercial activity in space and incentivizing enhanced commercial activity in space, and what should that framework look like if we were to legislate in that direction?

Mr. DUNSTAN. I'll kick off, Mr. Chairman. I think the important thing to understand about Article VI is there are two notions that are contained in Article VI, the first of which is that nations are responsible and liable for the activities. So, really, how the United States chooses to authorize and supervise is a matter of risk assessment for the U.S. Government. How much risk are we willing, as a government, to allow, and, therefore, how much of a regulatory regime do we want to pile on?

So it is this sort of risk versus reward, and I can tell you from my experience in private practice, if the regulations become so burdensome, all of this stuff can easily go offshore. We saw that with our satellite construction industry after the implementation of ITAR, and we could easily see it on this. I've already had clients who have looked at the existing regulatory regime and how expensive it is to get an FCC license, for example, and they've gone overseas to do this. So we must be cognizant of the fact that if we don't get it right, we're going to have flight of this technology and this industry abroad.

Ms. MONTGOMERY. I think one of the important things to consider in contemplating a regulatory regime is to make sure that it is actually very narrowly tailored to only those things which are hazardous to others or could create interference so that we would avoid the pitfall proposed by the Section 108 report that came out of the previous administration where everything would require authorization and supervision. I think we should start by Federalizing Connecticut, if we want to take that route, and see how it works out. It's a small state, and we could see if this is actually a feasible project.

But that being said, I don't think that the treaty does require any particular activity to be addressed or authorized even, and I think that mining is a perfect example of that. On the ground, mining is dangerous. There are landslides, toxic fumes, horrible issues for worker safety, cave-ins, environmental issues. In outer space, there's no one else around, and if your robot is mining an asteroid where no one is going to get hurt, what is the purpose of government regulation? And if you don't need the regulation, why do you need the authorization?

I use the frivolous example of playing the harp on the Moon as something that clearly doesn't require governmental oversight, and that goes to the point that you need to draw lines as to what requires oversight and what does not. So, clearly, lunar beer brewing might be dangerous—pressure vessels—I don't know—gases. But it might not. And so before we start saying everything needs to be regulated or that Article VI requires the regulation of everything, Congress needs to go through its usual process of saying, "Is this something that is so hazardous or could cause such interference to others that it needs to be regulated?" And if it does, you should call

out, as we have in the past, launch needs regulation, reentry needs regulation, satellite interference needs regulation, but we shouldn't say everything.

Ms. SCHAEFER. Permissionless innovation is never totally pure in the sense of no regulation at all. But at its core, there's a default presumption in favor of approval, and the Congress could certainly include a default presumption in favor of approval of these new space activities in an OST-compliant regime. They can also certainly limit the number of factors the Executive Branch can take into account: OST compliance, not interfering with existing U.S. commercial space activities, and not interfering with important U.S. Government existing activities and assets. The Congress can also give an agency that has promotion authority and experience with licensing and running an interagency process for space the lead over that process.

I'll also address, because it was brought up, planetary protection standards. There has been some talk that COSPAR standards, that were created in a science era of space, somehow now is what meets the definition of harmful contamination in OST Article IX. The U.S. State Department explicitly has rejected this view. COSPAR standards are not setting any minimum floor that commercial actors need to comply with. The Congress can actually have significant deference given to industry-created standards for those OST terms that have significant flexibility in their interpretation, like harmful contamination and like harmful interference.

The last thing I'll say is Ms. Montgomery mentioned that granting authority to authorize new on-orbit activities to the Executive Branch is akin to trying to federalize everything in Connecticut. It's really not. The better analogy because space is a non-sovereignty zone, is that it's really like telling U.S. citizens that travel to Antarctica, another non-sovereignty zone, the following: "Here are a few minimal criteria you have to follow to ensure we're complying with our international obligations and that you're not interfering with existing U.S. activities or U.S. Government activities down there." That's the appropriate analogy for what we're trying to do in the space.

Senator CRUZ. Thank you, Mr. Schaefer, and I'll note the next Senator up, the Ranking Member, is the Senator from Massachusetts, who might well be in favor of federalizing Connecticut.

[Laughter.]

Senator MARKEY. I know there are some red states that believe they've already been federalized—

Senator CRUZ. Indeed.

Senator MARKEY.—and that was the subject of the 2016 campaign.

Give me your view as to what the reaction would be in Russia or China or India if the Senate legislated in the area of Article VI, if it put requirements on the books. What's the reaction internationally if we do that?

Mr. Schaefer?

Mr. SCHAEFER. There are going to be some countries that oppose our interpretations of various OST provisions for matters of national interest, regardless of what we do. But I think when we comply with Article VI of the OST, we increase the number of countries

that we have credibility to lead toward the U.S.-inspired, commercially-friendly interpretations of the Treaty.

And when we don't comply with Article VI of the OST, what we do is we send some countries China and Russia's way. China actually has been noticeably pretty quiet when it comes to asteroid mining and property rights but as a general matter we send countries their way if we do not respect our treaty obligations. We also have less credibility to insist those countries follow OST obligations. When a U.S. company is a first mover, if we don't have as part of our criteria for authorizing commercial companies a look at whether they are causing harmful interference with a preexisting activity of other OST parties, then we won't have the credibility to insist on those parties doing the same for us.

Senator MARKEY. That's always the issue for the first mover. There are fast followers, sometimes even faster followers. So you have to think through the consequences of that.

Mr. Dunstan, what do you think?

Mr. DUNSTAN. I think, again, as I testified, that the United States is in a unique position because of our constitutional historical background, because of the sort of notion that Americans are free to do what they want unless they are prohibited from doing it. By taking action here, the Congress, I think, can lead internationally as we have in other areas, as Congress did just a couple of years ago with the CSLCA in extracted resources. We led. Sure, there was a pushback from some in the international community, claiming that that was equal to an Article II appropriation violation, but yet many other countries are following suit. See what Luxembourg is doing.

We certainly have led in tourists, suborbital tourists. The approach the United States has taken and directed the FAA in terms of that has been followed suit by other countries. We are—by being the first mover, we can be the leader, and I think that what Congress does here is going to be extremely important going forward, and I think, ultimately, we'll be followed by the vast majority of other countries.

Senator MARKEY. Mr. Schaefer, I heard you say in your testimony that you felt that there were lessons from the Internet that could be applied in outer space. Can you give me some details in that analogy that could help us to flesh out how we might proceed from here?

Mr. SCHAEFER. Sure. Permissionless innovation is a concept. You don't want to stifle innovators, people that are dealing with sophisticated technology, with overly burdensome regulation. Actually, a lot of the space entrepreneurs and Internet entrepreneurs are not real keen on hiring lawyers as their first people on board.

Senator MARKEY. Shocking.

Mr. SCHAEFER. They bring them on kind of last and reluctantly, right, and that's great. We want the engineers set free, right? But with that said, permissionless innovation is rarely, if ever, pure. Rather it's contextual. The space context is a little bit different than the Internet context because we do have an international agreement we're a party to, the OST, that has an Article VI that says we have to authorize and supervise, and the ordinary meaning of the term, authorize, is give official permission to the activity.

The important point, though, is this Treaty obligation certainly doesn't have to lead to overly burdensome regulation or an overly burdensome checklist that the Executive Branch would run through.

But that is one contextual difference between outer space and the Internet. We have very little international law and treaties governing the cyber domain, unless you're talking about use of force or criminal law issues. Then you can get into some treaties. But very little treaties other than that. In outer space, that's one difference.

The other difference is in outer space, it's longer time horizons for investment, typically, although there are some new business models that shorten that time horizon. But in the Internet, it's very quick, right? But when you have a long time horizon for investment such as with most space activities, you really do need more regulatory certainty.

And what happens when you have this authorization gap, you're creating domestic uncertainty with space businesses asking: Who do I go to to get authorization? Do I really need it? Are my investors still going to come on board? And then the international uncertainty of not complying with Article VI raises additional questions: Are foreign countries going to cut off access to foreign customers and to foreign partners? When you're dealing with long time horizons, it's really important to have that certainty and predictability, for sure.

Senator MARKEY. Thank you.

Thank you, Mr. Chairman.

Senator CRUZ. Thank you.

Senator Peters.

**STATEMENT OF HON. GARY PETERS,
U.S. SENATOR FROM MICHIGAN**

Senator PETERS. Thank you, Mr. Chairman.

And thank you to our panelists for your testimony here today.

One issue that came up in another committee—I serve on the Armed Services Committee in dealing with space policy. One issue that came up of particular concern is the amount of space debris that now exists in orbit. I think I was reminded of a recent launch by India where there were 104 satellites, I believe, on one launch vehicle that—many of those are U.S. nano-satellites, but, nevertheless, an awful lot of stuff is going up there, into the tens of thousands to keep track of. And as you are well aware, this material is moving at 17,000-plus miles an hour and can cause a great deal of damage.

Give me a sense of what you think—or should we put together some sort of legal framework to deal with this debris differently than we do now? Whoever.

Ms. MONTGOMERY. There are existing regimes on the commercial side, regulatory regimes that address debris. The FCC and NOAA both have debris rules and require mitigation of the creation of debris. The FAA also has regulations that require that you power down your batteries and vent your upper stage so that there is no debris created.

The question is whether other things will require debris regulation, such as satellite servicing, perhaps. Those all have cameras and transmitters on them, and they could all, perhaps, be placed without any change in law under the existing regimes of the FCC and NOAA. So I think there's something in place now. Whether more is required—

Senator PETERS. Is that sufficient, in your mind?

Ms. MONTGOMERY. It sort of covers everything you can think of at the moment. So I do think it's sufficient for the moment.

Senator PETERS. Does everybody agree?

Mr. DUNSTAN. Well, there are actually, potentially, five different government agencies that have their own separate—and they sit in five different sets of the Code of Federal Regulations. They're all based on models and standards adopted by NASA years ago, but they're all slightly different. So it's actually possible to have a mission where you may have to have three or as many as four different orbital debris mitigation statements, and if one of the agencies disagrees or wants a change, then you have to loop all the way back through.

So this is when I talk about sort of the cumbersome regulations, because they all sort of grew up generically in each of these stovepipes. A sort of consolidation of that authority, I think, would really be helpful to industry. And I would agree that there is enough on the books right now. As long as we enforce it and make sure that they abide by the debris mitigation standards, that's really not a worry going forward.

Senator PETERS. So if I understand both of you correctly, there's enough out there already, but we need to harmonize, in your estimation.

Mr. DUNSTAN. Yes, harmonization would be very nice.

Senator PETERS. Mr. Schaefer?

Mr. SCHAFFER. One thing I would add—there's a certain element of the scientific community that would like to see not just debris mitigation but actual active debris remediation. The mitigation guidelines internationally, that were inspired by the U.S. domestic guidelines originally, have certainly helped. But when you have incidents like the Iridium incident in 2009 or the Chinese ASAT test in 2007, those types of activities can basically erase a decade's worth of beneficial mitigation activities.

There is some thought for sustainability in space that you would want to actually remove some of the existing debris, and the problem becomes that many scientists would say the first objects to remove are the largest mass objects, and a lot of them are actually of Russian origin, and that gets us into the legal issues of ownership of space objects. Thus, there are some legal hurdles to work through in addition to technology to develop to proceed with active debris remediation.

But in addition to the mitigation guidelines that are present internationally, and enforced by the U.S. through licensing criteria that Ms. Montgomery spoke of, the Congress, in a 2010 statute, called on the Executive Branch to start looking more into active debris remediation.

Senator PETERS. And, finally, you mentioned, of course, the Russian debris and other debris from other countries that are now en-

gaged in active space programs. You've talked about the regulatory framework we have here in the United States. What's your assessment of the framework, broadly, with other countries that are launching spacecraft into orbit in relation to the debris?

Mr. DUNSTAN. I would say, generally, most countries are compliant unless it's in their interest not to be. There was an ESA satellite not that long ago, Envisat, which had been launched a number of years ago, and they ultimately ran it dry. It's almost half the size of this room. It's one of the largest satellites ever. And rather than de-orbit it, which they should have, which the debris mitigation standards required, they just ran the thing dry.

Their argument was, one, it was still producing scientifically important information; and, two, it was designed prior to when ESA had adopted orbital debris mitigation standards. So they went so far as to not say it wasn't launched, but it was designed, and therefore, the orbital debris mitigation standards didn't apply. There are many instances when countries in their own self-interest will either waive—and we do it ourselves from time to time. There are a number of Iridium satellites that have been—that the FCC has waived the requirement that they be de-orbited because they want to run them dry of fuel. So I think we have to be honest with ourselves and say we have these mitigation requirements and we need to stick to them even if it might not be in our own interest to do so.

Senator PETERS. Thank you.

Senator CRUZ. Senator Nelson.

Senator NELSON. I would ask, how is the existing Outer Space Treaty regime beneficial to the U.S. space industry? And I would leave hanging for Colonel Melroy in the second panel: What are the benefits of the existing Outer Space Treaty regime for our commercial, civil, and national security space interests?

Ms. MONTGOMERY. In the area of liability, it does create a certain amount of certainty because the treaty set out how a particular country is a launching state and therefore liable for any damage caused by activities that launch from the country, that the government of that country launches or procures, or using the facilities of that country. So a lot of that certainty is very useful for the commercial sector. It has been implemented domestically for the launch industry through the Commercial Space Launch Act, and that has proved to be a benefit for the commercial industry.

Mr. DUNSTAN. I would add that one of the most important provisions of the Outer Space Treaty is the provision that states—that any object that is launched from the surface of the Earth is the property of the launching state and always will be the property of the launching state. So that makes it very clear from an international basis that nobody can come along and pluck off your satellite under international law.

Now, the flip side, as Mr. Schaefer pointed out, when we've got all this junk, all this abandoned stuff up there, it still remains the property of, say, Russia, all these upper stages, and, unfortunately, we don't have sort of concepts of maritime law where we could go in and just yank these things out. But it certainly gives confidence to an American company that if they launch a satellite, it will always remain theirs, and they can operate it so long as they abide by United States law.

Mr. SCHAEFER. So I think it's a great question. We talked about minimally burdensome obligations in the OST for U.S. companies, but the reciprocal side, the other side, is that these obligations do benefit U.S. companies. Take, for example, OST Article II's non-appropriation, non-sovereignty obligation. If some other country is a first mover realizing there's going to be a couple of countries besides the United States that are possible first movers, we're not going to have an entire U.S. industry blocked from that area of a celestial body, because there's free access to all areas of celestial bodies. These obligations are certainly in our businesses' interest. The fact that countries have to think about whether they're causing potentially harmful interference with U.S. activities before they proceed is another example of a benefit. So there are protections in the OST that do provide more certainty for U.S. companies in terms of their business plans and ventures.

Senator NELSON. Thanks, Mr. Chairman.

Senator CRUZ. Thank you.

Senator HASSAN.

**STATEMENT OF HON. MAGGIE HASSAN,
U.S. SENATOR FROM NEW HAMPSHIRE**

Senator HASSAN. Well, thank you, Mr. Chair, and thank you to the panelists.

We're obviously talking about the opportunities that space exploration presents for scientific discovery and advancing our knowledge here on Earth and creating new opportunities for our businesses to thrive. I'm really pleased that you all are here today and that the Committee has gathered to examine the U.S. Space Treaty and whether and how this legal framework can be improved upon or sustained.

As Senator Cruz indicated, I also wanted to make sure that the testimony from Michael Listner was in the record. Mr. Listner happens to be not only a space expert and founder of the legal and policy consulting firm called Space Law and Policy Solutions, but he's based in my home state of New Hampshire. So I have spent a little time looking at his testimony, and I think it reflects what we've been discussing, which is the fact that the decision about whether to withdraw from the Outer Space Treaty would be a very difficult one for us to make. There are obviously lots of considerations, most of which that I had on my mind you've all touched on.

But I wanted to give you the opportunity just to help us think through, as we all assess these matters, how we should balance the interests of industry stakeholders for further exploration and advancement with our top priorities in national security. What should we be thinking about in terms of that balance?

Mr. DUNSTAN. That, of course, is the difficult question. How do you balance—and I would say there are three balancing acts. There's the commercial aspect, there's the scientific aspect, and then there's the national security aspect, and it's a tough balance to do.

I can just report, in terms of my experience, in what could potentially become a parallel mechanism, which was the ITAR, the International Traffic in Arms Regulations, and what we saw there was a regime which was non-transparent, which was non-appeal-

able. It was essentially a black box. So whatever we do, that balancing, to the extent we can—we understand there are national security interests where we can't always give you a reason, no.

But we've got to have a regime that allows you to have a right of appeal, that has the right to get an answer, as opposed to the ITAR regime. It was just no, and you never found out why. So transparency in whatever Congress does, I think, is critical, and that will give, I think, the industry as much sort of certitude as it can get.

Senator HASSAN. Thank you.

Ms. Montgomery.

Ms. MONTGOMERY. Yes. I think one of the problems—I agree with everything Mr. Dunstan said, just to start with. But, also, one of the solutions to that, as Congress considers drafting legislation, is to not just use—is to not use very vague language. There are lots of statutes in the space arena out there that just talk about national security. Well, there are lots and lots of things that that could mean, and, unfortunately, it can sometimes mean that the regulatory person in charge of figuring out if there's a national security issue sits there somewhat paralyzed—what could I be missing? And then you get lots and lots of delay.

So I think that if Congress clearly articulated the standards, for instance, we do not want anyone—and I'm just making this up—we do not want anyone transmitting pictures of my secret satellite back to Earth, and just make that a clear prohibition, then that would be very helpful, and so, of course, the National Security Agency might give you language a little bit more vague than what I just said, but perhaps not so vague that the non-transparent black box becomes the norm.

Senator HASSAN. Thank you.

Mr. Schaefer.

Mr. SCHAEFER. I would just say there are some competing interests there, but sometimes not. There are some synergies, too, and, in fact, one of the things I recommended in my written testimony was that Congress actually declare that having U.S. companies be the leaders in these new space activities, at least the ones that are foreseeable, is actually in the national security interest of the U.S.

To take a couple of examples, China controls 85 percent of the rare Earth minerals on Earth. If we have U.S. companies—and, again, it depends on whether there's an ultimate business case for it—but if we have U.S. companies that are able to get access to those minerals on celestial bodies, then that can change the dynamics. It's also in the U.S. national security interest for U.S. companies to be the first to do, and be the best performers at on-orbit satellite servicing. It requires rendezvous and proximity operations and it's better to have that technology, or the most advanced forms of that technology, developed in the U.S. and performed by U.S. firms.

I know in remote sensing, it seems to some like the tradeoffs are a little more stark. But in these new on-orbit activities, there are actually a lot of synergies, and I think Congress could actually so state in the law to limit that national security barrier to the commercial activities.

Senator HASSAN. Well, thank you, and thank you all for very thoughtful testimony.

Senator CRUZ. Thank you.

Let me ask another question that came up in some of the answers here. There were multiple references to satellites and space junk and property rights, and I want to ask the panel's view on what should the legal regime be. Mr. Dunstan referenced maritime law, for example, encouraging salvage. Should we have a similar regime encouraging salvage in the removal of space junk?

And a related question—Article II of the Outer Space Treaty says that outer space, including the Moon and other celestial bodies, is not subject to national appropriations by claims of sovereignty, by means of use or occupation, or by any other means. Is that prohibition consistent with our interest in encouraging robust investment in exploration and development of outer space?

We had the last great frontier in America, settling the West. We had the Homestead Act, which provided an acute financial incentive for people to take the great risk of going and investing. Do we need, with respect to outer space, with respect to the Moon or Mars, the equivalent of 40 acres and a mule, you know, 40 miles and a lunar rover? What role should property rights play in space, either with satellites or with lunar settlements or settlements on Mars or otherwise? And I would open this to all the witnesses.

Ms. MONTGOMERY. I think that there are two points on the property rights question, and I'll leave salvage to someone else. But Article II does not prohibit commercial or private ownership of land, and I think that's very clear. The fact of the matter is that property rights serve as a great incentive to investment. If you don't have property rights, you cannot put up your land as collateral. You cannot get investors. There's nothing to securitize your investors' interests, and you yourself are hampered in your ability to plan if you don't know that the property that you are using and, hopefully, going to be spending decades on is yours.

So I do think that the United States should figure out a way to recognize property rights extra terrestrially, and I do think that the Outer Space Treaty allows that. I do believe there are a lot of people who disagree with my view, and I think that it is something that needs to be looked at very carefully and thought through, because the incentives are there for development if there are property rights.

Mr. DUNSTAN. So I would disagree with Laura—the first time I've disagreed with her today—because I don't think the Outer Space Treaty, as it is written, would allow for the United States to even recognize domestically that.

But I would give you another analogy to the opening of the West, and that would be the fact that the United States retained title in what are now the reservations of the Native Americans, and yet you are able to go on and buy a mining lease or a drilling lease on those. Now, it's cumbersome, but that's because we put this bureaucracy on top of it.

But people can go in and mine resources off of our Native American reservations and extract those resources and profit from them without actually owning the land on which they're doing that. So I think in that way, an asteroid could be the same thing. You can't

own the whole asteroid, but everything you take out of it becomes yours, and that's what Congress recognized with the CSLCA in 2015.

Senator CRUZ. So let me press you a little bit on that, Mr. Dunstan. Two follow-ups. One, in your initial testimony, you did not advise renegotiating the OST. I want to ask how that's consistent with the answer you gave; and, two, that the analogy of Indian territories—there, the United States—if you're retaining title under Article II, the United States and other nations can't make claims of sovereignty. So how is that—how do we reconcile that to incentivize serious investment?

Mr. DUNSTAN. So the Native American analogy is the fact that the United States owns the land, not the tribe. So put the United States in this analogy at the sort of international level. So the tribe doesn't own it, yet the tribe can enter into mining leases, which don't convey a property right underneath it. So as the analogy said it, you don't have to have underlying property rights to still extract resources from it.

And, second, I think Article II is pretty clear that we can't domestically recognize property rights. We would have to go in and renegotiate that treaty, and I think that's a—

Senator CRUZ. But from whom would you obtain the lease? In your analogy, you have the United States, from whom you could obtain the lease.

Mr. DUNSTAN. Right.

Senator CRUZ. The international community—there is no entity from whom to obtain a lease.

Mr. DUNSTAN. That's correct. You just can go out and mine that asteroid. You just can't own that asteroid. You can't obtain a property right in the whole asteroid, only with what you extract from it.

Senator CRUZ. And you'd say the same for the Moon and for Mars?

Mr. DUNSTAN. Same for the Moon and for Mars, yes.

Senator CRUZ. Mr. Schaefer.

Mr. SCHAEFER. Well, on the question of salvage, maritime salvage doesn't work for most space debris because most space debris is valueless, so there's nothing to be saved from the peril, so to speak. There is a little used concept called "liability salvage" that has found some reflection in U.S. maritime law, where you're saving the person from the liability they would face if their piece of junk hit something valuable.

But given that it's a fault-based standard of liability in space even liability salvage may be difficult to implement. Who's at fault if a piece of debris hits an active satellite, the thing that can move or the thing that can't move? And it might depend quite a bit on the facts. Was the debris created in opposition to the internationally recognized debris mitigation guidelines or not? Thus, establishing liability would be very fact specific. In short, liability salvage theoretically may have some application, but pure maritime salvage doesn't work.

On the property rights issue, obviously, under U.S. interpretation of OST as now recognized and codified by the Congress, U.S. space businesses have property rights in extracted resources. That's 38

years, at least, of U.S. interpretation on the issue, now confirmed and codified by the Congress.

In terms of cordoning off areas, it's really the non-interference right that comes into play. It might be better to proceed on a case-by-case basis with adding flesh to the principle. We could get a situation of U.S. company versus U.S. company, both going for the same area of a celestial body, and needing to assess what a non-interference right encompasses.

We could also have a U.S. company versus foreign country situation, and it's probably best to leave the discretion in the Executive Branch's hands, case-by-case, applying those basic guiding principles than trying to do a complete rewrite and upset of Article II of the OST, which I think very few countries would join. I think bilateralism, case-by-case, is probably the better way to go in the near and medium term at least.

Senator CRUZ. Well, thank you to each of the witnesses. I think this was a very productive and educational panel. I will note that I'm looking forward to trying Ms. Montgomery's Celestial Moon Beer if and when it is brewed.

[Laughter.]

Senator CRUZ. And with that, I want to thank each of the three witnesses in the first panel and welcome to come forward the second panel, which we will move immediately to as soon as you have a seat.

I want to welcome the second panel now. We will have a total of four witnesses. The first is Dr. Bob Richards, who is a space entrepreneur and a futurist. He is Co-founder of Moon Express, Inc., a space transportation and lunar resources company located at Cape Canaveral, where he currently serves as President and CEO. Dr. Richards chairs the Space Commerce Committee of the Commercial Spaceflight Federation, serves on the Board of the Space Foundation, and is a Member of the International Institute of Space Law.

Our second witness is Mr. Peter Marquez, who is the Vice President for Global Engagement at Planetary Resources, where he is responsible for working with governments around the world. Mr. Marquez has held positions in the Air Force, in the Office of the Secretary of Defense, working on national security space programs and special programs. After his time in the Pentagon, Mr. Marquez served on the National Security Council as the Director for Space Policy for President George W. Bush and also for President Barack Obama.

Mr. Mike Gold is the Vice President of Washington Operations and Business Development at Space System Loral. Mr. Gold previously served for 13 years with Bigelow Aerospace, where he supported a variety of non-traditional space activities. Mr. Gold also serves as the chair of COMSTAC, which is the Federal advisory committee that provides advice and counsel to the Federal Aviation Administration's Office of Commercial Space Transportation.

And, finally, Colonel Pamela Melroy is a retired Air Force test pilot and NASA astronaut. Colonel Melroy is a veteran of three missions to the International Space Station and is one of two women to command the space shuttle. After leaving NASA, Colonel Melroy worked in industry and at the Federal Aviation Administra-

tion's Office of Commercial Space Transportation. Colonel Melroy recently left DARPA after serving 4 years as the Deputy Director of the Tactical Technology Office. Colonel Melroy is now owner and CEO of Melroy and Hollett Technology Partners.

Welcome to each of you.

Dr. Richards, you may begin.

**STATEMENT OF ROBERT (BOB) RICHARDS, FOUNDER AND
CHIEF EXECUTIVE OFFICER, MOON EXPRESS, INC.**

Mr. RICHARDS. Thank you, Mr. Chairman, Ranking Member Markey. It's an honor to be invited to speak with you today about reopening the American frontier and unleashing the innovative power of the U.S. commercial space industry as a driver of the Nation's space economy and settlement.

Our need to expand humanity into space is not in question. To consider otherwise would put an expiry date on the human species. What is in question is the way that we will expand into space and which nations will set the standards of freedom and endeavor and reward as we enter these new frontiers. As a country built on the foundations of first frontiers, the United States stands unique in all the world with the opportunity to focus the power of its entrepreneurial history and enterprising vision to open up the space frontier and in so doing create a peaceful, prosperous, and boundless future for all humanity.

Today, I address you as the founder and CEO of Moon Express, a privately-funded commercial space company created to seek and unlock the resources of the Moon through a progressive series of commercial robotic missions, starting with our maiden voyage scheduled to launch late this year. Relevant to the subject of this hearing is that last year, after months of interagency consultations, Moon Express became the first commercial entity to receive formal U.S. Government approval to send a robotic spacecraft beyond traditional Earth orbit and to the Moon. This was, in fact, the first time in history that any government signatory to the Outer Space Treaty exercised its rights and obligations to formally authorize and supervise a commercial entity to fly beyond traditional Earth orbit and to the Moon.

The framework we used for our mission approval was an interim patch that built on the existing payload review process of the Federal Aviation Administration Office of Commercial Space Transportation with a series of additional voluntary disclosures intended to help satisfy U.S. obligations under the OST. We worked independently with all stakeholder Federal agencies who, in turn, worked collaboratively and creatively to find a way to approve our ad hoc approach, even as Congress and the administration determined a more formal framework.

Looking beyond our mission approval, which is an interim solution, we support a process that focuses on streamlining the regulatory framework, limits the government's role to a light touch, promotes American innovation and investment, and satisfies our international obligations. In essence, we believe that a commercial space activity should enjoy deemed authorization, presumed authorization, unless there is a clearly evident or meaningful, demonstrable

impact on national security, U.S. obligations under international treaties, or harmful interference with others.

The key to our survival as a species, in fact, the only key we hold in the long term, is to evolve into a multi-world species, harnessing the practically infinite energy and resources of space and easing the pressure on our home planet. Preservation of the Earth and our civilization is precisely the reason we need to expand our economic and societal sphere into space, beginning with the Moon and then beyond.

But it's not just about boldly going. It's about boldly staying. It's about moving the economic sphere of Earth outward in a way that uses the material wealth of space to solve the urgent problems we now face on Earth, to bring the poverty stricken segments of the world up to a decent standard of living without recourse to war or punitive action against those already in material comfort, to provide for a maturing civilization the basic energy vital to its survival through freedom of commerce in space.

We are at the cusp of a magnificent adventure, an evolution of our species perhaps as significant as the evolution of life from ocean onto land. Our emergence from Earth into the ocean of space holds promise and opportunity, but also dangers of migrating conflict, and for the first time in human history, an opportunity to conquer new worlds without conquering each other.

The United States has taken proactive measures to support its private sector and has interpreted the Outer Space Treaty in favorable ways to the Constitution and the founding principles of this country. While the Outer Space Treaty may appear antiquated in some ways, it is a remarkably visionary document with profound principles that have served the world well for decades.

I believe time and energy is better spent in continuing to interpret the Outer Space Treaty in favor of international collaboration without constraining the rights, the benefits, or the freedoms of U.S. commercial enterprise. We aspire to the stars. Mars beckons as a second home for humanity. The Moon is our gateway.

Thank you, Mr. Chairman, for the opportunity, and I welcome questions afterwards.

[The prepared statement of Mr. Richards follows:]

PREPARED STATEMENT OF ROBERT (BOB) RICHARDS, FOUNDER
AND CHIEF EXECUTIVE OFFICER, MOON EXPRESS, INC.

Mr. Chairman, Senator Nelson, members of the Committee,

It is an honor to be invited to speak with you today about reopening the American frontier and unleashing the innovative power of the U.S. commercial space industry as a driver of the Nation's space economy and settlement. Although our lives are dominated with the everyday challenges of life on Earth and with each other, these matters are ultimately trivialized by the challenge of securing humanity's future through our expansion into space, utilizing the practically infinite energy and resources of space, and ultimately becoming a multi-world species.

Our need to expand humanity into space is not in question, to consider otherwise would put an expiry date on the human species. What is in question is the way we will expand into space, and which nations will set the standards of freedom of human endeavor and reward as we enter these new frontiers. As a country built on the foundations of Earth's frontiers, the United States stands unique in all the world with the opportunity to focus the power of its entrepreneurial history and enterprising vision to open up the space frontier, and in so doing, create a peaceful, prosperous and boundless future for all humanity.

Personal Journey

My personal journey has been vested in creating international institutions and enterprises necessary to create a peaceful and prosperous spacefaring civilization. As a student in the 1980s, I co-founded Students for the Exploration and Development of Space, today still the largest student-run global space organization; the Space Generation Foundation, whose follow-on Advisory Council works with the United Nations to inspire and enable global youth to pursue their dreams in space; and the International Space University, which since its founding in 1987 has instructed thousands of graduate level students from both our main campus in Strasbourg, France, and our Space Studies Programs hosted around the world. Many graduates of this program today are in positions of leadership in the global space arena. More recently in 2008, I co-founded Singularity University, which has become a hub of global entrepreneurial innovation from our campus in Silicon Valley, tackling some of the worlds grand challenges with exponential technologies.

I have also had the honor of working with NASA on the successful delivery of a robotic spacecraft to the north pole of Mars, a scientific mission that added much to our understanding of the Red Planet, and with the U.S. Air Force on the demonstration of technologies in Earth orbit that enable new capabilities in autonomous rendezvous and proximity maneuvers.

Today, I address you as Founder and CEO of Moon Express, a privately funded commercial space company created to seek and unlock the resources of the Moon through a progressive series of commercial robotic missions, starting with our maiden voyage scheduled to launch late this year.

The Moon—Our Eighth Continent

I look on the Moon as Earth's eighth continent; a new world with a total land mass approximating North and South America combined. Thanks largely to the terabytes of data generated by the NASA's Lunar Reconnaissance Orbiter, we know the Moon has vast resources, accumulated through billions of years of asteroid bombardment that enriched the Moon much the same way as Earth, except for one key difference: accessibility. Unlike Earth, these lunar resources are largely on or near the lunar surface, relatively accessible except for the challenging economics of retrieving them when all the energy to do so needs to come from the Earth's surface. But this too has now changed . . .

Perhaps one of the greatest practical discoveries of our generation is the presence of vast quantities of water on the Moon, verified by NASA in 2009. The discovery of water on the Moon is a game changer, not just for the economic viability of lunar resources, but for the economics of reaching Mars and other deep space destinations.

Water is the oil of the solar system, and the Moon will become a way-station in the sky. With private sector interest emerging in economic activity outside of traditional Earth orbit, the question of how the U.S. will enable and protect its national interests and non-governmental players is now timely and serious.

'Mission Approval' for the 1st Private Venture to the Moon

To date, all spacecraft that have ventured beyond Earth orbit on pre-authorized missions have been government spacecraft, and therefore were de-facto compliant with the Outer Space Treaty's (OST) Article VI requiring government authorization and supervision. The U.S. has always believed that the private sector would be a growing part of our national space enterprise, and U.S. negotiators of the OST insisted on recognition for non-governmental actors in space. In its 'Mission Approval' framework, Moon Express recognized the requirement to comply with the treaty's framework as a U.S. company, and is honoring that commitment while pursuing a vital commercial role in our human space future.

Following the welcome enactment of the Space Resource Exploration and Utilization Act of 2015, we weighed the risks of seeking funding from investors for the final development and maiden launch of our first spacecraft with one critical question unanswered: would the U.S. Government actually give us permission to fly? In early 2016, after visiting a number of Federal agencies involved in the interagency review of launch licenses, it became clear that although any of the agencies could potentially say "no", no one agency had the independent authority to say "yes". We needed certainty to attract further funding from our investors, within a timeline desired by our customers, so we began seeking an answer.

In the absence of any prescribed process or clarity of regulatory authority, we proposed a 'Mission Approval' framework, intended as an interim 'patch', that built on the existing payload review process of the Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST) with a series of additional 'voluntary disclosures' intended to help satisfy U.S. obligations under the OST. We worked independently with all stakeholder Federal agencies, who in turn worked

collaboratively and creatively to find a way to approve our ad hoc approach, even as Congress and the Administration determine a more formal framework.

As a result of our initiative and the Federal agency efforts, on July 20th, 2016, Moon Express became the first commercial entity to receive formal U.S. Government approval to send a robotic spacecraft beyond traditional Earth orbit and to the Moon. This was in fact the first time in history that any government signatory to the Outer Space Treaty exercised its rights and obligations to formally authorize and supervise a commercial entity to fly a mission beyond Earth orbit. So let us be clear: for our ‘Mission Approval’, the United States government has more than complied with Article VI. But let’s also be clear that what we received was qualified as a “one-time only” authorization, because it was made clear to us that the positive determination does not extend to future missions by Moon Express or similar missions from other entities. We are therefore still contending with regulatory uncertainty for future missions.

We can only be thankful for the efforts of the FAA’s Office of the Associate Administrator for Commercial Space Transportation, and in particular George Nield, Shana Dale and Laura Montgomery, who championed our ‘Mission Approval’ application through an enhanced payload review process. Aided in particular by the concerted interagency efforts of Tom Kalil and Ben Roberts at the White House Office of Science and Technology Policy, Brian Israel and Ken Hodgkins at the State Department, Robin Frank at NASA, Doug Loverro at the Department of Defense, and many others who worked with them or at other agencies, we were able to secure a consensus approval, communicated to us by the FAA Office of Commercial Space Transportation, so Moon Express could move forward with our mission plans. Equally as important, this approval allowed us to solidify our private financing which had been hampered by the uncertainty regarding Federal permission to undertake our mission.

The Mission Approval as Precedent for a Future Regime

In 1983 Congress began the long effort to craft and enact the Commercial Space Launch Act of 1984, which gave the Department of Transportation sufficient authority to become a one-stop shop for launch licensing. Three decades later, this committee helped write the Commercial Space Launch Competitiveness Act, which directed the previous administration to propose a long-term solution to authorizing and supervising commercial space ventures beyond launch, telecommunications, and remote sensing.

The effort for our ‘Mission Approval’ came at a huge cost of company executives’ time and expense, triggered exhaustive interagency deliberations, and delayed our fundraising and our mission. We’re glad we were able to do this, but it wasn’t an easy path and we were never assured success. To some extent we believe our ‘Mission Approval’ framework was accepted because we were proposing a fairly simple, short-duration mission. Lacking any further Federal clarification of approval process, we plan to use our ‘Mission Approval’ framework again, and we need to be able to use it again soon, as we have follow-on lunar missions already in the works for 2019 and 2020. We are hopeful that the Congress and Administration, in consultation with industry, can apply principles like those we based our approach on to craft a more permanent system for companies like us, and the many companies that are yet to be born who will join us in expanding U.S. commercial space activity to the Moon and beyond.

Supporting a Regulatory Framework with Minimal Burden and Maximum Certainty

We support a process that focuses and streamlines the regulatory framework, limits the government’s role to a light touch, promotes American innovation and investment, and satisfies our international obligations. We believe this could be accomplished with a “presumed authorization within predefined boundary conditions” approach to non-traditional commercial space activities beyond Earth orbit.

In essence we believe that a commercial space activity should enjoy “deemed authorization” unless there is a clearly evident or meaningful demonstrable impact on national security, U.S. obligations under international treaties, or harmful interference with others.

Our premise is that the U.S. Government should in principle enact laws that assure freedom of enterprise in space, making it illegal for the government to deny or restrict private sector space activity, provided the activity satisfies three fundamental axioms that should be the foundations of any U.S. policy governing non-traditional space missions in or beyond Earth orbit:

- (1) no meaningfully demonstrable negative impact on national security
- (2) no harmful interference with existing space infrastructure or activities

(3) does not breach U.S. obligations under international treaties

And otherwise, whatever Federal body that is in charge of the application/registration has no legal right to object to it. In other words, it is “presumed authorized within predefined boundary conditions”, and only if those boundary conditions are shown to be violated would the application go to an interagency ‘secondary review’ cycle in which the onus would be on the government to prove that the boundary conditions are breached in order to deny the application/registration, accompanied by a proposed enabling solution, which then would be subject to revision, appeal, etc. We also suggest that a legally binding time-frame would be imposed on both the first and secondary reviews, after which the presumed authorization would prevail.

Public-Private Partnerships

One of the reasons it is vital for the U.S. Government to create policy clarity and streamline regulatory burdens for commercial lunar and other nontraditional space business ventures is because in almost every case, some Federal agency is likely to want to directly or indirectly purchase a space good or service from these companies.

In our case, we have benefitted from many Space Act Agreements with NASA which allowed us to learn from the agency and jointly develop new capabilities based on historic ones. Most of our early Space Act Agreements with NASA involved us paying NASA for access to technologies and facilities, but that has evolved in recent years into the use of no-exchange of funds Space Act Agreements that involve mutual value. In particular, NASA’s Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST) program has provided us significant access to NASA technologies, facilities, and expertise that is accelerating our initial mission. The reason NASA is doing this is because they need less expensive ways to conduct robotic lunar exploration and seek to spur commercial cargo transportation capabilities to the surface of the Moon with competitively selected industry partners.

Over the years NASA has funded many existing “orphan” payloads from U.S. scientists that need a ride into lunar orbit or to the surface. Recent U.S., Indian, Japanese, and Chinese missions to the Moon have only wetted the appetite of lunar scientists. Given NASA’s primary focus on Mars exploration, it is not likely that NASA will send another large dedicated spacecraft to the Moon, but it could purchase rides from commercial providers such as Moon Express.

We are therefore particularly happy about recent announcements by NASA of potential interest in commercially-provided robotic systems for science and exploration investigations of the Moon. Extending the public-private partnership model of commercial transportation services beyond Earth orbit will enable new growth in U.S. industrial capacity and capability while introducing the economics of private sector competitive innovation to deep space and planetary exploration.

As Moon Express’ capabilities grow, we can bring back samples from geologically interesting lunar sites. Eventually, as we grow to begin to harvest lunar water ice and turn it into liquid hydrogen and oxygen for propellant and commercial uses, one of the largest customers may be NASA’s human missions to Mars. If NASA (or another agency) wishes to accelerate a specific capability on our roadmap, then a public-private partnership such as that used so effectively on cargo resupply of the International Space Station could deliver results much sooner and cheaper than a traditional contracting approach.

Public-private partnerships are much more fundamental to the U.S. Government’s goals in space than just serving as a more efficient procurement method. NASA’s organic law mandates that the agency “promote the fullest commercial use of space”. The vision that Chairman Cruz has set for these hearings is one of the government opening the space frontier to commerce and settlement by private citizens. Therefore, whereas a traditional procurement may or may not develop technologies with some potential commercial application, a public-private partnership fosters the emergence of privately-owned, largely privately-capitalized space goods and services providers who can and will seek out new markets beyond government customers. That economic infrastructure which grows out from the government’s legal and regulatory framework and limited public sector investments is what promises our broader society a hopeful future as our Nation leads the expansion of humanity into space.

Therefore, creating the right policy environment is vital to achieving the full strategic benefits of American leadership on the space frontier. Our nation’s entrepreneurs and engineers, students and scientists, teachers and tourists will follow NASA’s pioneering steps into the solar system carrying American civilization with them.

The U.S. Government needs to create a framework that allows and encourages U.S. enterprise to invest in utilizing these lunar resources, or other nations will do so.

American Preference

One concern that has emerged in America's leadership on the space frontier is that NASA has typically tended to use international partnerships with other space agencies more than domestic public-private partnerships to carry out science missions. While Moon Express certainly supports the national security and foreign policy benefits to the U.S. from such cooperative scientific projects, it is important for policymakers to realize that these international efforts can preclude American commercial participation.

For example, if NASA spends its dollars on helping another nation learn how to land a spacecraft on the Moon, including the provision of hardware and launch services for the mission, instead of buying a ride from a commercial provider, then it is arguably subsidizing the creation of a foreign capability, while not utilizing a nascent or extent domestic commercial service. This choice is not a simple matter of "domestic preference" versus international diplomatic benefits, but one of pursuing space goals that are more relevant to U.S. commercial providers via public-private partnerships, while more advanced or purely scientific projects can be internationalized.

The Big Picture

So far, modern humans have been resident on Earth for a few thousandths of a percent of our planet's lifetime; a microscopic sliver of planetary history. Civilization as we know it has been around a 100 times less than that. In the last few frames of our planetary cinema, barely a subliminal flicker, the first artifacts of a technological civilization have left the atmosphere and can be found on our neighboring worlds. Some farther than that. If the story of humanity ended tomorrow, by natural or self-inflicted calamity, these extraterrestrial human artifacts might be the only remaining evidence that there was an emergent spacefaring species on the third rock from the Sun.

The key to our survival as a species, in fact the only key we hold in the long term, is to evolve into a multi-world species, harnessing the practically infinite energy and resources of space and easing the pressure on our planet.

Space is vast, and if we lived on a planet isolated like an island in an empty ocean, it would be very hard to develop space resources. But luckily, we are an archipelago with a sister world containing resources we can utilize. The Moon; our eighth continent, rich in resources, the gateway to the solar system, is also the gateway to our future.

Preservation of the Earth and our civilization is precisely the reason we need to expand our economic and societal sphere into space, beginning with the Moon and then beyond.

Sixty years ago we began our journey as a spacefaring species. We need to get a toe-hold back on the Moon, and this time not let go. Moon Express is dedicated to exploring and unlocking the resources of the Moon for the benefit of humanity. We're undertaking this goal with private investment, not on the backs of the taxpayer. The risk is ours. The rewards will become available to everyone. We will conduct ourselves responsibly and with respect to national and international laws. We will avidly support science and exploration of the Moon as we seek water and minerals. But we're going. And we're thrilled to have the laws of the United States protecting our activities and backing our efforts to find new resources that could one day help the economies of planet Earth and secure our future in space.

It's not just about boldly going; it's about boldly staying. It's about moving the economic sphere of Earth outward in a way that uses the material wealth of space to solve the urgent problems we now face on Earth: to bring the poverty-stricken segments of the world up to a decent living standard, without recourse to war or punitive action against those already in material comfort; to provide for a maturing civilization the basic energy vital to its survival . . . through freedom of commerce in space.

We are at the cusp of a magnificent adventure, an evolution of our species perhaps as significant as the evolution of life from the oceans onto land. Our emergence from Earth into space holds promise and opportunity, but also dangers of migrating conflict, and for the first time in human history, an opportunity to conquer a new world without conquering each other.

The United States has taken proactive measures to support its private sector and has interpreted the Outer Space Treaty in favorable ways to the Constitution and founding principles. While the Outer Space Treaty may appear antiquated in some

ways, it is a remarkably visionary document with profound principles that have served the world well for decades. I believe time and energy is better spent in continuing to interpret the Outer Space Treaty in favor of international collaboration without constraining the rights and benefits of the freedom of U.S. commercial enterprise in space.

We aspire to the stars. Mars beckons as a second home for humanity. The Moon is our gateway.

Thank you for your time and the opportunity to present this testimony.

Senator CRUZ. Thank you, Dr. Richards, and I appreciated your invocation of the mission statement to boldly go where no one has gone before, or perhaps the most famous split infinitive in all of history.

[Laughter.]

Senator CRUZ. Mr. Marquez.

**STATEMENT OF PETER MARQUEZ, VICE PRESIDENT FOR
GLOBAL ENGAGEMENT, PLANETARY RESOURCES**

Mr. MARQUEZ. Chairman Cruz, Ranking Member Markey, thank you very much for the opportunity to come here today and talk about the Outer Space Treaty. I especially want to thank you and your staff also for the 2015 passage of the CSLCA. It was a tremendous event for this community, so thank you.

I come here today representing a multinational asteroid mining company, Planetary Resources. We exist to extract and utilize resources from asteroids that are needed for humanity to create a truly universal space economy, have a permanent presence in the solar system, and increase the quality of life for all people living on Earth.

We'll harvest water from asteroids to be used as fuel for spacecraft and satellites, as life support for a space workforce, as radiation shielding, and to grow food. We'll extract metal, which will, in turn, be 3-D printed so that we can construct nearly anything in space or any component needed; and we'll provide the fuel and raw materials needed for any long-term, sustainable, and scalable mission to the Moon, Mars, and beyond. In the long term, we will bring back extremely scarce resources, like platinum group metals, to the Earth to increase the quality of life for everybody.

We'll continue to build upon the great successes that we've had so far. In 2015, our company began the asteroid mining age when we launched our first technology demonstration satellite. In 2016, we used materials from a meteorite to 3-D print the first object 3-D printed from outer space material. We've built two follow-on satellites that will be launched soon, and in 2020, we will launch and operate the first ever private deep space mission. We will also conduct an unprecedented mission to visit, survey, and prospect several near-Earth asteroids.

Our team that we have is an example of, I think, many of the commercial space companies here now. Our engineers helped design, build, and operate a variety of Mars missions to include all the recent landers and rovers. We have a staff that comes from a variety of industries, from mining to semiconductors to planetary science to agriculture to the automotive industry to the IT community and many more. And despite what Mr. Schaefer said, we do have a pretty good law and policy team on staff, too, coming from

the State Department, the United Nations, the White House, and the national security community.

For Planetary Resources to accomplish this mission, we need stability and predictability. This nation has a history of not only supporting commercial space activities, but leading and implementing the international legal structure that created that stable and predictable space environment.

During the early negotiations of what would become the Outer Space Treaty, the U.S. actually fought to include commercial space activities because they believed it would be important. On the other side of the argument was the Soviet Union, which sought to have those operations limited to governments only. If the U.S. had not promoted those principles early on, I would not be here, my fellow panelists would not be here, there would be no Blue Origin, there would be no Virgin Galactic, no XPrize, and none of the other hundreds of small businesses that support this community across the country.

This U.S. national space policy was founded on these principles. Indeed, the principles from President Eisenhower on have become the foundation of our international legal environment and the Outer Space Treaty, principles that we as a nation have held since the dawn of the space age and that enabled the various space commercial capabilities that we have now. The treaty has proven to be a flexible foundation for those activities. Indeed, one of the keys to the treaty's enduring relevance is that the framers did not attempt to regulate specific activities. To do so, or today, for that matter, would be a recipe for obsolescence. Instead, the treaty establishes foundational principles.

There are now active discussions in the international community about how to interpret and apply the OST to these unprecedented activities. The U.S. comes to these negotiations from a position of strength. For one, the U.S. played a leading role in the treaty's formation, as I said, and it is this unbroken consistency of the U.S.'s interpretation of the treaty and application of the treaty for more than 50 years and across the past 12 Presidential administrations that is key to our credibility in this process.

For our company, the value of the international legal framework is clear. Without it, we'd be trying to operate in a reality without rules—chaos and anarchy. However, the treaty must be meaningful and responsive, and in order to do that, we will need the appropriately interpreted and implemented national legislation. As I mentioned before, the CSLCA is an excellent example of how to build upon the foundation of the Outer Space Treaty with national law.

None of this is to say the treaty is perfect or that it's complete or that Congress' work is complete. We are concerned, however, that opening up the treaty will leave our industry worse off and will overall be to the detriment of national and international security. And as a brief aside, I would say that it's worth noting that many of the principles and motivations espoused in the early U.S. negotiations and garnering support of the Outer Space Treaty were to protect national and international security. Again, in my previous occupations, I'd be remiss in not mentioning the purpose of many of these things.

My strong recommendation is that we continue to build upon the Outer Space Treaty with strong national legislation, and with strong national legislation and international collaboration, our commercial space industry will continue to thrive and innovate to broaden our horizons, add to our knowledge, and improve our way of living on Earth.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Marquez follows:]

PREPARED STATEMENT PETER MARQUEZ, VICE PRESIDENT FOR GLOBAL ENGAGEMENT,
PLANETARY RESOURCES

Chairman Cruz, Ranking Member Markey, and members of the Subcommittee, thank you for the opportunity to provide comments on the vital role of the Outer Space Treaty to our growing space industry.

I represent a multi-national asteroid mining company. Planetary Resources exists to extract and utilize resources on asteroids that are needed for humanity to; create a truly universal space economy, have a permanent presence in the Solar System, and increase the quality of life for all people living on Earth. Planetary Resources began the age of asteroid mining in 2015 when we launched the first asteroid mining technology demonstration satellite. We have built two follow-on satellites that are currently awaiting launch. In 2020, we will launch and operate the first-ever private deep-space mission where we will also conduct a historic and unprecedented mission to visit, survey and prospect several near-Earth asteroids.

What we do

Our business is to provide resources for people and the products they will need in space.

- We will provide fuel and raw materials that will be integral to any long-term, sustainable and scalable missions to the Moon, Mars, and beyond.
- We will harvest water from asteroids to be used as fuel for spacecraft and satellites, life support for a space workforce, radiation shielding, and to grow food.
- We will extract metal which will, in turn, be 3-D printed into nearly any structure or component needed in space.

Our near-term initiatives are providing fuel to launch providers for refueling their rockets in space with liquid hydrogen and oxygen we extract from asteroids. The refueling of rockets in space allows for significant reductions in launch costs and increased payload capacity for missions to the Moon and Mars. For example, our analysis shows cases where refueling a rocket on a Mars mission can decrease the cost of launching a payload from roughly \$40MM per metric ton down to \$11MM per metric ton while simultaneously increasing the maximum payload capacity from about 3 metric tons to 26 metric tons. Long-term and permanent exploration is infeasible without space resource utilization.

Longer-term, platinum group metals are also one of our key targets. They are extremely rare on Earth but in nearly limitless supply on asteroids. For example, a single 500-meter platinum rich asteroid contains 175 times the global annual output of platinum or 1.5 times the known global platinum reserves. Our activities will make these previous scarce resources ubiquitous and increase the quality of life for all humanity.

The Context

Less than a decade ago, asteroid mining was still relegated to science fiction novels or movies. In the span of the past few years we have been able to harness a confluence of technical development, increasing scientific knowledge, and reductions in costs to move asteroid mining from fiction to reality. But there is still much to learn and do.

The position we find ourselves in today regarding asteroid mining is not much different than the situation our predecessors found themselves in over 50 years ago. Many of the technologies that would define the space age were still in development and there was uncertainty as to how space activities would evolve. The U.S. had a firm position that private activities would play a key role in the future of space. The Soviet Union, on the other hand, sought to have space operations limited to Governments. If the U.S. had not promoted commercial space activities in the 1960s I would not be here today, my fellow witnesses would not be here, there would be

no Blue Origin, no SpaceX, no Virgin Galactic, no XPrize, and none of the hundreds of small businesses that support our commercial space industry would exist.

Today, we find ourselves in a time of opportunity. The breadth of space activities, and the services they provide to people in space and on Earth, is growing exponentially. This period of unprecedented space expansion is a product of the stability that we have had in space since the launch of Sputnik in 1957. Despite global tensions, space has remained a realm of peace and predictability. That stability, in no small part, has been assured by the tenets of the Outer Space Treaty. Through the development of a common agreement with the international community the foundational precepts of the Treaty have kept the space domain safe, stable and sustainable for 50 years.

The Value of the Foundations of the Space Legal Regime

For Planetary Resources to accomplish our mission, we need such stability and predictability, not only in space but also in the domestic and international legal landscapes. This Nation has a history of not only supporting commercial space activities but leading and implementing the international legal structure that allowed it to exist in the first place.

The U.S. National Space Policy was founded on these legal principles. Indeed, every President since Eisenhower has espoused the same principles for space exploration and utilization which, in turn, became the foundation of our international legal environment and the Outer Space Treaty.

Given its central role in assuring peace and stability in space, our success relies very much on the Outer Space Treaty. The consistent interpretation and application of the Treaty by the U.S. Government provides a predictable environment in which we can flourish. Since the dawn of the space age, as new technologies and capabilities have arisen, the Treaty has proven to be a flexible foundation for space activities. Indeed, one of the keys to the Treaty's enduring relevance is that its framers did not attempt to regulate specific space activities. To do so then—or today, for that matter—would be a recipe for obsolescence. Instead, the Treaty establishes certain foundational principles, and a basic legal framework within which space activities have been addressed through dialogue among States and implementing legislation by national legislatures.

Perhaps the most crucial dimension of the Outer Space Treaty for our company is the Treaty's enabling framework for space resource utilization. At this moment in time, as Planetary Resources brings utilization of asteroid resources ever closer to humanity's reach, there are active discussions in the international community about how to interpret and apply the Outer Space Treaty to these historic activities. The United States comes to these negotiations from a position of strength. For one, the U.S. Government played a leading role in the Treaty's formation. Yet it is the unbroken consistency of the United States' interpretation of the Treaty, over fifty years and across the past twelve Presidential administrations, that is the key to our credibility in this process.

The Importance of Domestic Legislation in the Context of the OST

For Planetary Resources, the value of the international legal framework for space is clear—without it we would be trying to operate in an anarchic reality. However, for that regime to be meaningful and responsive to the advancement and expansion of space technologies, its tenets must be appropriately interpreted and implemented by effective national legislation.

Relevant to space resources, the United States has Title IV of the Commercial Space Launch and Competitiveness Act (CSLCA) which recognizes the legal right to own resources extracted from asteroids, in full accordance with international law. Planetary Resources strongly thanks the Senate, and specifically, this Committee's Members and staff in developing and passing this law.

The leadership of the U.S. Government, nationally and internationally, and the steadfast support to commercial space activities created technological advances that increased our scientific knowledge, economic prosperity, and international security. That support continues today as evidenced by this hearing today and the Committee's continued strong interest in nurturing this industry that is critical to both national security and economic competitiveness.

The Space Resource Utilization Act of 2015 is an excellent example of the ways the Congress can support innovative, new commercial space activities by building atop the Outer Space Treaty's basic foundation. We are confident that U.S. diplomats, strengthened by the United States' unmatched consistency in interpreting the Treaty, will continue to engage with the international community and find common direction on the interpretation of the Treaty in a manner that promotes innovative, ground-breaking commercial space activities.

Conclusion

Internationally, the 1967 Outer Space Treaty is the backbone of the stability and predictability of not only the legal landscape, but space operations themselves. Article VI ensures that all operators, public or private, from all countries, operate according to a common set of basic rules. This legal level playing field for all spacefarers is allowing new space industry to flourish across the globe.

Planetary Resources is proud to be part of one of those new industries. Utilizing asteroid resources fundamentally changes our ability to operate in space. Here in the United States, our large, and growing team, spans five states in addition to our presence in the Grand-Duchy of Luxembourg. Our investors are from all corners of the globe and our customers are on Earth and in space. This is an exciting time.

Space is a global endeavor with profound national-level implications. We consider that the two legal pillars of a stable international legal regime agreed to by all global players, the Outer Space Treaty, coupled with effective domestic legislation that can be responsive to technological advancements, as typified by the 2015 CSLCA will allow us to effectively prosper, and will allow others to operate and compete on a level playing field.

None of this is to say that the Treaty is perfect in every way, or that the Congress's work in enabling a robust and globally competitive commercial space sector is complete. We are concerned however, that opening up the Outer Space Treaty will leave our industry worse off and will, overall, be to the detriment of national and international security.

We look forward to continued successful U.S. engagement with international partners to interpret and apply the Outer Space Treaty to evolving circumstances, and the continued support of the Congress in developing timely domestic legislation to support space technology developments.

Our simple message is that our focus should continue to be building upon the foundation of the Outer Space Treaty, rather than putting that foundation at risk. I thank you Mr. Chairman.

Senator CRUZ. Thank you, Mr. Marquez.
Mr. Gold.

STATEMENT OF MIKE GOLD, VICE PRESIDENT, WASHINGTON OPERATIONS AND BUSINESS DEVELOPMENT, SPACE SYSTEMS LORAL

Mr. GOLD. Thank you Chairman Cruz, Ranking Member Markey, and the dedicated Subcommittee staff for this opportunity to discuss the Outer Space Treaty's impact on American commerce and settlement in space.

I serve as Vice President of Washington Operations and Business Development for Space Systems Loral, or SSL. SSL is America's most prolific commercial satellite manufacturer. Over 80 satellites built by SSL are currently in orbit and providing coverage to the entire populated surface of the Earth. SSL is also a global leader in space-based robotics, advanced propulsion, as well as data extraction and analytics.

There has never been a more exciting time to be in the space industry. Asteroid mining, space tourism, private sector space stations, and commercial lunar rovers are all transitioning from science fiction to reality. We are living in an age of wonders.

Like every other space activity, satellite operations may be transformed by new ideas and technologies. For example, the operational lifetime of satellites is nearly always limited by their fuel supply. This can and will change. Via the Restore-L program, SSL and NASA are developing robotic LEO spacecraft that will rendezvous with and refuel satellites. If the Restore-L mission is successful, it could fundamentally alter the nature of satellite operations while providing the U.S. with a vital technological advantage.

Moreover, SSL was selected by DARPA to support the Robotic Servicing of Geosynchronous Satellites, or RSGS program. RSGS, an innovative public-private partnership between DARPA and SSL, will produce a robotic servicing vehicle that can repair satellites in orbit as well as replace or add new components to a satellite. Per DARPA's participation in RSGS, satellite servicing would not only bolster job creation and enhance American competitiveness, but such capabilities will be critical for national security.

During testimony before the Senate Select Committee on Intelligence earlier this month, Dan Coats, the Director of National Intelligence, stressed that China and Russia are developing directed energy weapons, missiles, and robotic spacecraft capable of disabling American satellites in both LEO and GEO. Restore-L, RSGS, and satellite servicing in general will substantially bolster the security and resiliency of America's vital orbital assets, while supporting domestic high-tech job creation and commercial innovation.

However, satellite servicing and all other forms of new space activities need funding, and what investors are looking for is a legal regime that offers certainty, transparency, and efficiency. Article VI of the Outer Space Treaty requires nations to provide authorization and continuing supervision of their private sector space activities. This Treaty obligation actually aligns with the desire of investors for regulatory certainty. Investors and insurers need to know that relevant Federal departments and agencies, particularly the Department of Defense, the Department of State, and NASA, will not object to their proposed activities.

Unfortunately, there is no established process for the Federal Government to provide entrepreneurs with this regulatory reassurance. Currently, companies, including SSL, are bringing their innovative space activities to the FAA Office of Commercial Space Transportation, or FAA AST. The FAA AST conducts an inter-agency review and subsequently has provided companies with what is called a payload approval letter.

The simplest, least bureaucratic, and most expeditious means of addressing not only Article VI, but providing entrepreneurs with the predictability that they desire is for Congress to direct the FAA AST to establish an enhanced payload review process that would leverage and formalize the work that the AST is already successfully conducting. Additionally, when such payload review approvals are issued, they should contain a proviso requiring that if substantive changes occur, the private sector applicant will update the FAA AST. This simple proviso, in conjunction with the enhanced payload review process, would be sufficient to meet Article VI's authorization and continuing supervision requirement.

Even with any Article VI concerns fully resolved, the Outer Space Treaty still contains a variety of clauses and provisions that are vague or challenging for private sector operations, such as Article II and Article XII. Despite these challenges, it would still be ill-advised for the U.S. to withdraw from the Treaty or open it up to revisions. Although the Treaty is imperfect, due to its focus on principles instead of prescriptive requirements, it has largely stood the test of time.

The Treaty has provided a foundation that international space law and public and private sector activities depend upon. If the U.S. pulled out of the Treaty, it would create confusion and uncertainty, hindering new commercial developments as well as established private sector space activities. Moreover, opening up the Treaty to amendments would risk the international community inserting even more language that would run counter to U.S. interests.

Instead, the Department of State in cooperation with the private sector should engage with likeminded countries, particularly launching states, to establish bilateral and multilateral understandings regarding aspects of the Treaty that require additional clarity and interpretation. Again, predictability, efficiency, and transparency are the key values necessary for a successful legal regime. If Congress can do its part and provide entrepreneurs with the regulatory certainty that they need, we can all start spending less time with lawyers and more time on launches.

Thank you for this opportunity.

[The prepared statement of Mr. Gold follows:]

PREPARED STATEMENT OF MIKE GOLD, VICE PRESIDENT, WASHINGTON OPERATIONS
AND BUSINESS DEVELOPMENT, SPACE SYSTEMS LORAL

Thank you Chairman Cruz, Ranking Member Markey, distinguished members of the Subcommittee, as well as the Subcommittee's dedicated and hardworking staff, for this opportunity to discuss the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, commonly referred to as the Outer Space Treaty ("OST" or the "Treaty"). My name is Mike Gold and I am Vice President of Washington Operations and Business Development for Space Systems Loral ("SSL").

SSL is America's most prolific commercial communications satellite manufacturer. Over eighty satellites built by SSL are currently in orbit providing services to the entire populated surface of the Earth. Billions of people depend upon satellites manufactured by SSL every day. Moreover, SSL is a trailblazer in space-based robotics, supporting a variety of innovative projects with both the National Aeronautics and Space Administration ("NASA") and the Defense Advanced Research Projects Agency ("DARPA"). SSL is also a global leader in space-based propulsion, leveraging highly reliable and robust systems such as the 1300 bus, a proven workhorse, while advancing the state of the art with new solar electric propulsion technologies. Earth observation and other types of satellites are generating an ever-increasing volume of data that can be leveraged for national security, commerce, and science. SSL and its affiliated companies have decades of experience extracting useful information from data through advanced image and signal processing as well as change detection. SSL provides customers with complete end-to-end services from satellite manufacturing to data analysis.

SSL employs thousands of engineers, scientists, and technicians across the country, and has been a leader in 'commercial space' over many decades. For SSL, and the American commercial space industry as a whole, to continue to survive and thrive, a regulatory environment that is conducive to innovation as well as private sector operations and growth is vital. The OST, which forms the foundation of global space law, addresses a wide variety of issues and activities. However, the most relevant portion of the Treaty, which requires immediate action from policymakers, relates to Article VI.

I. "Continuing Supervision" Under Article VI of the Outer Space Treaty

Article VI of the Outer Space Treaty states in relevant part:

"The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require *authorization and continuing supervision* by the appropriate State Party to the Treaty." (*emphasis added*)

Authorization and continuing supervision for established commercial space activities, such as telecommunications or remote sensing, are currently conducted by, respectively, the Federal Communications Commission ("FCC") and the National Oce-

anic and Atmospheric Administration (“NOAA”). However, there is no established process for the United States Government (“USG”) to authorize or supervise new, innovative commercial space activities.

There has never been a more exciting time to be in the commercial space world. Private sector space stations, space tourism, asteroid mining, and commercial lunar rovers are all transitioning from science fiction to reality. American entrepreneurs are leading the way into this new frontier, and we are still at the very beginning of what is certain to be an era of great change and progress. Like every other space activity, the satellite industry could be transformed by new technologies and concepts. Specifically, the introduction of robotic satellite servicing in low Earth orbit (“LEO”), as well as in geosynchronous orbit (“GEO”), may substantially alter the industry’s existing paradigm.

A. The Importance of Satellite Servicing

SSL is currently supporting two innovative satellite servicing activities, NASA’s Restore-L and DARPA’s Robotic Servicing of Geosynchronous Satellites (“RSGS”). The Restore-L mission is focused on a robotic spacecraft refueling Landsat-7 (a NASA remote sensing satellite). SSL satellites are built to last and their operational lifetimes are nearly always limited due to a lack of fuel. Via Restore-L, NASA and SSL will demonstrate the ability to overcome this challenge by delivering fuel to satellites, substantially extending their lifetimes.

DARPA’s RSGS program will focus on repairing satellites as well as adding and replacing satellite components. Fixing a satellite that has failed to deploy properly would save American taxpayers hundreds of millions of dollars. Moreover, the ability to add and/or replace various components will substantially bolster satellite capabilities, ensuring that regardless of when a satellite is launched, it can still take advantage of new technologies. This ability to add components could also be used to attach payloads that will enable a satellite to protect itself from tampering or attacks.

RSGS and Restore-L are complimentary activities, each focused on unique technological proficiencies, although both systems will be capable of conducting such operations as satellite inspection and refueling. However, RSGS and Restore-L will operate in two very different environments. Restore-L will be placed in a LEO Polar orbit where it will circle the Earth approximately fourteen times per day. Restore-L will use Tracking and Data Relay Satellite Systems (“TDRSS”) for communications and will serve as a testbed for advancing critical space-based robotics and automation to support future human spaceflight and robotic exploration missions. RSGS will operate in GEO, where it will orbit the Earth only once per day and will utilize ground-based communications systems. The primary objective of RSGS is to enhance the security and resiliency of military satellites while evolving the state of the art in defense-related robotics.

Per DARPA’s support of RSGS, mastering satellite servicing is critical to national security. Earlier this month, Daniel Coats, Director of National Intelligence (“DNI”), made the following statements for the record to the Senate Select Committee on Intelligence.

“We assess that Russia and China perceive a need to offset any U.S. military advantage derived from military, civil, or commercial space systems and are increasingly considering attacks against satellite systems as part of their future warfare doctrine. Both will continue to pursue a full range of anti-satellite (ASAT) weapons as a means to reduce U.S. military effectiveness. In late 2015, China established a new service—the PLA Strategic Support Force—probably to improve oversight and command of Beijing’s growing military interests in space and cyberspace. . . . Some new Russian and Chinese ASAT weapons, including destructive systems, will probably complete development in the next several years. Russian military strategists likely view counterspace weapons as an integral part of broader aerospace defense rearmament and are very likely pursuing a diverse suite of capabilities to affect satellites in all orbital regimes. Russian lawmakers have promoted military pursuit of ASAT missiles to strike low-Earth orbiting satellites, and Russia is testing such a weapon for eventual deployment. A Russian official also acknowledged development of an aircraft-launched missile capable of destroying satellites in low-Earth orbit. Ten years after China intercepted one of its own satellites in low-Earth orbit, its ground-launched ASAT missiles might be nearing operational service within the PLA. Both countries are advancing directed energy weapons technologies for the purpose of fielding ASAT systems that could blind or damage sensitive space-based optical sensors. Russia is developing an airborne laser weapon for use against U.S. satellites. Russia and China continue to conduct sophisticated on-orbit satellite activities, such as rendezvous and proximity operations, at least some of which

are likely intended to test dual-use technologies with inherent counterspace functionality. For instance, space robotic technology research for satellite servicing and debris-removal might be used to damage satellites. Such missions will pose a particular challenge in the future, complicating the U.S. ability to characterize the space environment, decipher intent of space activity, and provide advance threat warning.”

As described by the DNI, potential adversaries are actively developing weapons to attack satellites in “all orbital regimes” while perfecting their own space-based robotics, rendezvous, and proximity capabilities. The U.S. cannot leave its critical orbital assets vulnerable to attack and the U.S. Government should be sponsoring additional follow-on programs to RSGS and Restore-L. Numerous missions will be needed to successfully develop and implement holistic satellite servicing proficiencies, ensuring that vital national security and economic assets in both LEO and GEO are properly protected.

Moreover, while satellite servicing capabilities are vital, they are only the first step on the road to even more exciting technological developments, such as the deployment of persistent platforms. Currently, roughly eighty percent of an average GEO telecommunications satellite is comprised of propulsion, power generation, radiators, redundant parts, and other subsystems that keep the satellite flying and healthy. Only twenty percent of the mass of most satellites conduct the revenue generating activity.

We need to reverse this paradigm and reduce the amount of infrastructure that each satellite requires. The persistent platform concept accomplishes this by deploying a truss in space, similar to what was done with the International Space Station. However, instead of accommodating astronauts and habitats, this truss would contain power generation, thermal controls, propulsion systems, and connection points for a dozen or more ‘plug and play’ payloads. Robotic servicing systems developed via programs such as Restore-L and RSGS would deliver the payloads (that would support a wide variety of activities including communications, remote sensing, and space situational awareness) to the persistent platform for attachment. The payloads would share the platform’s propulsion, power, and other capabilities, removing the cost and need to construct, launch, and support these systems and subsystems for each individual payload. Additionally, when a payload becomes obsolete or fails, the robotic servicing craft will switch out the old payload with a new one, providing the ability to refresh technology in a way that is impossible today. This persistent platform architecture will dramatically lower the cost of orbital operations while enhancing capabilities. Space Systems Loral is currently investing millions of its own dollars to further develop this next-generation strategy, which will play an important role in transforming not only commercial space operations, but national security and scientific missions as well.

B. The Challenge of Regulatory Uncertainty

For satellite servicing, persistent platform, or any other technological advances to take place, funding is required. Investors that will finance such projects crave predictability, transparency, and efficiency. When a positive regulatory environment is aligned with technological growth, innovation flourishes. However, as described previously, there is no established USG process for providing authorization and continuing supervision of non-traditional space activities such as satellite servicing. This situation has already caused confusion and could ultimately lead to programmatic delays and forum shopping. Currently, the FAA Office of Commercial Space Transportation (“FAA AST” or “AST”) serves as the de facto Federal entity that companies have gone to for their innovative commercial activities. Bigelow Aerospace and, most recently, Moon Express, have leveraged the FAA AST’s payload review process to obtain reassurance that their proposed lunar operations would not conflict with USG interests or activities. Due to the lack of an established process, both companies combined their payload review applications with voluntary disclosures to relevant Federal agencies and departments such as NASA, and the Departments of Defense and State, to support and expedite the interagency process. Although I believe that both Bigelow Aerospace and Moon Express were ultimately satisfied with the end result, officials at the FAA AST as well as the Departments of Defense and State, have repeatedly voiced concerns that the current ad hoc process is untenable and may result in negative payload reviews if Congress does not provide additional direction to clarify jurisdiction and establish relevant procedures.

Entrepreneurs pursuing daring new concepts have helped to revitalize the American aerospace sector and will carry this Nation into the future. However, innovative commercial space activities require funding. Internal and external investors, as well as insurers, need to know what, if any, regulatory risks a particular project will face before financing an initiative. Therefore, the lack of a defined process for non-tradi-

tional space activities is anathema to investors and insurers alike. Non-traditional commercial space operations inherently involve many risks. Businesses and investors that are already embracing trailblazing activities should not be asked to also bear the added burden of regulatory uncertainty. The U.S.'s regulatory environment should encourage growth and investment, whereas the current lack of an established process creates yet another challenge for entrepreneurs to overcome. For example, the existing lack of defined deadlines, explicit areas for review, and transparency requirements all empower the bureaucracy while leaving companies with little to no recourse to gain the certainty they need to obtain funding and execute their business plans. Congress should take action with alacrity to address this challenge and remove a potentially problematic barrier to entry.

C. Enhanced Payload Reviews

As noted previously, the FAA AST already has the authority to conduct payload reviews. Despite the lack of an established process, the AST has successfully executed these reviews for non-traditional commercial space activities. The AST has a great deal of experience conducting interagency reviews in an effective and expeditious manner, and while no process is perfect, my professional experiences working with the AST has been overwhelmingly positive. Instead of creating new bureaucracies and needlessly spending additional taxpayer dollars, Congress should support a concept that was initially proposed by Congressman Jim Bridenstine, to simply expand the existing payload review process to include non-traditional space activities. This 'enhanced' payload review process represents the most expeditious, cost effective, and least disruptive strategy to address America's Article VI obligations. Congress could direct the AST to augment payload reviews in this manner, while also establishing a presumption of approval, deadlines, and other forms of protection to support an efficient process. Again, the AST is essentially doing this work already and has demonstrated the ability to successfully execute a non-traditional interagency payload review.

The enhanced payload review process would provide an elegant and effective means of addressing Article VI's requirement for authorization and continuing supervision of non-traditional space activities. By providing a governmental review and approving a payload, the 'authorization' component of Article VI is clearly met. The 'continuing supervision' obligation could similarly be addressed in a relatively simple fashion by including a proviso in a payload review approval letter requiring that if the proposed non-traditional space activity substantially changes from what was described in the payload review application, an update must be provided to the AST. This simple, benign clause, would be sufficient to address Article VI's continuing supervision requirement, and I believe that the relevant attorneys and policy leadership at the Department of State would agree with this contention.

An enhanced payload review approval is especially helpful to entrepreneurs since, via the interagency process, the approval carries with it the support of both the Department of Defense and the Department of State. While NASA, the Department of Commerce, the FCC, and other agencies are also part of the payload review process, it is particularly important to have a mechanism for the Departments of Defense and State to be able to provide feedback. Companies need to know that their proposed activities will not interfere with Defense and/or Intelligence Community operations. Similarly, it is vital that a review process include an avenue for the Department of State to provide input relative to international treaty obligations. Ensuring that neither the Departments of Defense or State will object to a commercial space activity taking place is vital for entrepreneurs to obtain the regulatory certainty that they need to raise funds and execute innovative programs.

Again, regulatory certainty is vital, and even if the U.S. were not a signatory to the OST, entrepreneurs would still need the enhanced payload review process to ensure that their operations could proceed without fear of objection from Defense, State, or other USG departments or entities. Moreover, the Enhanced Payload Review process provides a mechanism to de-conflict domestic private sector activities, ensuring that non-traditional commercial space operations can occur without fear of interfering with each other.

The Enhanced Payload Review process also provides the private sector with protection against a more pernicious interpretation of the OST's 'continuing supervision' requirement. In the realm of export control, USG supervision was often implemented in a counterproductive and even irrational manner. The Enhanced Payload Review process would establish a commonsense means of meeting U.S. obligations under Article VI, while also providing the private sector with the regulatory certainty that it needs regardless of any treaty obligations.

II. Problematic and Unclear Aspects of the Outer Space Treaty

A. Article XII

Article XII of the OST states that:

“All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.”

It is likely that when the OST was drafted fifty years ago, private sector space stations, lunar facilities, and commercial transportation vehicles were not contemplated or even imagined. However, what was once science fiction is now becoming reality, and Article XII’s requirement that foreign representatives be allowed to visit such facilities or spacecraft represents an unreasonable and possibly illegal demand for the USG to make upon the private sector. As a matter of fact, if a private sector company complies with Article XII, such actions could violate domestic export control laws depending upon the nationality of the visiting foreign representative. Although the U.S. has and should continue to support the peaceful development of space and encourage international cooperation and comity, due to the development of non-governmental spacecraft and the potential for future private sector orbital and/or lunar facilities, the requirements of Article XII warrants attention.

B. Unclear Aspects of the OST

There are several aspects of the OST that remain vague and/or are open to interpretation. For example, Article I of the Outer Space Treaty states in relevant part that:

“The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.”

Although nothing in the OST prohibits commercial activities, language such as this has been raised by some nations to justify calls for the mandatory sharing of any economic benefits gained by private sector entities via outer space operations. Conversely, the U.S. and many other nations would interpret this clause to support free access (which is referenced later in Article I) to all countries for the exploration and use of outer space.

Additionally, Article II of the OST states that:

“Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”

Some nations have interpreted this language to prevent the extraction and utilization of space resources by the private sector, or to create a global system of benefits distribution per the language cited previously in Article I. The U.S., and many other countries, do not share this interpretation of Article II and, per the Commercial Space Launch Competitiveness Act, contend that the utilization of extraterrestrial resources by the private sector does not conflict with Article II or any other aspect of the OST. During the most recent meeting of the United Nations Committee on the Peaceful Uses of Outer Space (“COPUOS”) Legal Subcommittee, the issue of asteroid mining and Article II were discussed at great length. Again, Article II does not prohibit or even limit asteroid mining or similar activities on other celestial bodies, but this debate and issue also warrants continued attention.

III. The Benefits of the Outer Space Treaty and the Dangers of Revision

The Outer Space Treaty provides the fundamental underpinnings for international space activities. As described previously, there are aspects of the Treaty that are imperfect and open to interpretation, but despite the passage of fifty years, the OST has generally withstood the test of time. The reason for this can be found in the name of the OST itself. Specifically, The OST is a “Treaty on Principles”. The OST lays out general principles such as the prohibition of weapons of mass destruction, the prevention of one country interfering with another country’s space operations, and nation’s supervising non-governmental activities. The OST is not a prescriptive document and, in a manner that is similar to federalism in the U.S., the Treaty provides each nation with the freedom to meet its obligations in their own way. For example, Article VI does not dictate how countries should supervise private sector operations, it simply states that supervision should take place, and

leaves it to individual countries to adopt laws and regulations that best suit their own unique needs and circumstances. This inherent flexibility and adherence to simple, core principles, is why the OST has survived for fifty years and is as relevant today as it was in 1967.

Again, investors, insurers, and the private sector in general need certainty and predictability. For a half century, the OST has provided a stable framework for global space operations that public and private organizations alike have come to depend upon. The U.S. dropping out of the OST would result in a period of great uncertainty and international confusion, hindering the development and growth of both new and mature commercial space activities.

As described previously, there are certainly aspects of the OST that are in need of clarification. It is important for U.S. policymakers to vigorously engage in the dialogue surrounding Articles I, II, and XII, and I am grateful to the Subcommittee for raising the profile of these issues. However, opening up the OST to revisions would likely only result in more language being inserted into the Treaty that would run counter to U.S. interests. There are 84 nations that belong to the COPUOS, and many of them do not share the U.S.'s desire to bolster commercial space development. Therefore, opening up the OST would create additional uncertainty for public and private space operations while running the risk of new language being inserted into the Treaty that would hinder commercial space development. Alternatively, if the U.S. were to drop out of the OST, it would undermine international obligations that support American interests such as the prohibition on weapons of mass destruction in space.

IV. Addressing Outer Space Treaty Issues Without Revising the Treaty

In lieu of actually changing the language of the OST, the Department of State should meet with industry to identify aspects of the OST that need to be addressed. Subsequently, State, in conjunction with industry, can reach out to like-minded nations, focusing on launching states, to establish a consensus via bilateral and multi-lateral correspondence and agreements. This strategy would help to clarify and address any shortcomings of the OST, without running the risk of opening the Treaty up to modifications that would further hinder commercial development.

The Department of State should be commended for aggressively reaching out to the private sector. As Chair of the Commercial Space Transportation Advisory Committee ("COMSTAC", the Federal advisory committee to the FAA AST), I have joined the U.S. delegation during COPUOS sessions and have been consistently impressed with the leadership the Department of State has shown in vigorously defending private sector interests. Under the stewardship of Secretary of State Rex Tillerson, who of course has substantial experience in both international relations and exploring the development of new resources, I expect that the Department of State will continue to work closely with the private sector to grow domestic commercial space activities benefiting both the U.S. and the world.

However, additional industry feedback is always helpful, and the Department of State may want to consider establishing a Federal Advisory Committee, similar to the COMSTAC, to provide the Department with independent input, guidance, and advice. Members of such an Advisory Committee could be nominated by the Director of the Office of Space and Advanced Technology for review and approval by the Secretary. The Department of State already actively consults with numerous companies and trade associations, and creating a Federal Advisory Committee would formalize this process, ensuring a continued strong and productive relationship between the Department and the commercial space sector.

V. American Policy Leadership

When the U.S. leads in space exploration and utilization, the world benefits. Furthermore, U.S. leadership should not be limited to technological advances, but must also include policy development. The U.S. has an opportunity to demonstrate how nations can address their Article VI obligations, establishing a model for other countries to follow, and I therefore urge the Subcommittee to address this issue with alacrity. Innovative space operations such as private sector space habitats, asteroid mining, commercial lunar rovers, and satellite servicing are all transitioning from dreams into reality. Yet, the question remains, where will these activities occur and which nations will benefit. Again, when a positive regulatory environment is aligned with technological growth, innovation flourishes. Countries such as the United Arab Emirates have already developed holistic national space laws that comply with the OST while empowering entrepreneurship. Similarly, Luxembourg has leaned forward and has not only developed laws that support asteroid mining, but is actually investing government dollars to fund such commercial endeavors. The U.S. should learn from the UAE, Luxembourg, and other nations to adopt a regulatory regime

that implements and improves upon global best practices. American entrepreneurs, investors, engineers, and scientists are doing their part to create a bold new future for our country in the final frontier. Now we need Congress to support aerospace innovation by establishing a regulatory regime that provides certainty, transparency, and efficiency.

I appreciate this opportunity to testify before the Subcommittee and look forward to your questions.

Senator CRUZ. Thank you, Mr. Gold.
Colonel Melroy.

**STATEMENT OF PAMELA MELROY, U.S. AIR FORCE (RETIRED),
AND FORMER ASTRONAUT**

Colonel MELROY. Thank you, Chairman Cruz, Ranking Member Markey, and your superb staff, for inviting me here today. It's a privilege to be here to discuss this important topic.

Today, I'd like to talk about satellite servicing. Satellite servicing is not new. As a NASA astronaut, I had the privilege of conducting and overseeing robotic activity on the space shuttle and during the construction of the International Space Station. To date, only the space shuttle, ISS, and the Hubble space telescope were designed to be serviced, and all of these activities occurred in low Earth orbit.

From a commercial perspective, the high-value orbit is geosynchronous Earth orbit, GEO, home to hundreds of the most valuable commercial and national security satellites. These satellites are 36,000 kilometers from the surface of the Earth. If they experience any issues today, they cannot be repaired, losing valuable revenue or national security capability. GEO is a hugely impactful place to take the capability of servicing, and several companies have announced ambitions to develop those capabilities.

Satellite servicing starts with what is called rendezvous and proximity operations, RPO. Two spacecraft begin thousands of kilometers from each other and use a powerful suite of sensors to perform precise navigation to converge their orbits within a centimeter of accuracy. In the most challenging cases, robotic operations will be required, nudging a solar array or aperture that failed to deploy, or even replacing a failed system on a satellite.

These activities can spectacularly restore capability, but are potentially perilous to both the servicer and the client satellite. Improper actions or inadvertent error can generate orbital debris, which is a danger to all spacecraft. This potential for debris generation provides a clear connection to the Outer Space Treaty's Article IX references to harmful contamination and harmful interference, which the U.S. Government is obligated to avoid.

Given Article VI's requirement for continuing supervision, I think commercial satellite servicing must have some form of scrutiny by the Federal Government to protect the sustainability and the safety of the space environment. However, as has been mentioned by several today, should this oversight regime be too onerous, the initiative will simply go to other countries. Having other countries set norms around RPO that may not be based on a technical or safety basis could be very damaging to both national security and to our economic interests.

At the FAA's Office of Commercial Space Transportation, I learned that a simple regulatory change, even editorial, takes a

minimum of 2 years. A complex rule can take five or more years to achieve. This is a nightmare in the face of rapidly evolving technologies and business plans.

However, I also saw the use of industry consensus standards. Industry standards allow companies to be an advocate for their innovative technologies and business plans. Standards can be updated much more easily and, long-term, they could be helpful in enabling regulations that are performance-based and not prescriptive.

When I was at DARPA, I helped initiate a joint program with NASA called CONFERS, the Consortium for Execution of Rendezvous and Servicing Operations. The goal of the program is to fund a consortium to bring together technical experts across industry and government to develop consensus technical standards for rendezvous and servicing. These standards could provide a basis for evaluating compliance with the Outer Space Treaty by the U.S. Government and may prove a successful model for future oversight of other areas as well.

A few other comments regarding that oversight. Today, most cameras in space are pointed down at the Earth, not at other satellites. Any oversight must consider the powerful suite of sensors carried by satellite servicers to accomplish RPO with respect to the protection of national security operations and proprietary commercial information. For national security, it'll be critical to verify that a commercial satellite is, in fact, acting cooperatively when it approaches another satellite and is operating in a predictable way to prevent misunderstandings.

Verification of RPO activities will likely be the most stressing case for space traffic management. A single window to industry for authorization and verification of servicing operations seems best.

Thank you, Mr. Chairman, for the opportunity to discuss this important and exciting topic.

[The prepared statement of Colonel Melroy follows:]

PREPARED STATEMENT OF PAMELA A. MELROY, NASA ASTRONAUT, RETIRED

Thank you Chairman Cruz, Ranking Member Markey, distinguished members of the Subcommittee, and your superb staff for inviting me here today. It's a privilege to be here to discuss this important topic and to be with eminent colleagues and friends who are as passionate as I am about commercial space. I am thrilled that this committee has taken on the important work of considering the Outer Space Treaty and appropriate oversight of commercial space activities in the United States.

There are many exciting activities and proposals in commercial space. With respect to the Outer Space Treaty, I am deeply concerned that we would be opening a Pandora's Box by attempting to change it. My concern is that the likely outcome would be a lack of consensus, resulting in no amendments. Instead, we will have a weakened dedication to the Principles of the Treaty and the sustainability of space. Great changes are occurring and many countries are developing capabilities that previously were the purview of only a few nation states. Our ability to compete both economically and technologically in space is crucial. These Principles form the basis for the dialog that we have with other countries about what is appropriate and what is not. Without them, the dialog becomes chaos.

Today I would like to discuss a specific activity—satellite servicing. Satellite servicing itself is not new. As a NASA astronaut, I had the privilege of conducting and overseeing robotic activity on the Space Shuttle and the International Space Station (ISS) during its construction, and the opportunity to observe my colleagues conduct extraordinary work on the equally extraordinary Hubble Space Telescope. I saw first-hand the power of the capability to inspect, repair, and upgrade satellites. To date, only the space Shuttle, ISS, and Hubble have been designed to support being serviced, and all of these activities occurred in low earth orbit. Low earth orbit

(LEO) is conducive to tele-operation (think “joystick”) of robotic arms by astronauts in space, who can observe out the window and use real-time video. In addition, ground operators have proven capable of performing robotics in virtually real time from the ground to LEO. Advances in technology now permit impressive levels of autonomy that are less reliant on the intense supervision of humans that can only occur in LEO. These advances in autonomous rendezvous and docking, and greater levels of autonomy in robotic task performance now provide the potential to push satellite inspection and repair beyond LEO.

From a commercial perspective, the high value orbit is geosynchronous earth orbit (GEO), which is home to hundreds of the most valuable commercial and national security satellites. Commercial revenues from GEO satellites exceeded \$110 billion in 2015, according to the Satellite Industries Association. These satellites reside 36,000 kilometers from the surface of the earth; at present, if they experience any issues they cannot be repaired, losing valuable revenue and national security capability. GEO is a hugely impactful place to take the capability of servicing. And several companies have announced ambitions to develop these capabilities, either on their own or in public-private partnerships with the government.

Let’s break down the term “satellite servicing” into the operations terms that best describe the kind of activities that actually occur during servicing. The first is getting close to the client satellite that you intend to service. This intentional bringing together of two objects in orbit is called, in space parlance, rendezvous and proximity operations (RPO). It begins with two spacecraft thousands of kilometers from each other and the orchestration of a suite of sensors to perform precise navigation to converge orbits to a specified location within a centimeter of accuracy on final docking to the client (should it be required). In the most challenging cases, some sort of robotic operations will be required—nudging a solar array or aperture that failed to deploy, grasping a fouled thermal blanket, even replacing a failed system on a satellite.

These activities are massively impactful in restoring capability, but potentially perilous to both the servicer and the client satellite. The consequences for improper actions or inadvertent error during either RPO or robotics are not just the damage to one or both satellites, but more critically the generation of debris. This orbital debris can cause additional damage to the servicer or client, creating even more orbital debris, and it can float away and damage other spacecraft in the same or lower orbits.

The safety issues associated with these space operations are not trivial—in fact I would argue that servicing is the activity most dangerous to space sustainability of any of the proposed commercial operations. NASA and national security operators have demonstrated the capability to safely perform rendezvous and proximity ops, and NASA has perfected and mastered space robotics operations during Hubble repairs and the construction of the ISS. As commercial servicing operations go into business, what assurance do we have of their safety?

These operations are challenging, but the government and its contractors do have over fifty years of experience in this area. In fact, today commercial satellites are safely performing RPO and collaborative robotics with a government satellite. That’s thanks to NASA’s Commercial Cargo program, where industry has proven capable of maneuvering cargo vehicles in close proximity to the ISS, where they are grappled and docked by astronauts. NASA has proven that the safety and policy issues can successfully be addressed via the contract with the government and these commercial providers. The same companies providing services and performing RPO at ISS are also developing business to service commercial satellites. While we can expect technologies and best practices should transfer, when a commercial provider is servicing another commercial provider and no government experts are involved, how will the government be confident they will be adhered to? That is essence of what I want to talk about today.

The potential for debris generation provides a clear connection to the Outer Space Treaty’s Article IX reference to “harmful contamination” and “harmful interference” which the U.S. Government is obligated to avoid. Given Article VI’s requirement for continuing supervision, I think that commercial-on-commercial satellite servicing operations must have some form of scrutiny by the Federal Government to protect the overall sustainability and safety of the space environment. The lack of clarity on regulatory oversight creates financial and regulatory risks for industry, and diplomatic risks for the U.S. Government.

However, should this oversight regime be too onerous, the business advantage will simply go to other countries. Other nations will pursue this technology whether or not the U.S. does. Having other countries set norms in this area is potentially extremely damaging to both national security and to our economic interests. The U.S.

Government must provide support and clarity to enable these new businesses both for the benefit of our satellite systems and benefit for our economy.

So what should be considered when planning oversight responsibilities?

I'll point out again that NASA and its commercial partners are operating just fine right now. Whatever solution is devised, it should not add new layers of oversight onto previously existing arrangements, or reduce any government agency's authority and flexibility to accomplish their mission.

From a governance perspective, there are significant national security implications to these activities. It will be extremely important to verify that operators are trained to prevent debris generation—that is obvious. But it's also important to national security to verify that a commercial satellite is in fact acting cooperatively when it approaches another satellite, and is operating in a predictable way to prevent misunderstandings. In the long term, verification of proper behavior—and attribution of improper behavior—will also be necessary. Unfortunately, the ability to have real-time information about the space domain—all space objects, at all orbits, at all times—is a challenge that has yet to be overcome. Tracking and verification of RPO activities will likely be the most stressing case for space traffic management technical capabilities—far more difficult than predicting potential collisions with debris in slow-changing orbits. As discussions inside the government continue about who should be responsible for space traffic coordination, please consider that those activities will have to be closely coordinated with any servicing oversight. It seems best to consider having a single window to industry that oversees both the authorization and the verification of servicing activities.

Another consideration is that national security satellites do not like having their picture taken. This is not shyness, but in fact needed protection of our capabilities and support for operational activities on the ground. Commercial satellite operators turn out to be just as concerned on this point. A competitive advantage may be gained by learning exactly what equipment a specific satellite is carrying and if there are any failures evident. Today most cameras in space are pointed down at the earth, not at other satellites. Any future regulator must consider the powerful suite of sensors that servicing satellites carry to accomplish RPO with respect to the protection of both national security operations and proprietary commercial information.

In terms of what oversight should look like to industry, careful thought and caution is needed. At the FAA's Office of Commercial Space Transportation, I learned that a simple regulatory change—even editorial—takes a minimum of two years to accomplish if you simply put the days required by the process end to end. A complex rule—even the revocation of a rule—can take five or more years to achieve. This is a nightmare in the face of rapidly evolving technologies and business plans. One process I observed at the FAA on the aviation side was the use of standards which the FAA scrutinized, then issued a statement to advise that compliance with the standard was adequate to meet the intent of corresponding simple, performance-based regulations. Standards can be updated much more easily and a relatively short process used to validate that they continue to meet the intent of the regulations. Standards can be tremendously helpful in enabling regulations that are performance-based, and not prescriptive.

At this time, there is no single agency with clear authority to oversee all of these types of on-orbit activity. As has been described by others, the FAA has launch and entry oversight. The FCC has spectrum oversight. NOAA has oversight of remote sensing of the earth. But even if today, with a mighty penstroke Congress decided to issue such authority, none of these agencies yet has the resources—including operational experts in these areas—needed to perform oversight of specialized activities like RPO and robotics. It will take years to develop regulations, and these regulations may be outdated by the time they are passed.

It is my assertion that industry consensus standards can fill in the gap and provide a basis for evaluating safety by future regulators when they do have this authority. Industry must be involved from the beginning and provide the advocacy for their innovative technologies and business plans. Industry consensus standards will allow an agency tasked with oversight to consider and nurture these needs, while still being mindful of best practices learned over decades of government servicing activities.

It might appear that the wholesale transfer of NASA's safe operating procedures and "flight rules" could solve the problem. However, these operating procedures are written with the specific design of the client satellite—in this case, ISS—in mind. The size of the solar arrays, and the desire not to spray them with the outflow from the thrusters of the approaching spacecraft, and similar constraints dictate the approach corridor, keep out zones, and safety gates. One example of the difference between a flight rule and a standard which applies to all vehicles is the concept of

a passively safe orbit. A passively safe orbit means that you have designed the approach using orbital mechanics that will allow the two spacecraft to pass by each other harmlessly with no collision. At some point you then initiate the final approach which will result in docking. Keeping that point as late as possible limits the amount of time that you are exposed to the risk of collision if there is a failure on either spacecraft or a loss of communications. The size of the client spacecraft dictates the distance at which you can continue to be passively safe. Therefore, a standard would not give a distance; rather, it might state that approaches should be passively safe until as late as practical. This is but one example of how government know-how can be translated into standards. NASA experts carry the vast store of knowledge we have about RPO in low earth orbit, and robotic servicing operations. Other experts around the government have also been involved in various RPO activities. Government experts must also be involved in the development of these standards.

So if this model is such a paragon, why isn't it in practice today in other areas of commercial space? The good news is that the advantages of industry consensus standards is well understood. The Commercial Space Transportation Advisory Committee (COMSTAC), the FACA committee advising the FAA is working on standards around a variety of areas that the FAA already has jurisdiction over. It was recently announced that ASTM International has formed a working group to develop a standards roadmap for commercial space.

RPO and servicing are arguably a very small part of the range of commercial space activities, but a vital one, and require the attention of specialists. When I was at DARPA, I advocated for and helped initiate a joint program with NASA called CONFERS—Consortium for Execution of Rendezvous and Servicing Operations. The goal of the program is to fund the creation of an industry/government consortium to develop non-binding consensus technical standards for safe rendezvous and servicing operations. I emphasize technical, because it is not the intent for these standards to incorporate policy guidance or preferences for behavior, but physics and operational safety-based best practices.

Often standards development is hindered by the lack of funding for administrative support; technical experts are willing to have discussions but there is less interest in the administrative tasks of writing everything down, tracking issues to be resolved, etc. If it's no one's "day job"—much less full-time day job—the process can take many years. By funding an Executive Director and a standards organization to provide the persistent leadership to develop this special set of standards, CONFERS will ensure that the effort will more quickly produce those standards. I believe that this approach will enable the U.S. government to have a technical and safety basis for understanding servicing activities when oversight is eventually put into place. This approach may prove a successful model for future oversight of other areas as well under the Outer Space Treaty.

Thank you for the opportunity to discuss this important and exciting topic with you, and I look forward to lending my technical expertise to the discussion.

Senator CRUZ. Thank you, Colonel Melroy.

Thank you to each of you for very helpful testimony. Let me start with a question that we asked the preceding panel as well to each of you, which is: Should this committee take up legislation to provide greater certainty and predictability and clear incentives for the private investment of resources in space, and, if so, what should the contours of that legislation, the contours of any such regulatory regime be, and to what extent does the Outer Space Treaty serve as a barrier to doing so?

Mr. RICHARDS. Well, perhaps, Mr. Chairman, I could start. Having lived the dream and come up against the stark reality that we had a mission planned, we had investors invested, but didn't have a way forward at the end of 2015. Not that the government—there was anybody that didn't want to say yes. There was just no mechanism to do so.

So we were able, through months and months of expensive and time-consuming effort, both on our company's executive side and the great people throughout all the interagency Federal stakeholders, found a solution, but a temporary patch in this mission ap-

proval. However, the mission approval was—once it was given, it was made clear that it was a one time only thing for our one company, for our one mission, and although there would be a proactive desire to continue that type of support, there was no guarantee that it could be done again.

So we need a certainty. Here we are, about to execute on our first lunar mission, planning further missions—and, Mr. Chairman, you mentioned those peaks of eternal light on the Moon. Those are, indeed, the destinations that we are looking at for our second mission, and we have yet to have a certainty of process in order to gain the Article VI authorization and supervision to go there.

So I did recommend a light-touch regulatory environment that promotes certainty with a minimum of regulatory burden. Inaction or nothing is not enough. And we have found a way through existing protocols with a little bit more voluntary disclosure to find a way through. So perhaps that's a data point for the models that will be helpful in the more permanent solutions that are found in the future.

Senator CRUZ. And, Dr. Richards, let me follow up on your answer there. My understanding is that your mission approval from the FAA states, quote, “The FAA made a favorable payload determination for this particular mission. However, not all non-traditional space missions may lend themselves to favorable payload determinations under the payload review authority in 51 U.S.C. 50904. Future missions may require additional authority to be provided to the FAA to ensure conformity with the Outer Space Treaty.”

My question is: What impact did that statement have on Moon Express and the certainty you need to continue to receive funding from investors to facilitate future missions?

Mr. RICHARDS. That letter was written on July 20 of 2016, which was a venerable date, of course, for that to happen. It was great news that the authority was given for that once. It was an indication that it was possible, but it was certainly not an indication of certainty for the future.

We are moving forward with the belief that the United States will continue to find a way. These hearings and the conversations that are underway right now are giving us great hope that these things will happen. Our colleagues in other industries want to go to asteroids and want to go to Mars. We want to go to other destinations, too, and it's going to start happening fast and frequently. So although we're not there yet, I have confidence that these conversations and others will lead to a permanent solution that we can all live with and flourish with.

Senator CRUZ. Do others have thoughts on this?

Mr. GOLD. Senator Cruz, if I could—

Senator CRUZ. Sure.

Mr. GOLD. The language that you just quoted is actually much more frightening for those coming afterward than it was for the company that received it, and we certainly fall into that category. This is not science fiction. This is not academic. These satellite servicing missions are happening, both RSGS and Restore-L, in LEO and GEO, both of which are critical orbital domains. Satellite

servicing is a race that we cannot afford to lose in America, whether it's for national security, commerce, or both.

Our experience is that we are in a state of relative confusion. We don't know what agency will be responsible. You have already heard negative reactions to the status quo and what has occurred. We need certainty, because our investors want it, insurers want it. The private sector must have it, and we don't have sufficient certainty now, which is why we implore you to take action.

Now, that action should be based upon common sense, it should be balanced. Just to go back to the Connecticut analogy—

Senator CRUZ. Common sense. I'm sorry. This is Washington.

[Laughter.]

Mr. GOLD. I know. Hope springs eternal in a science fiction fan, Senator.

We don't want to see the Federalization of Connecticut, as described before. But there should be a speed limit. Now, I've been to Connecticut. They don't abide by that, but, nonetheless, it's helpful.

I believe we should take the existing process at the FAA AST and enshrine and formalize it. It's working. I think both Dr. Richards and I had positive experiences with it. What we don't want to see is whole new bureaucracies stood up, new requirements, new licenses, new processes. We have a system that is working. Let's enshrine it. Let's proceed.

And relative to your question about the Outer Space Treaty, there is actually an alignment here between the private sector's desire for certainty and the requirements of Article VI. By going the simple route and just creating the enhanced payload review process at the FAA AST, we can solve both at once.

Part of the reason I'm so concerned about Article VI is not because of today. I think the Department of State and the Department of Defense have done a great job. But it's because of tomorrow. No two words in the English language scare me more than "continuing supervision," particularly when it comes to the government.

Per the example of export control, we saw the worst of what continuing supervision can mean. When we would travel to Russia, I would travel with a number of U.S. Government officials breathing down our necks, monitoring every word that we would say, and we had the pleasure of paying for the privilege, \$150 per monitor per hour. We would joke with the Russians that the KGB may have spied on you back in the day, but at least they had the good courtesy to do it for free.

[Laughter.]

Mr. GOLD. So we need a regime that locks in this, dare I say it, common sense approach because if there's some sort of crisis—and this is what happened with export control, there was an incident, and when that occurs, then you get bad policy. You get knee-jerk reactions. So let's take this time now to create a system that benefits national security, benefits the private sector, and meets our Article VI obligations.

Senator CRUZ. So let me ask two final questions. The first is: If there should be an agency in charge of implementing these rules, what agency should that be?

And the second question, I want to address specifically to Mr. Marquez, which is that Planetary Resources is establishing a European headquarters in Luxembourg to conduct research and development activities in support of commercial asteroid prospecting. I want to ask how does the competitiveness in the United States compare to Luxembourg and other jurisdictions, and what can we do to ensure that America remains the most competitive place in the world for commercial space entrepreneurs? Either or both of those questions.

Mr. GOLD. I'll take the first question and then turn the other over to Peter. Relative to the agency, please don't make me go to any more agencies. I go to enough as it is. The FAA Office of Commercial Space Transportation has demonstrated that it's capable, it's willing, and it can be successful in running an interagency process, because, ultimately, it's never going to be a single agency. We're going to have to go to Defense. We're going to have to go to the Department of State. What I need is a single belly button, a single door, an ombudsman to the rest of the Federal Government so that, like Dr. Richards, we don't have to go to every single agency ourselves as a private sector entity.

Via the enhanced payload review, the AST has proven it can talk to those other agencies, bring them together, and get through the process. So I would like a single front door for the government, and then for that agency to go to the other departments with interests and come back with a response. Again, I believe the most expeditious way to do that is to go through the FAA AST since they're doing it already and I already have to go there.

Senator CRUZ. Any different views on that question from Mr. Gold's?

Mr. MARQUEZ. I just have a few—I don't want to say different, just more detail on it. One, I think, foundational item we need to do is in Article VI, it says authorize and continually supervise. Nobody in this room knows what that means. We need to work on what that means and what our obligations—as we interpret our obligations to be under authorized and continually supervised.

Again, I agree with my colleagues here that regulation needs to be a light touch, even if it is regulation. I think something akin to even filing a flight plan is good enough. Again, I also agree that having a known front door and having that front door staffed and funded to review these types of activities, having the process and method known for what you're going to be authorized and supervised known, that there's an assumption of compliance with the treaty. None of us want to violate the treaty. We're in this for business. We have no interest in making space an unpredictable and unsafe place to operate.

The second—or the fourth element here is that it needs to be transparent, the process. We have to know what's going on inside that process. And the final one, again, coming from the national security community, is as a company, I want to know—if I'm denied, I want an avenue for redress and appeal, to be able to change something that may be a national security threat so I can still do my operation, but do it in a way that is not an issue for national security.

To your second question, Senator, about competitiveness versus Luxembourg, our subsidiary in Luxembourg is taking advantage of a great opportunity in that we have access to engineers from around the world that we would not be able to have access to here in the United States. It gives us an opportunity to access all those people due to things that Mr. Gold is very well aware of on export control issues.

The competitiveness, I would say, is that they have taken initiative to not only create an analog to Title IV of the recognition of the right to own resources that you obtain from objects in space, but they've taken the next step to put that structure in place that meets their Article VI obligations. So there is a certain level of certainty in operations to be conducted in Luxembourg. The Emirates is doing the same thing. I've actually heard positive language from the Chinese about trying to do the same thing.

So this is a growing area where I think, competitively, this is no longer just a space race. This is a legal race. It's a race to give surety and predictability to the commercial space industry. And we're not looking to completely uproot and move to another place, but we're taking advantage of the opportunities it gives us to get that wonderful staff that exists elsewhere in the world.

Colonel MELROY. Mr. Chairman, I'd just like to reinforce, first of all—yes, this most definitely is a legal race with national security implications. So I'd like to pile on that statement.

As far as who should be in charge of oversight, I think the most important thing is that right now, none of the agencies proposed have the resources to appropriately oversee some of these activities. They don't have all the technical experts that are needed in these areas. They may have some. But I would like to say that AST has a very high concentration of space experts with a variety of backgrounds and expertise in this area, and it makes sense if you're going to give responsibility and you have to find extra resources to start with where that dense population already exists.

Senator CRUZ. Thank you.

Senator Markey.

Senator MARKEY. Thank you.

So let's go to what, briefly, each of you might think are standards that you think should be put in place domestically that then could be used as precedents for international standards that our competitors around the world would then understand that they would have to meet, because we were the leader? So let's just talk about—if each of you could just give us a couple of standards that you'd like to see, if we did legislate, put on the books.

Mr. RICHARDS. Sure. Well, I guess we can go in sequence.

Senator MARKEY. Sure.

Mr. RICHARDS. I mentioned maximum certainty with minimal regulatory burden. I mentioned a presumed or a deemed approval, and I think that's an important concept. When we go to whatever agency is selected to adjudicate this, we're not going as a commercial company asking permission. There should be a presumed right of commerce in space just like there's a presumed right of commerce in aviation. But that doesn't mean you don't have to file a flight plan.

So being transparent about what each of us wants to do in space is important to make sure we're not interfering with each other or somebody else, as Peter has said—

Senator MARKEY. So that should be a standard?

Mr. RICHARDS. That should be a standard.

Senator MARKEY. Another standard?

Mr. RICHARDS. Right. So non-threatening to any national security interest, number one.

Senator MARKEY. OK. Number one.

Mr. RICHARDS. Number two is not abrogating or threatening any of our international obligations under treaty. Number three is not interfering with ourselves or any other foreign activity in space.

Senator MARKEY. Thank you.

Mr. Marquez, international standards that we should set here domestically that you think would be important to have internationally.

Mr. MARQUEZ. Again, I'll concur with my colleague from Moon Express. I think that the irreducible standard here is one of non-interference, of non-harmful interference, in making sure that whatever we approve to do here in the United States is not going to interfere with our own actions, the actions of our government, and the actions of our friends and allies who are also signatories to the Outer Space Treaty, and even those that are not signatories to the Outer Space Treaty.

There are probably a few other technical things that would go into a specific review—

Senator MARKEY. Well, just give us a couple.

Mr. MARQUEZ. I think the ability to show that you can maintain positive command and control over your satellite and the ability to communicate with it so that it won't go awry and stray, those types of things. And then, again, like I said, filing a flight plan so that people know where you're going and the purpose of your mission, you know, the transparency in what it is that you hope to achieve in your activity.

Senator MARKEY. Mr. Gold?

Mr. GOLD. I think you will hear a lot of repetition, but national security interests, international treaty obligations, and non-interference, domestic or foreign, should all be reviewed. I believe another aspect that we need to pay attention to is if an agency generates a negative response to an application, the answer shouldn't be a simple "no", instead we need "yes, but" forcing an agency to explain to a company what it is that they need to do to try and get to yes, because just saying no really doesn't leave a lot of room for innovation or growth, and I think that is a problem that we have seen occur during remote sensing commercial licensing. I believe if you just take those simple values and put it into a light-touch, almost a registration-based regime, that it would function and function well.

And per the race discussion, this is a race—

Senator MARKEY. And that's all you would really expect from United Arab Emirates or from India? Is that what you're saying—the same kind of standard?

Mr. GOLD. Yes. I think UAE, in particular, has done an excellent job of establishing a common-sense approach that balances the

need for a secure environment and for non-interference, again, foreign and domestic, without being too heavy handed. Unfortunately, a lot of this doesn't lend itself to blanket solutions. Many of these issues need to be addressed on a case-by-case basis, requiring a policy that is sufficiently broad and flexible to handle that, and I think if the U.S. leads and joins other countries like the UAE, et cetera, we can see this develop as an international standard.

The last thing I would say is that, going back to the ITAR example, there can be crises or incidents that lead to bad policy and, currently, we are experiencing a smallsat revolution, with thousands of cubesats in orbit and many more to come. We just heard about the deployment with India of 100 or more cubesats in a single launch. That is why we need to get these rules in place in a manner that supports innovation, because we want that to occur, but balances it with the security of the environment in space.

Senator MARKEY. Colonel Melroy, let's deal with that question. India is launching, and they're doing things that we've never done. So what standards do you want to have set here that then we would say, "Well, these are what we believe are legitimate standards, India, or other Middle Eastern countries. What are you doing to meet these minimal standards that we think should be in place?" What are those standards, from your perspective, and how would we then, if we established them, ensure that Middle Eastern countries, India, then met them so that there was a certain rule of the road for outer space going forward?

Colonel MELROY. Thank you, sir. I think that's a wonderful question. I have to say that we've heard some less than flattering things about lawyers here. But, in my opinion, we need to get the engineers and the lawyers together, because these need to be technically based. The truth is that everybody has preferences for how they want other people to operate their satellites to the benefit of their own country. But if you don't have a basis, a safety or technical basis, that is actually going to generate mistrust, you know, "Why do you want me to do it that way?" So it's very, very important, I think, that we should use the universal language of physics.

Space is a unique domain. It's not intuitive the way it is to us here on the ground, in the maritime, and even the air domain. So really understanding the implications of what you're doing—a great example of that is you might think it would be a standard to stay a certain distance away from any given satellite. However, that's meaningless in low Earth orbit, as satellites might be passing each other in orbits that will never collide, ever, ever. On the other hand, they seem to be coming close to each other. So you really have to understand, actually, what's going on.

A better idea is that you have a passively safe orbit so that you won't collide with any other satellite until, if you decide to do a rendezvous, at the very latest practical moment, which is usually guided by the physics of the client's satellite. So those are the kinds of predictable behaviors that I think give us confidence that people actually have done the science behind what they're doing, and they're not going to collide with each other and generate debris.

Senator MARKEY. OK. What is your training, Colonel?

Colonel MELROY. An Air Force test pilot, sir.

Senator MARKEY. What was your major in college?

Colonel MELROY. Physics.

Senator MARKEY. I was wondering—physics. So you want us to abide by the rules of physics?

[Laughter.]

Senator MARKEY. There's the rule of law and the rule of physics.

Colonel MELROY. Exactly, exactly. I think they can be worked to be harmonized.

Senator MARKEY. Right, and lawyers and physicists can learn from each other a little bit about how, then, to put that into a useable form.

Colonel MELROY. Yes, Senator. Perfectly said.

Senator MARKEY. Thank you. Thank you so much for your service to our country.

Thank you, Mr. Chairman.

Senator CRUZ. Thank you, Senator Markey, and I would note for any skeptics in the hearing room that for those who don't believe in miracles, we've seen not one, but two witnesses on this panel defend lawyers.

[Laughter.]

Senator CRUZ. I suspect we may go many years in the Senate without that ever occurring again.

With that, I want to thank each of the witnesses for participating in today's hearing, both in the second panel and the first panel. I think it was a very educational and enlightening hearing.

It is the intention of this committee to go forward with legislation, seeking to create a system that incentivizes the investment and maximizes the potential for exploration in space. So I would extend an invitation to each of our witnesses and to other interested players in this arena. We are in the process of a multi-part series of hearings to learn, to study, and, hopefully, to come to consensus about how to create the best system of rules to provide certainty and maximize investment.

The hearing record for this hearing will remain open for 2 weeks. During that time, Senators are asked to submit any questions for the record, and upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible.

And with that, the hearing is now adjourned.

[Whereupon, at 4:23 p.m., the hearing was adjourned.]

A P P E N D I X

INTERNATIONAL INSTITUTE OF SPACE LAW
Paris—France, 24 May 2017

To: U.S. Senate Committee on Commerce, Science, and Transportation
Senator John Thune, Chairman
Senator Bill Nelson, Ranking Member

CC: U.S. Senate Subcommittee on Space, Science, and Competitiveness
Senator Ted Cruz, Chairman
Senator Edward Markey, Ranking Member

Subject: Letter for the record for the hearing on “Reopening the American Frontier:
Exploring How the Outer Space Treaty Will Impact American Commerce and Set-
tlement in Space”

Dear Chairman Thune and Ranking Member Nelson,

Founded in 1960, the International Institute of Space Law (IISL) is an independent non-governmental organization dedicated to fostering the development of space law. The purpose of the IISL includes the promotion and further development of space law and the expansion of the rule of law in the exploration and use of outer space for peaceful purposes.¹ As such, the IISL has a keen interest in the topics to be discussed at the hearing organized by your Subcommittee on May 23, 2017. We submit the following letter in support of the Subcommittee’s deliberations.

1. Status of the Outer Space Treaty

The Outer Space Treaty of 1967 was drafted and negotiated within the Committee on the Peaceful Uses of Outer Space (COPUOS), a body of the United Nations constituted in 1958 as subsidiary to the United Nations General Assembly. Meeting in New York and in Geneva, Switzerland, COPUOS and its Legal Subcommittee drafted the treaty in the mid-1960s amidst geopolitical tensions which threatened to spill over into outer space, a new realm of humankind’s exploration and use. The founders of the IISL participated in the drafting of this important instrument.

Then comprised of 28 states, COPUOS adopted the draft text of the treaty in late 1966, which was expedited to the United Nations General Assembly for inclusion in its Resolution 2222 (XXII) of December 17, 1966.² Signing ceremonies were held in Moscow, London, and in Washington D.C. at the White House. The Outer Space Treaty entered into force on October 10, 1967.

The Outer Space Treaty was quickly followed by a number of subsequent treaties on space, also negotiated and drafted within COPUOS with the direct involvement of IISL membership. These treaties clarified and expanded many of the major provisions of the Outer Space Treaty. The 1968 Astronaut Agreement expanded on Article V of the Outer Space Treaty. The 1972 Liability Convention expanded on Articles VI and VII of the Outer Space Treaty. The 1975 Registration Convention expanded on Article VIII of the Outer Space Treaty.

¹ Composed of individuals and institutions of more than 40 countries elected on the basis of their contribution to space law, the IISL is sister organization of the International Astronautical Federation (IAF) and the International Academy of Astronautics (IAA). With special consultative status to the United Nations Economic and Social Committee (ECOSOC), the IISL is an officially recognized observer at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and of two subcommittees, the Scientific and Technical Subcommittee, and the Legal Subcommittee; *see also* www.iislweb.org.

² Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, G.A. Res. 2222 (XVII), U.N. Doc A/RES/2222 (Dec.17, 1966), available at <http://www.un-documents.net/a21r2222.htm>.

As of 2017, the Outer Space Treaty has 105 states which have ratified the treaty.³ These include all of the major and historical spacefaring states such as the US, Russia, China, India, Brazil, Japan, and all the Member States of the European Space Agency (ESA). New and emerging space powers also often sign the treaty as a way to solidify their arrival in the community of serious spacefaring states. Additionally, a further 25 states have signed the treaty, which expresses their intention to ratify it in the future, or at least not to take actions which violate the intentions of the treaty.

2. Effects of the Outer Space Treaty

The Outer Space Treaty is an instrument of guiding principles that have served all aspects of the space sector successfully since inception. First granting space freedoms to explore and use outer space for peaceful purposes and the benefit of all mankind, the treaty's subsequent articles provide a framework denoting activities that are either permitted or prohibited in furtherance of those freedoms. Commercial space applications and activities have flourished in this legal environment. The framework relies upon responsible legislation promulgated at the national level by State Parties to the Treaty. The United States has shown leadership in this regard, enacting laws and regulations that are aligned with treaty obligations while constructively facilitating innovation.

Many significant accomplishments have been achieved within the parameters of the Outer Space Treaty. Benefits directly accrue to the space sector and all State Parties. However, because of the far reach of space applications and their intrinsic role in improved quality of life,⁴ all of humankind benefits from responsible behaviour in space. Withdrawal from the treaty could invite a number of undesired outcomes, including *inter alia* far greater uncertainty to the thriving private sector, or withdrawal by other State Parties, or loss of credibility in the international space community, or worse.

3. National Implementation of International Obligations

Article VI of the Outer Space Treaty creates the international legal responsibility of states to ensure treaty compliance with regard to the activities of their governmental agencies and non-governmental entities in outer space. Further, the activities of its non-governmental entities trigger a State's authorization and continuing supervision ("shall require"). This direct responsibility and liability for damage on the international plane for the activities of nongovernmental actors is absolutely unique in international law, and is the impetus for supervision on all nongovernmental actors in the space domain. Further, Article VI accountability has served the private sector, both in the United States and internationally, in providing a level of transparency, legal certainty, and responsibility in the development of space applications. The United States has maintained Article VI responsibility with the promulgation of a well-developed *res* of domestic law overseeing launches and re-entries, the telecommunications industry, and earth observation activities.

4. Conclusion

In conclusion, the International Institute of Space Law would like to recognize the Subcommittee's serious inquiry into the appropriate level of legislation necessary to maintain treaty compliance in furtherance of the United States' international responsibility while also fostering an environment of innovation. We further remind this Subcommittee of the lasting and fundamental importance of this foundational and visionary treaty governing the activities of States, and of the non-governmental actors they are responsible for, in the peaceful exploration and use of outer space.

Respectfully,

President of the International Institute of Space Law
Prof. Dr. Kai-Uwe Schrogl (Germany)

Vice-President of the International Institute of Space Law
Prof. K.R. Sridhara Murthi (India)

Treasurer of the International Institute of Space Law
Prof. Dennis Burnett (United States)

Executive Secretary of the International Institute of Space Law

³United Nations, Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Status of International Agreements relating to activities in outer space as at 1 January 2017, A/AC.105/C.2/2017/CRP.7 (2017) available at http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_22017crp/aac_105c_22017crp_7_0.html/AC105_C2_2017_CRP07E.pdf.

⁴Space applications will figure prominently in the achievement of the United Nations Sustainable Development Goals for 2030.

Prof. Dr. Diane Howard (United States)
Board of Directors of the International Institute of Space Law
 Prof. Dr. Setsuko Aoki (Japan)
 Prof. Dr. P.J. Blount (United States)
 Prof. Dr. Frans G. von der Dunk (Netherlands)
 Prof. Dr. Marco Ferrazzani (Italy)
 Prof. Dr. Steven Freeland (Australia)
 Prof. Joanne Irene Gabrynowicz (United States)
 Prof. Dr. Stephan Hobe (Germany)
 Prof. Dr. Mahulena Hofmann (Czech Republic)
 Ms. Corinne Jorgenson (United States)
 Dr. Martha Mejia-Kaiser (Mexico/Germany)
 Prof. Sergio Marchisio (Italy)
 Ms. Elina Morozova (Russia)
 Prof. Dr. Lesley Jane Smith (United Kingdom)
 Dr. Milton 'Skip' Smith (United States)
 Prof. Dr. Maureen Williams (UK/Argentina)
 Prof. Zhenjun Zhang (China)

LIFEBOAT FOUNDATION
 Minden, NV, June 5, 2017

Commerce, Science, and Transportation
 Committee Space, Science, and Competitiveness Subcommittee
 United States Senate
 Washington, DC.

To: U.S. Senate Committee on Commerce, Science, and Transportation
 Senator John Thune, Chairman
 Senator Bill Nelson, Ranking Member

CC: U.S. Senate Subcommittee on Space, Science, and Competitiveness
 The Honorable Senator Ted Cruz, Chairman
 The Honorable Senator Edward Markey, Ranking Member

Subject: Letter for the Congressional Record from the Hearing: "Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space"

Mr. Chairman, Ranking Member Nelson, and Members of the Committee,

STATEMENT FROM LIFEBOAT FOUNDATION

Extolling Global Leadership and New Space Opportunity

The Lifeboat Foundation is a non-profit organization dedicated to encouraging scientific advancements while helping humanity survive existential risk.

In June 2018 the UNISPACE+50 international conference will establish the Fourth International Dialog on the Peaceful Uses of Outer Space.

This UN based platform will celebrate the achievements of the original Outer Space Treaty since inception in 1967. The objective of the program is to evaluate changing conditions and identify potentials, within the advancing technological frontiers.

America's leadership influence may be placed at risk regarding the Geneva program for the 50th Anniversary of the Space Treaty. As there is no consensus from the multi-billion dollar New Space industries, it is essential to situate America for global space leadership through an open discussion based on opportunities, and not legislative restrictions. The time frame is immediate. This perspective includes a guiding political platform describing an innovative U.S. policy for leadership and international engagement. Cohesive national objectives need to be developed before the UNISPACE+50 conference takes place next June in Geneva. Developments such as the creation of associated agreement and regulatory frameworks for space-based issues, will be suitably upheld, and enabled through this motivated public initiative.

The space development paradigm is exponential and highly relevant: Topics that can be addressed within the UN auspices, will include national and global security platforms, space based information and communication technology (ICT) for global development, and global partnership for manned space venture and settlement.

Opportunities and interests are extensive: the transition to commercial launch, the achievement of space-based infrastructures, manned space settlements and the upcoming trips to Mars. This paradigm shift clearly demonstrates the need for not

only international engagement and inter-agency collaboration, but also for original public/private partnership dynamics. In this way we will create an optimal climate for the best peaceful global opportunities.

The current expectation is that the revisionary basis within the treaty umbrella will be addressed through the preparation of a number of rider and associated agreements. These types of negotiated agreements, unless inclusively orchestrated would normally take several years for placement. It is also apparent that U.S. policy might move ahead in advance of the UNISPACE+50 program, and position for a notable and extensive global leadership role.

Topics of national import, which are under consideration, will include the role of next generation and quantum communications, the establishment of a secure international cyberspace and the significant value of distributed ICT systems for global development, economic growth and new fiat currencies. This process will address the research and development phases and objectives of an incremental and collaborative space based architecture, along with the use of advanced and sensitive technologies. These issues may include hypersonic flight, the discussion for nuclear deterrence, and the global non-proliferation process, supporting the tenet of the original treaty.

The recommendation of Lifeboat Foundation is that a significant policy making potential can be readily assumed and brought forward by the U.S. administration ahead of the UNISPACE+50 conference in 2018. Innovative leadership at this early stage will greatly facilitate the many and forthcoming levels of engagement.

Lifeboat Foundation is currently making arrangements to bring forward an original forum dedicated to the establishment of U.S. space leadership for the international community. This event will be held at the United States Institute of Peace in Washington, D.C., sponsored by several member's of the U.S. Congress and Senate, non profit communities and commercial entities.

We invite your participation and support. In particular, we feel that time scales are very limited and that considerable problem solving effects, may be suitably provided, by looking towards the establishment of an expedient "short path" U.S. space policy platform. The present window of opportunity from June 2017 to June 2018 can best be utilized through a consolidated political front, which acknowledges both the immense value of U.S. technological export, and the opportunity represented by global collaboration and partnership.

We much appreciate the notable and ongoing discussion for the Outer Space Treaty, within U.S. Senate and Congress, especially in regard to the development of the nascent markets.

Sincerely

Eric Klein,
Lifeboat Foundation.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. BILL NELSON TO
JAMES E. DUNSTAN

Question. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer.

Thank you for allowing me to respond to your question above. You are correct that the United States can provide leadership internationally by establishing enforceable domestic norms and standards for space activities that other countries can follow that can result in either the establishment of customary international law, or provide the basis for new international agreements. These norms and standards can be broken down into four categories:

- 1) Ensure no violations of the key provisions of the OST;
- 2) Open coordination of activities between U.S. parties;
- 3) Tackling the orbital debris "tragedy of the commons;" and
- 4) Balancing priorities between exploration and use—and ensuring science isn't squeezed out.

Ensure No Violations of the Key Provisions of the Outer Space Treaty

Congress should enact a regulatory framework that ensures that all Americans abide by the provisions of the Outer Space Treaty—which, in turn, will encourage other countries to do the same, and thus protect U.S. interests. While I have argued that Article VI is not self-executing, there are other provisions in the OST that are self-executing:

- a) Space and celestial bodies are not subject to claims of appropriation by means of use or occupation (Article II);
- b) No placing of nuclear weapons or weapons of mass destruction in outer space (Article IV);
- c) No establishing military bases on the Moon or other celestial bodies (Article IV);
- d) Avoiding harmful contamination (Article IX); and
- e) Avoiding harmful interference (Article IX).

The first three are simple to implement in a future regulatory regime: just add these prohibitions as conditions to the issuance of any authorization/registration, and mandate instant revocation of the authorization/registration for any breaches of these prohibitions.

The last two prohibitions contained in the OST will require further clarification either through statute or regulation. Whichever agencies are granted jurisdiction to issue regulations will need to carefully define terms and develop standards in this area.¹

Harmful Contamination. The Treaty does not define the words “harmful” or “contamination”. This means Congress, the State Department and domestic regulators will need to wrestle with questions such as:

- “*What constitutes contamination?*” Is disturbing the surface of a Celestial Body² “harmful contamination”? If so, then the United States violated Article IX in landing six Apollo missions on the surface of the Moon—and Article I’s talk of the freedom to use and explore space would be meaningless.
- “*What constitutes harm?*” Is any change to a space environment a harm? Again, obviously not. The term “harmful” must involve some relative weight—but of what factors?
- “*Harmful to whom?*” Is the harm to the environment the standard, or does harm come into play only if the activity will harm future humans visiting the Celestial Body? There is an argument that this provision relates back to the “no nukes” provision in Article IV and that contamination must impact human activities.³ An alternative interpretation is that human *biological* contamination of Celestial Bodies must be limited so that such contamination not lead to “false positives” in the search for extraterrestrial life.⁴
- “*Contamination to what?*” Some argue that future visits to the Apollo sites must be limited or prohibited outright because to do so would contaminate these historical areas.⁵
- “*How non-contaminated must a mission be?*” NASA has interpreted the “no harmful contamination provision” to mean that its missions to Mars must guard against microbial contamination as well, limiting the presence of bacterial spores on any surface to no more than 300,000.⁶ (Obviously, this number reflects some kind of weighing test.) ESA, the European Space Agency, follows similar measures. Are those same measures appropriate for private missions, and appropriate regardless of the destination of the mission? Or should they be tailored to the context of the mission?

Whatever agency ends up processing mission authorization applications (or registrations) must be staffed with experts capable of crafting a balanced approach to “harmful contamination” that balances protection of the space ecosphere with the right to exploration and use of space and Celestial Bodies that is guaranteed by Article I of the OST.

Harmful Interference. Although often confused or conflated with harmful contamination, harmful interference relates to the activities of humans vis-à-vis each other in outer space (rather than the impact of human activities on the space environment). Article I implies this principle: “Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all states”—*i.e.*, without interference. And Article IX makes this principle explicit:

If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with ac-

tivities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.”

While the activities of nationals are specifically mentioned in the first clause,⁷ at its core, Article IX relies upon government-to-government diplomatic activity without the force of law. The United States could begin to establish international norms for adjudicating—and avoiding—interference disputes by:

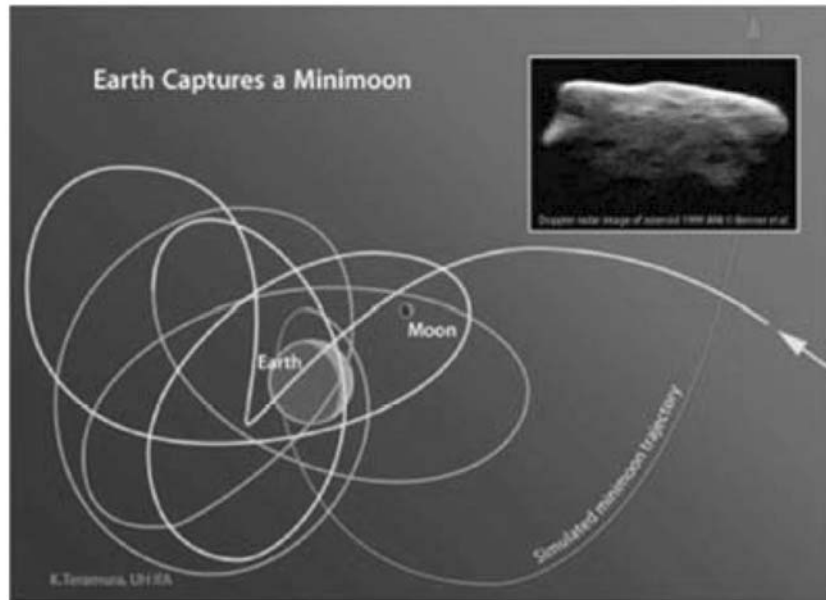
- a) Establishing a standard for defining “harmful interference.” Harmful interference should be limited to activities of one party that interrupt or impinge the operations of another party or cause actual physical harm to a space object that negatively impacts the operations of the second party. Harmful interference could also include radio frequency interference—as radio frequencies will be critical to any space mission. Congress should make clear that economic harm, absent a physical harm (radio frequencies, too, are issues of pure physics), does not rise to the level of harmful interference.
- b) Establishing basic interference parameters for U.S. domestic operations (*e.g.*, orbital distance separations, and lunar operations separation).
- c) Declaring that principles of terrestrial tort law apply to outer space operations, and establish jurisdiction in the Federal district courts to hear claims of interference between U.S. parties. Ultimately, the goal should be to promote tort law as the basis for resolving disputes between U.S. and foreign parties, as well—to have a single common law for space and a mechanism for resolving U.S.-foreign disputes that is more effective, faster and cheaper to use than the state-to-state coordination mechanism contemplated by Article IX. As much as any particular private U.S. company might like to have the weight of the U.S. government behind it to enforce its rights to a particular mission, such a heavy-handed approach (empowering the government to pick winners and losers) would be costly for the government to engage in, and simply not necessary given the well-established field of tort law.

Are there missions that should not be authorized simply because the “first mover” will preclude other users? For example, several geographic points at the lunar south pole are highly valuable. There appears to be only one good “down ramp” into Shackleton Crater, for example. Would the U.S. authorize a company to place a base on this down ramp with a concomitant interference-free zone that would preclude anyone else from using that down ramp—even if this meant giving that company an effective property right over the entire crater? Similarly, there are a few “peaks of eternal light” surrounding Shackleton Crater where operators would want to set up both communications and solar collectors. These areas are quite small, however, and multiple users might not be able to place installations there. How should such “prime real estate” be treated for non-interference purposes?

Open Coordination of Activities

In order to minimize “harmful interference,” Congress should require an open coordination of activities between space operators. This is already done by the FAA/AST when it comes to launch/reentry licenses (to ensure that objects are not launched into conflicting orbits) and by the FCC when it comes to spectrum use in outer space.⁸ Whatever regulatory regime is established for innovative space activities, the overseeing agency should require all operators seeking authorization or (as we have proposed) filing for registration⁹ to describe their planned mission with sufficient specificity to allow later operators to develop non-interfering mission scenarios. That agency should also be given the power to require that operators coordinate their activities so as to allow later operators to conduct activities in a non-interfering way, if possible. For example, an entity seeking authority to mine the volatiles at the south pole of the Moon should be required to coordinate those activities with later operators seeking authority to do the same thing. Similarly, an operator seeking to mine asteroids should be required to specify what asteroid is to be mined, and the method of resource extraction. That way, a subsequent operator could plan a similar mission accordingly (or determine that multiple mining operations on that asteroid are not feasible because of the size of the asteroid¹¹ or the method of harvesting the resources (*e.g.*, a “bag and blow” approach)).¹²

The difficulty with the coordination process, as the FCC’s experience has made clear, is dealing with the problem of “warehousing” a space resource. Consider this example:



Asteroid 2006RH120 has been “captured” by the Earth-Moon system and a mission in 2028 could rendezvous and land on it with a Delta-V of only 58 m/sec (*i.e.*, extremely small amount of thrust needed). 2006RH120 is only 2.3 x 7.4 meters, meaning that it is highly unlikely that multiple operators could mine it without interfering with each other. If Company A seeks authorization to mine the asteroid and specifies a 2028 rendezvous date, would that preclude Company B from seeking authorization to rendezvous with it in 2026 using a higher-energy/less efficient trajectory? What if Company B agreed that it would vacate the premises prior to Company A landing in 2028? What if the mission calls for a “bag and blow” approach such that there would be virtually nothing left of 2006RH120 by the time Company A arrives?

On-orbit servicing presents another example where open coordination is necessary. One person’s servicing satellite is another person’s ASAT: any vehicle with the capability to match orbits, rendezvous and dock with another object could easily be used to disable, destroy, and/or steal a satellite. Such operations must be conducted in such a manner that all space operators know where that servicing satellite is, and what it is doing, at all times.¹³

Regulations will need to be crafted to account for these types of issues. Ideally, authorizations would not be granted unless/until the entity can demonstrate that they can actually perform the mission. For satellites, the FCC has set up a system of “milestones” against which operators must purchase a bond which is forfeited in the event that the satellite is not timely launched. The complication here is that there is the added element of transit time for asteroid missions, where a later-authorized mission could beat a prior-authorized mission. Is the first-to-file applicant always the winner? Is that a rational approach if a later applicant can demonstrate that it can perform the mission sooner?

By adopting domestic legislation and regulations that establish a responsibility for operators to openly coordinate their activities as a norm, the United States can urge other countries to adopt similar standards—and, as proposed in my testimony, could effectively require adoption of similar standards as a condition of recognizing another country’s legislation as consistent with that of the U.S. in a system of interlocking domestic legislation modeled on the Deep Seabed Hard Mineral Resources Act of 1979. Coupled with the adoption of tort law concepts to interference, discussed above, this would go a long way toward eliminating instances of open conflict between innovative space operators.

Tackle the Orbital Debris “Tragedy of the Commons”

As Douglas Adams famously wrote in *The Hitchhiker’s Guide to the Galaxy*: “Space is big. Really big. You just won’t believe how vastly, hugely, mind-bogglingly big it is. I mean, you may think it’s a long way down the road to the chemist, but that’s just peanuts to space.” He wasn’t kidding.

The total area of the 800 kilometer orbital sphere¹⁴ encompasses 664 million square kilometers (or 411 million square miles) of area. Were the approximately 1000 currently operating satellites all bunched in this one orbit (which they obviously are not), each would have some 664,000 square kilometers (411,000 square miles) in which to operate.¹⁵ The mindset of many in the early years of spaceflight was that space was so vast that the likelihood of two objects actually colliding was so remote as to not be worth worrying about, and certainly not worth taking into consideration when planning space activities. This became known as the “Big Sky” theory of space operations.¹⁶ Recent debris generating collisions (both accidental and intentional) have demonstrated, however, that the days of the “Big Sky” theory are over—if the theory ever had any validity to begin with. Today satellites must operate in orbits that not only contain 1000 other operating satellites, but 50 years’ worth of rocket bodies, derelict satellites, the flotsam and jetsam created by on-orbit explosions,¹⁷ and even debris created by routine space deployment activities, where pieces just float away from a vehicle while deploying payloads or during normal operation.¹⁸

Finally, and most importantly, the orbital debris situation is not static. While a certain number of pieces of debris reenter the atmosphere each year, countries continue to launch vehicles and create more debris on a yearly basis. Yet this accounts for a relatively slow and somewhat manageable increase in orbital debris. This steady state ecosystem of junk is upset, however, whenever there is a major collision incident. On average, as discussed above, such incidents create between 2,500 and 3,500 new trackable pieces of junk. The fear, which is not yet predictable, is if such major collision events continue, there may be a cascade effect—“the Kessler Syndrome”—whereby collision events and new debris occur at exponentially increasing rates, creating huge clouds of debris and rendering certain orbits so dangerous as to be useless.¹⁹

The United States has taken a lead internationally on orbital debris mitigation, through the work done at NASA, as well as being a founding member of the Inter-Agency Space Debris Coordination Committee (IADC).²⁰ Any new regulatory regime should continue this leadership. The regime should also strive to consolidate, harmonize, and streamline regulations in this area. Currently, there are at least five separate regulatory regimes for orbital debris mitigation that, while all based on the NASA standards, nonetheless differ slightly in approach and reporting requirements.²¹ It is thus possible for a mission to have to submit multiple debris mitigation plans to different agencies.

Most important, the United States must take the lead in actually enforcing debris mitigation standards. The DoD routinely waives its debris mitigation guidelines for its launches, and the FCC has allowed Iridium to operate 10 of its satellites until they “run dry,” rather than requiring Iridium to de-orbit or move those satellites to a “graveyard” orbit.²² If the U.S. wishes to lead internationally in establishing norms and standards, then it must enforce its own regulations, before it can demand that the rest of the world also “gets tough” on orbital debris.²³

Finally, the United States must begin to establish norms and standards for orbital debris remediation (the actual removal of orbital debris). This could include a statutory declaration that any U.S. registered abandoned space object that poses a potential threat to space navigation can be removed, under maritime law concepts of “salvage and finds.”²⁴ The United States should also begin to explore ways of creating Public/Private Partnerships to incentivize the private sector to actively remove derelict space objects.²⁵ One possible source of funding for a “bounty pool” would be the approximately \$15 million annually the FCC collects in regulatory fees from satellite operators.²⁶ Any regulatory regime next adopted by Congress should direct the applicable agency to study private sector approaches to orbital debris remediation.

Balance Priorities Between Exploration and Use (ensuring science isn’t squeezed out)

Article I of the OST declares that outer space shall be free for both exploration and use by all nations. In the rush to encourage American businesses to continue to develop an outer space economy that will benefit all humanity (and increase the tax base of the United States), the United States cannot overlook or downplay the important role exploration will continue to play in outer space. As a species, we have only just begun to learn about our planet, our solar system, and the universe

we inhabit. The continued exploration of outer space, both by government actors and private companies, must be encouraged and protected.

Any new regulatory regime must act in a way that both encourages private sector “use” of outer space but also protects scientific “exploration.” We cannot repeat the mistakes the FCC made late in the last century of reallocating significant spectrum from space uses to terrestrial uses, simply because, at that time, there was less activity in space and a desire for more terrestrial services.²⁷ The relevant agency or agencies should be charged by Congress to incorporate the needs of the science community into any authorization regime. That is not to say that science can “veto” private activities in space: the science community must participate in the same open coordination process that will be required of private actors.²⁸

This is a critical standard to adopt domestically so that worldwide the important scientific exploration of outer space is protected—and, again, a requirement that could be a core part of a system of interlocking domestic legislation adopted by spacefaring nations piecemeal, without any need to re-open the Outer Space Treaty for negotiation or even to negotiate a new space law convention.

References

¹The contamination aspects of orbital debris are discussed separately below.

²The term “Celestial Body” also is not defined in the OST. There was some discussion at the time of the negotiation of the OST that Celestial Body should be defined to limit it only to natural objects in space that are not capable of being moved from their current orbits. See E. Fasan, *Asteroids and other Celestial Bodies Some Legal Differences*, 26 J. Space L. 33 (1998) (arguing that early space law writers and possibly the negotiators of the OST limited the definition of “Celestial Body” to include only the planets and major moons).

³It should be noted that prior to the OST negotiations, the United States had carried out “Project West Ford” (also known as “Project Needles”) in which the U.S. launched 480,000,000 1.78 cm long copper needles into near polar orbits at between 3,500 and 3,800 kilometers (2,200–2,400 miles) to determine whether an artificial ionosphere could be created such that radio waves could be bounced off the needles allowing for long distance (over the horizon) radio communications. International scientists objected to the mission, fearing that the needles would negatively impact astronomy programs. Many legal scholars point to Project West Ford as the catalyst for the consultation requirements of Article IX, but tie that provision to the non-interference language of Article IX, *not* the no harmful contamination provision. See, e.g., D. Terrill, “The Air Force Role in Developing International Space Law,” Air University Press, 1999, available at https://media.defense.gov/2017/Apr/07/2001728438/-1/-1/0/B_0069_TERRILL_OUTER_SPACE_LAW.PDF (last visited 6/22/17); see also J. Gabrynowicz & S. Langston, “A Chronological Survey of the Development of Art. IX of the Outer Space Treaty,” Special Topics in Aerospace Law Series, no. 3, a Supplement to the Journal of Space Law, available at <http://www.spacelaw.olemiss.edu/resources/pdfs/article-ix.pdf> (last visited 6/22/17).

⁴See M. Williamson, “A Pragmatic Approach to the ‘Harmful Contamination’ Concept in Art. IX of the Outer Space Treaty,” 5th Eilene M. Galloway Symposium on Critical Issues in Space Law, December 2010, available at: <http://www.spacelaw.olemiss.edu/events/pdfs/2010/galloway-williamson-paper-2010.pdf> (last visited June 13, 2017).

⁵See “NASA’s Recommendations to Space-Faring Entities: How to Protect and Preserve the Historic and Scientific Value of U.S. Government Lunar Artifacts,” Released July 20, 2011, available at: https://www.nasa.gov/pdf/617743main_NASA-USG_LUNAR_HISTORIC_SITES_RevA0508.pdf (last visited June 13, 2017).

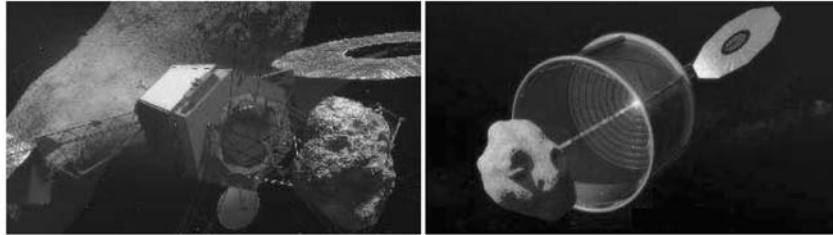
⁶See https://mars.nasa.gov/mer/technology/is_planetary_protection.html (last visited June 13, 2017).

⁷Some space law scholars argue that private activities are only addressed in the first clause of Article IX, and that private citizens have no right to petition their governments to complain about an activity that might interfere with that private citizen’s space activities. See <http://groundbasedspacematters.com/index.php/2017/03/31/the-non-interference-provision-of-article-ix-of-the-outer-space-treaty-and-property-rights/> (writings of Laura Montgomery, last visited June 13, 2017).

⁸See, e.g., proposed Order In the Matter of WorldVu Satellites Limited (OneWeb), available at http://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0601/DOC-345159A1.pdf (last visited June 13, 2017) (requiring operators of NGSO systems to coordinate their operations and frequency usage to allow for the flying of multiple constellations of satellites).

⁹TechFreedom has previously advocated for a “Mission Registration” approach rather than the “Mission Authorization” approach advocated for by the Obama Administration in response to Section 108 of the CSLCA. For the purposes of this section, the type of regulatory regime is not critical to this analysis.

¹¹Only one operator might be able to mine a small asteroid as depicted below in this NASA concept image.



¹²One approach, depicted above in a NASA concept image, is to capture the asteroid in a bag and then blow it up to extract the resources, again, making it virtually impossible for two entities to mine the same asteroid.

¹³For example, in the proposed WorldVu order, *supra* note 8, the FCC is proposing to require that OneWeb publish the orbital parameters (ephemeris data in two-line orbital element format) at least once every three days. Similar regulations could be adopted requiring any on-orbit servicing mission to publish in near-real time the orbital parameters of their service vehicles and any intended altitude or plane changes.

¹⁴The 800 kilometer orbit was chosen for this calculation because it is considered one of the more crowded orbits.

¹⁵This calculation is a significant oversimplification since in addition to assuming that the approximately 1000 operating satellites all occupy the 800 kilometer orbit, the calculation assumes that all are exactly orbiting on the surface of a perfect sphere 800 kilometers above the mean surface of the Earth (and hence 7271 kilometers above the center of the Earth). Therefore, it only calculates the square kilometers surface area of the sphere. Since satellites don't operate at exactly the same orbital altitude, even within a designated orbit, and since orbits aren't entirely circular (the apogee—or high point—of an orbit is usually slightly different than the perigee—or low point), to be more accurate the calculation should be made using a three dimensional slice of sphere centered around 800 kilometers above the surface of the Earth, making the amount of “Big Sky” surrounding each satellite appear much larger. However, what also makes the calculation incorrect is the assumption that somehow all of satellites are flying “in formation,” while in reality, they are orbiting in a variety of directions (predominately West to East, North to South (polar) or South to North (polar)), such that their orbits cross each other.

¹⁶The origin of the term “Big Sky” is unknown. Most likely it comes from aviation traffic modeling where the assumption is that two randomly flying bodies are unlikely to collide because of the size of the three dimensional space in which they operate. The earliest reference this author can find to such a theory applied to space is the SURVEY OF SPACE LAW, STAFF REPORT OF THE SELECT COMMITTEE ON ASTRONAUTICS AND SPACE EXPLORATION, H. R. DOC. NO. 89, 86TH CONG., 1ST SESS., at 7 (1959) [hereinafter SURVEY OF SPACE LAW] (where Dr. John P. Haden, the director of Project Vanguard is quoted as saying “space is a very big area”).

¹⁷Between 1961 and 1995, for instance, 124 fragmentation events were cataloged. See Office of Science and Technology Policy, *Interagency Report on Orbital Debris*, 12 (Nov. 1995), available at <http://orbitaldebris.jsc.nasa.gov/library/references.html>.

¹⁸One of the earliest and most publicized pieces of space debris was NASA astronaut Ed White's glove, which he lost on the first American spacewalk during the Gemini 4 flight (June 3, 1965). See National Aeronautics and Space Administration, *Gemini 4*, <http://nssdc.gsfc.nasa.gov/nmc/masterCatalog.do?sc=1965-043A> (last visited Sept. 12, 2013). Fortunately, the Gemini 4 capsule was orbiting at a relatively low altitude (166 x 290 km orbit), such that the glove reentered the atmosphere within a month. For a look at eight interesting (tagged as “weird”) pieces of orbital debris, see Clara Moskowitz, *Lost in Space: 8 Weird Pieces of Space Junk*, WIREd (Feb. 13, 2013), <http://www.wired.com/wiredscience/2009/02/spacestuff/>.

¹⁹The “Kessler Syndrome” is named after (and not directly by), retired NASA engineer Donald J. Kessler. According to Kessler, the term was coined by a colleague, John Gabbard, a NORAD analyst. See Donald J. Kessler, *The Kessler Syndrome* (Mar. 8, 2009), <http://uebpages.charter.net/dkessler/files/KesSym.html>. See also Donald J. Kessler & Burton G. Cour-Palais, *Collisional Frequency of Artificial Satellites: The Creation of a Debris Belt*, Paper 8A0210, 83(A6) J. GEOPHYSICAL RES., 2637 (June 1, 1978); Donald J. Kessler, *Collisional Cascading: The limits of population growth in low earth orbit*, 11(12) ADVANCES IN SCIENCE RES., 63–66 (1991). See also James Rendleman, *Space Traffic Management—Private Regulation*, in PROC. OF THE AIAA SPACE 2012 CONF. & EXPO., n. 6, AIAA 2012–5124 (Sept. 2012), <http://arc.aiaa.org/doi/abs/10.2514/6.2012-5124>. For a fascinating PBS interview with Donald Kessler about orbital debris and the “Kessler Syndrome,” see <https://www.youtube.com/watch?v=LaKz8VDkDkI> (last visited June 15, 2017).

²⁰<http://www.iadc-online.org/>.

²¹Compare, 14 C.F.R. § 417.129 (FAA/AST orbital debris mitigation standards for launch/re-entry); 47 C.F.R. § 25.114(d)(14) (FCC regulations on orbital debris mitigation for satellites); 15 C.F.R. Part 960, Appendix 1: C (NOAA remote sensing orbital debris requirements; NASA–STD–8719.14A (74 pages), which puts into effect NASA Procedural Requirement 8715.6, and includes reference to NASA-Handbook (NASA–HDBK) 8719.14 (NASA orbital debris mitigation guidelines); DoD Directive 3100.10 (Space Policy), 2012; DoD Instruction 3100.12 (Space Support), 2000 (DoD guidelines on orbital debris mitigation).

²²See Iridium Constellation LLC, DA 14–1118, released July 31, 2014.

²³For example, in 2002, ESA launched Envisat, an 8,000 kilogram Earth observation satellite into the highly crowded 790 km polar orbit. At 26 meters x 10 meters, by 5 meters, it is one

of the largest satellites orbiting Earth. It had an expected operational life of five years, but ESA continued to operate it for an additional five years. In April of 2012, ground controllers lost contact with the satellite. Although being operated well beyond its expected operational life, no efforts were made to deorbit the satellite, move it to a safer orbit, or safe the fuels and batteries onboard. It is estimated that the satellite will remain in orbit, and a danger to space navigation, for between 100 and 150 years. ESA's response to why nothing was done to prepare Envisat for its inevitable end of life? According to one report, "ESA officials insist that the international guidelines on disposal of debris were not in force when Envisat was designed." See Peter B. de Selding, "Envisat to Pose Big Orbital Debris Threat for 150 Years, Experts Say," SPACE NEWS (July 26, 2010), at 1, <http://www.spacenews.com/article/envisat-pose-big-orbital-debris-threat-150-years-experts-say>.

²⁴For a fuller discussion of the application of the laws of salvage and finds to outer space, see J. Dunstan, "Space Trash: Lessons Learned (and Ignored) from Space Law and Government," 39 J. Space Law 23 (2013).

²⁵For one approach to a "bounty system" for orbital debris, see J. Dunstan and B. Werb, *Legal and Economic Implications of Orbital Debris Removal: A Free March Approach*, presented at the International Conference on Orbital Debris Removal hosted by DARPA, December 8–10, 2009, available at: <https://spacefrontier.org/wp-content/uploads/2009/12/Legal-and-Economic-Implications-of-Orbital-Debris-Removal-A-Free-Market-Approach.pdf> (last visited June 16, 2017).

²⁶See *Assessment and Collection of Regulatory Fees for Fiscal 2017, Notice of Proposed Rulemaking*, FCC 17–62, p.22 (released May 23, 2017). This annual regulatory fee is in addition to substantial application fees operators have to pay the FCC to receive licenses.

²⁷See J. Dunstan, *Earth To Space—I Can't Hear You: Selling Off Our Future To The Highest Bidder*, Proceedings of the Thirteenth Space Studies Institute/Princeton Conference on Space Manufacturing, 1997.

²⁸Coordination between space telecommunications uses and radio astronomy provides a good example of how the needs of science can be accommodated at the same time private enterprise is allowed to operate in space. See *WorldVu Draft Order*, *supra* n. 8, ¶10 (reminding OneWeb of its obligations to coordinate with the radio astronomy community).

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. BILL NELSON TO
LAURA MONTGOMERY

Question. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer. The norms that the United States should establish domestically to promote commercial activity should recognize private property rights and protect the activities of commercial operators from interference by others.

Property rights: Article II of the Outer Space Treaty does not prohibit commercial or private ownership of land or extracted resources. Instead, it is silent regarding commercial interests, and directs its prohibition on appropriation at "States Parties." Property rights serve as an incentive to investment. Without property rights and recognized title, a person cannot offer land as collateral on a loan or to obtain financing. Investors are more leery when there is no means of securitizing an investors' interests, and the operator itself is hampered in its ability to plan if it does not know that the property it is using and, hopefully, going to be spending decades on, will remain under its control. Accordingly, the United States should figure out a way to recognize property rights extraterrestrially.

Interference and safety: Although commercial progress on reaching celestial bodies is still not very far along, orbital activities show how the U.S. is already a leader in seeking to avoid interference between spacecraft. U.S. Government practice and regulatory codes direct spacecraft to avoid collisions with other spacecraft and to prevent the generation of orbital debris. It is probably premature to worry about interference between commercial operators yet on celestial bodies.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. BILL NELSON TO
MATTHEW P. SCHAEFER

Question. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer. Domestically, the U.S. space industry and U.S. Government should begin discussing standards to meet some key Outer Space Treaty (OST) obligation terms, such as harmful contamination in OST Art. IX. The U.S. State Department took the position in the recent Moon Express payload review that COSPARS standards do not create a floor for what will be compliant with OST Art. IX. In other words, COSPARS standards created in a scientific era are not the standards that need be complied with in a new commercial era. There is significant flexibility in how to define harmful contamination. Commercially-friendly standards, even ones create by

industry groups, can be deferred to, as long as those standards do not stray from the treaty terms properly interpreted under the well-established rules of treaty interpretation codified in the Vienna Convention on the Law of Treaties, Art. 31 & Art. 32. Those interpretation rules place primary emphasis on the ordinary meaning of the terms of the treaty, and in this case lend themselves to significant flexibility in interpreting the term harmful contamination. If the United States industry comes to agreement on a standard, and that standard does not conflict with international obligations, then the U.S. Government, together with industry, can seek to promote those standards internationally. Congress can require deference to industry standards by the Executive Branch when delegating on-orbit authorization authority to the Executive Branch. Congress can also encourage exportation by the Executive Branch of those standards internationally.

The U.S. industry and government may also wish to discuss standards on what constitutes harmful interference, but may wish to wait on developing too rigid of standards in this area until experience under actual cases is gained. The United States successfully internationalized (exported) its debris mitigation principles that now find reflection in the IADC and UNCOPUOS principles. Such exportation of standards and guidelines is eased when the United States shows good-faith respect for international obligations. Congress' codification of the United States' long-standing OST interpretation allowing for property rights in extracted resources in 2015 (Public Law 114-90) in a manner that acknowledged and respected U.S. international obligations is an example of establishing interpretations and principles in a manner that increases and maximizes the chances of bringing other countries onboard with commercially-friendly interpretations and principles to the benefit of U.S. space companies.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BILL NELSON TO
PETER MARQUEZ

Question 1. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer. Background.

The norms and standards set by the United States will have a profound impact on how the rest of the world reacts to commercial space activities. As history has indicated, the United States Government's approach to implementing its obligations under Article VI of the Outer Space Treaty in relation to highly innovative private space activities will influence the approach of the 100+ other Parties to the Treaty.

The Treaty lays out some basic rules of the road for all actors in space, public or private. National implementing legislation is the necessary connection between international law and private space operators. To maintain this continuity across all space activities, and to preserve the global competitiveness of the commercial space sector, it is imperative that the United States Government impose no more than is legally necessary to ensure conformity with the provisions of the Outer Space Treaty.

Recommendations

First, I urge Congress to distinguish between measures that are legally required to implement the United States' obligations under the Outer Space Treaty, and those that are intended to further public policy interests.

Policy-driven measures that would constrain private space activity must be carefully weighed against cross-cutting public policy interests in opening up entirely new space-based economies, with its tremendous potential for job creation and improvements to quality of life.

As a former national security professional, I am well aware that the United States' national security interests may, in some cases, counsel for specific conditions on private space activities. It is imperative that any such conditions, and the process for evaluating commercial space activities in light of U.S. national security interests, be narrowly tailored—limited to major, specific national security threats, with procedural safeguards built in that prevent an endless and opaque review process that kills innovation, destroys investment, and cedes commercial innovation and technological development to non-U.S. actors. In this connection, we see elements of the recently introduced American Space Commerce Free Enterprise Act, H.R. 2809, as a step in the right direction.

Measures to implement the United States Treaty obligations must be narrowly tailored to require no more than legally necessary for Treaty compliance. In this regard, we are encouraged by features of H.R. 2809, building in definite time tables,

a presumption of approval, and authorizing only such conditions as legally necessary to ensure conformity with the Outer Space Treaty.

Second, it is imperative that regulators not get too far ahead of the technologies and capabilities of the coming generation of commercial space activities, attempting to regulate based on their best guess of how technologies and activities will unfold. The government is not well placed to make informed guesses, and in many cases the commercial space sector will find the optimal technical solutions through a process of experimentation. This is an essential piece of our industry's innovation engine, and there is an ever-present risk of regulators inadvertently forcing sub-optimal technical choices.

Third, the United States should promote the foundational elements of the Outer Space Treaty as the key norms and standards for all international actors to follow and domestically enact, especially in accordance with Article VI. Key among them are the protections from harmful interference. We believe that it is in the best interest of all Nations to preserve the right of all actors to operate in space free from harmful interference from other activities.

Regulatory Approach. Col. Melroy's testimony describes a regulatory approach where a few very high-level, performance-oriented requirements are complemented by industry standards that contain the details.

Question 2. Could each of you please comment on whether such an approach would make sense for providing U.S. Government oversight and regulatory certainty for emerging commercial space activities that are not covered under existing regulations? And what should the role of government agencies be in, if any, in developing industry standards for commercial space activities?

Answer. Recommendations.

As the Outer Space Treaty lays down general principles, rather than specific requirements, there are many paths to conformity with each provision. Which path is commercially feasible (or optimal) will only become clear as capabilities near or mature.

In many instances, private operators are much better placed to know the optimal means of complying with these broad principles.

Therefore, industry should be proposing means of meeting OST principles, and Government confirming conformity with the treaty, rather than a top down approach.

The Government has a role in publicly supporting these industry standards, with particular emphasis placed on supporting these standards in international discussions-bilaterally or multilaterally.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BILL NELSON TO
MIKE GOLD

Question 1. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer. The U.S. should support an efficient and effective regulatory approach that meets Article VI obligations while ensuring that American commercial space activities avoid causing harmful interference with domestic or foreign operations. A process should be established that encourages innovation and investment while still protecting the safety of the environment in orbit and beyond. Moreover, the U.S. should set an example by continuing to involve the private sector in standard setting activities via Federal Advisory Committees and initiatives such as the DARPA Consortium for Execution of Rendezvous and Servicing Operations ("CONFERS") program.

Regulatory Approach. Col. Melroy's testimony describes a regulatory approach where a few very high-level, performance-oriented requirements are complemented by industry standards that contain the details.

Question 2. Mr. Gold and Col. Melroy, what improvements are needed in space traffic management to enable expanded commercial activity in space?

Answer. The U.S. Air Force has done a superb job of supporting the private sector with collision avoidance data. However, the Air Force and Department of Defense ("DoD") are justifiably concerned with the amount of time and resources that have gone into such activities. The DoD should be allowed to remain focused on core national security responsibilities and has expressed the need for a civil agency, focused on safety, to step in and provide the private sector with potential conjunction warnings and related information.

A pilot program for FY 2018 is being established for the DoD to work with the FAA Office of Commercial Space Transportation ("FAA AST") to play this role. Via

a partnership with the DoD, the FAA AST will begin the process of developing and demonstrating a system for sharing data with commercial entities while still providing robust protection for classified information. Moreover, the FAA AST will leverage innovative capabilities being developed by industry and academia to further enhance the existing U.S. Space Catalogue. The FAA AST hopes to combine all of this with a customer service-oriented approach emphasizing transparency, accuracy, and efficiency.

If this demonstration is successful, the FAA AST can ensure that the private sector receives space traffic management information in a timely and easily accessible manner. This will allow commercial space activities to survive and thrive, while freeing the DoD to focus on its core national security mission.

Regulatory Approach. Col. Melroy's testimony describes a regulatory approach where a few very high-level, performance-oriented requirements are complemented by industry standards that contain the details.

Question 3. Could each of you please comment on whether such an approach would make sense for providing U.S. Government oversight and regulatory certainty for emerging commercial space activities that are not covered under existing regulations? And what should the role of government agencies be in, if any, in developing industry standards for commercial space activities?

Answer. I believe the approach described by Col. Melroy is sound. Unlike mature industries, such as aviation, many emerging commercial space activities are so new that only the companies themselves have a comprehensive understanding of their systems. Moreover, emerging commercial space activities vary widely in nature and scope. Therefore, while it's possible and proper for the U.S. Government to establish high-level requirements, industry should develop the relevant details. This process has already been initiated via efforts supported by the Commercial Space Transportation Advisory Committee ("COMSTAC") and the Commercial Spaceflight Federation.

Beyond providing high-level, performance-oriented requirements, the U.S. Government has an important role to play in supporting and facilitating standards development. Many emerging space companies are run on a relatively tight budget and their personnel have limited time that can be dedicated to regulatory efforts and discussions. Consequently, the U.S. Government should provide funding and support personnel for standards development to ease the burden on private sector companies. For example, via the COMSTAC, the U.S. Government helps to provide a framework and some personnel support for standards development and regulatory discussions.

Another example of a constructive role that the U.S. Government can play is the previously referenced DARPA CONFERS program. Under CONFERS, DARPA is sponsoring the creation of a "secretariat" that will support standards development involving both domestic and foreign entities. DARPA will provide funding to this secretariat, which will be operated by a nongovernmental organization. As the secretariat and field of satellite servicing evolves the government funding and support will be phased out. CONFERS presents an attractive model for the role of the U.S. Government in standards development that, if successful, could be replicated to address additional issues and activities.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BILL NELSON TO
PAMELA A. MELROY

Question 1. What are some of the norms and standards that we should be establishing domestically in order to promote the types of international norms and standards that would be conducive to commercial activity in space?

Answer. There is an urgent need for norms and standards around certain activities in space operations—specifically, those that involve risk. A great example of how this can be successful can be seen in the NASA orbital debris mitigation standards, which began organically at NASA and then were adopted by the U.S. Government; all or most of those standards have been adopted internationally. They were successful for several reasons. First, they addressed a universal safety issue. Second, they were reasonable and had a path to be achieved without serious financial burden. Third, they were technically based. These are all important criteria to be considered for the future.

FAA AST has already published some guidelines relative to commercial human spaceflight that will be very helpful going forward, and their advisory group COMSTAC is working on others related to launch safety. Other safety-based standards and norms could include rendezvous and proximity operations (such as the CONFERS effort being funded by DARPA and NASA), docking and refueling, and

even standard liability clauses for spacecraft servicing contracts. Examples of standards include the use of passively safe orbits (meaning that if there is a communications failure, the spacecraft will pass by each other and not collide) until as late as practical in the docking timeline; the use of grounding features during spacecraft refueling to avoid the buildup of electrical current and attendant hazards; and notification of intent for cooperative rendezvous to a space traffic management organization. In some cases hardware standards can be very helpful—for example, in the shipping industry certain standards at ports make it possible for all ships to dock and be serviced.

Question 2. Mr. Gold and Col. Melroy, what improvements are needed in space traffic management to enable expanded commercial activity in space?

Answer. Today, we do not truly have space traffic management—we have Space Situational Awareness (SSA) with monitoring and notification of potential conjunctions. First, an organization must be identified which has both the technical capability and the resources to provide the full range of services—surveillance, monitoring, notification, and regulatory authority to punish bad actors.

We must also increase the tempo of information to improve accuracy; today a dozen exquisite certified sensors are used by the Air Force to track objects in space, but repeat observations can be days apart, which greatly decreases the accuracy of the orbital track. Recently there have been major strides made by commercial entities such as COMSPOC in gathering less exquisite data from many sensors around the world—commercial, academic, and government—and blending them together for more rapid and accurate observations. At this time, the Air Force's JSpOC and National Space Defense Center (formerly JICSpOC) are currently exploring opportunities to use this commercial Space Situational Awareness (SSA). The civil government entity responsible for space traffic management should be closely coordinating with the Air Force to encourage this new space industry and take advantage of the lower cost, higher tempo data that commercial SSA provides. Government organizations should also coordinate how they purchase and use this data to help industry optimize the business model.

Next, we must use advanced technology to reduce the cost of these activities which are labor-intensive and largely manual today. More (and better) SSA data—even if it is less expensive—means that much greater levels of automation will be needed, and special tools for big data analysis. These automated features can simplify conjunction notifications as well.

Finally, as the commercial launch (and recovery) services industry continues towards higher ops tempo, we will begin to find our air traffic system increasingly stressed in order to clear wide swaths of airspace for launch and landing activities. Integration of air and space traffic management will be essential to allow spacecraft to safely launch through busy air routes on schedules that are commercially viable. Spectrum may play a connected role in this integration as the use of transponder frequencies allotted to aircraft users may be needed for spacecraft that are launching.

Question 3. Col. Melroy, what are the benefits of the existing Outer Space Treaty regime for our commercial, civil, and national security space interests?

Answer. The major benefit of the existing Outer Space Treaty is that it is better than nothing. Based on recent agreement attempts such as the Code of Conduct, I am concerned that if we attempted to re-negotiate the treaty, it would likely fail or at least take many years. When we open up re-negotiation, we weaken the overall commitment to this one agreement with the force of international law. The current treaty does not prohibit anything we want to do which makes it a good starting point.

The other benefit is that the Treaty is based on principles rather than being prescriptive. This provides flexibility. While it was not written with today's changes in national security or the expanding commercial environment in mind, we can tailor the principles individually through standards and other agreements for specific sets of activities. In fact, it's urgent that we do so, and the State Department should be forwarding this goal at UN COPUOS with the support of Congress and departments and agencies.