THE OPENNESS PRINCIPLE IN MULTILATERAL AGREEMENTS FOR SPACE EXPLORATION

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ABSTRACT

The 2006 release of NASA's new Vision for Space Exploration, including the Lunar Architecture program, represents a step forward for the human exploration of Mars. To that end, the NASA Global Exploration Strategy was a significant first step toward developing a model of global participation, but it falls short in terms of the global cooperation and international joint ventures that will likely be necessary given the funding and technological needs required for a decade-long program to put humans on the Martian surface. With US national funding commitments to the space program constrained by domestic and international funding priorities and with the potential for cost overruns over long time-scales and multiple political administrations, any real potential for human exploration of Mars will likely require international cooperation.

The NASA Global Exploration Strategy involved NASA asking the world's thirteen space agencies and a variety of experts about their visions of space exploration, including priorities for research, but did little to form a coherent international agenda. Rather than a go-it-alone approach, a first priority for the NASA

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Vision for Space Exploration program should be the establishment of an international space partnership.

This international space partnership should include a multilateral agreement between the participating states to establish policies for levels and types of participation, information sharing, handling dual use technologies, remote sensing, and the allocation of legal liabilities. This Agreement would have the principle of openness at its core. While a pragmatic multilateral agreement would build upon both the common and civil law traditions, it would be based on a broad vision of contract as a way of establishing clear boundaries and obligations between signatories.

As clear and transparent contracts often make for the best relationships between signatories and, as multilateral agreements may sometimes have a normative, aspirationial character to them, we propose that any such Agreement be guided by a principle of openness. The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

A multilateral agreement will have to cover potential problem areas concerning the ways and means of getting to Mars, such as technology research and development, cost sharing, potential environmental degradation and protection, and security concerns. We must also consider the possibility of discovering new and valuable Martian resources – requiring clarity between the domestic private property regimes and public resource and environmental stewardship for the planet, which should include developing nations that would otherwise not have the standing to participate.

I. INTRODUCTION: MULTILATERALISM DEFINES THE 21ST CENTURY

As Earth citizens commence the launching of space platforms and lunar bases and become a space-faring civilization in the higher frontier, such exploration will require an international legal framework that embodies the principle of the free and open use of the outer space environment and its planetary bodies. Exploring Mars, the most immediately feasible of

Earth's planetary neighbors and likely the first target of human space exploration beyond the moon, will require multilateral agreements for all levels of the expedition, from the Space Transport Multilateral Agreement we propose here to agreements that set forth environmental policies and property and resource allocation regimes on extraterrestrial bodies once humans land on them.

The way to think about openness and transparency in international agreements is as a way of creating good research relationships. With the Chinese government considering a human settlement on the Moon and strong evidence of the existence of water on or beneath the Martian surface seemingly everyday, we may be heading into what is potentially a new space race. What this new space race has as its underlying concern remains to be seen, but recent saber-ratting suggests that at least a portion of the missions, whether Chinese, American, European or Russian have military and strategic aims. Dual-use technologies, those that can be used for both research and military aims, such as remote sensing technologies, rocket boosters and launch platforms, tracking and positioning technologies, etc., foster uncertainty between nations – one may declare publicly a scientific research agenda while clandestinely building military capability. No player being able to trust any other player, leads to a go-it-alone philosophy that has the potential to damage the major scientific research goals of interplanetary exploration – international cooperation would likely relieve single player budgetary pressures, reduce research replication and amplify scientific knowledge.

At the outset of this new space exploration, with greater technological prowess, new financial incentives in the private sector and increasing economic feasibility of space-based activities, we must build on the United Nations' conventions and international treaty regimes governing local space activities and create a "law of space" that will govern both the relatively local near Earth orbit and more far-reaching space exploration. Increasing activity in the private sector, conjoined with increasing military concern for space-based technologies, encourages an even greater need to create a set of rules that will govern how and for what purposes space may be used.

Conceptualizing a law of space requires two levels of analysis: on the one hand, it entails the creation of a working set of agreements and doctrines regulating the activities of spacefaring nations in the areas outside of the planetary airspace by creating enforcement mechanisms and rules for information gathering, liability allocation, property rights and environmental protection. This type of legal regime governs the relatively mundane legal and physical realities of space activities: objects move, information is gathered and transmitted, resources may be discovered, property may be owned, contracts may be entered into and torts may be committed; for this space we must create agreements pertaining to the relationships between planetary support staff for how to govern interactions outside the atmosphere.

On the other hand, at a time when space travel and exploration are becoming a greater reality and as environmental and economic problems plague the Earth and set the human imagination looking outward for new possibilities, conceptualizing a law of space creates an opportunity for futurist thinking – rational problem-solving for challenges that have not yet become reality. The citizens of Earth have an opportunity to use their own historical frames of reference to create a legal regime based on the knowledge they have gained from the practice of the rule of law on Earth. At a crossroads, as near Earth space is becoming a valuable economic resource, Earth citizens must decide whether to allow the private sector to set the regulatory and policy agenda for ever-expanding exploration – the search for resources – or to foster a regulatory agenda that benefits humanity as a whole by providing opportunities for joint exploration, research partnerships and information gathering – the search for knowledge.

Thinking through such a legal regime puts a series of difficult questions to citizens of the Earth given wealth disparities between nations, trade gulfs, multinational corporate agendas, environmental damage, resource depletion, treaty regime enforcement, and liability allocation: who should set the rule-

agenda? Who should benefit from exploration and discovery? Who should bear the costs and the risks?[1]

A law of space also gives an opportunity for humans to ask other important political questions as though they were behind the Rawlsian veil of ignorance:[2] what environmental laws would we create if we had a pristine world in and for which to create them? How would we allocate property and resources? How would we ensure that all are protected by distributive justice concerns? How would we develop in a smart and coherent manner that best benefits all while still providing incentives for each?[3]

We take a human mission to Mars as an example of the next steps in space exploration, in part because it is increasingly on the exploration agenda and in part because of the recent strong evidence of flowing water upon and below the surface of the planet.[4] The development of a set of Multilateral Agreements is a necessary first legal step for a manned mission to Mars. Useful Agreements will need to address technology transfer, information sharing, environmental management, and equipment and mission costs.

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[1] These questions are variations of the classic political theory questions: who decides? For whose benefit? At whose expense?

[2] The "veil of ignorance" notion is from Rawls' seminal work of political theory entitled *A Theory of Justice*. The veil of ignorance is a thought experiment whereby Rawls attempts to arrive at the most "just" system of legal rules and resource allocation by imagining what rules we would create if we were in the "original position" with our identities shrouded and we were tasked with creating such a system from scratch. That is, if we did not know our ethnicity, race, religious affiliation, socio-economic status, etc., what rules would we as a society create to best provide for our chances and the chances of others? He settles on the concept of "justice as fairness" as opposed to the Hobbesian savage "state of nature." JOHN RAWLS, A THEORY OF JUSTICE (Belknap Press of Harvard University Press, 1971).

[3] We are, of course, not in an original position, but we are presented with an opportunity to imagine ourselves as explorers and, ultimately, settlers, of new worlds. It is almost even more incumbent upon us to take up John Rawls' original position to help us create the rules that will guide us in deciding how we will govern our conduct both in space and at home. Who goes? For whose benefit? At whose cost? Who shares in the knowledge?

[4] *See* Michael C. Malin & Kenneth S. Edgett, *Evidence for Recent Groundwater Seepage and Surface Runoff on Mars*, 288 SCIENCE 2330-35 (2000); Press Release, NASA, Evidence of Wet Mars Meridiani Planum (Mar. 2, 2004) (Opportunity Rover Finds Strong Evidence Meridiani Planum Was Wet); Press Release, NASA, NASA Images Suggest Water Still Flows in Brief Spurts on Mars (Dec. 6, 2006).

We take the historical frame of reference provided by existing space treaties at the United Nations level as the baseline. As the world community saw the potential significance of space as a strategic military position, it established a series of high-minded agreements that hold space as "the province of all mankind" and establish that space should be used for peaceful purposes only and that the exploration and use of space would be free to all States.[5] The Outer Space Treaty showed the world community at its very best, agreeing to be bound by rules that would foster peace between nations. To that end, we envision a space policy that utilizes the previously established UN space law benchmarks that have created a global ethic of open and peaceful exploration for space activities and greater cooperation between nation-states. This ethic requires that space resources, research, and, in some instances, equipment be shared in a non-discriminatory manner that does not require *quid pro quo* concessions by nation-states that have an interest in but not the funding for space exploration.

The 2006 release of NASA's new Vision for Space Exploration, including the Lunar Architecture program and the NASA Global Exploration Strategy, represents a step forward for the human exploration of Mars.[6] The NASA Global Exploration Strategy is a significant first step toward developing a model of global participation, but it falls short in terms of the global cooperation and international joint ventures that will likely be necessary given the funding and technological needs required for a decades-long program to put humans on the Martian surface. The NASA Global Exploration Strategy involved NASA asking the world's thirteen space agencies and a variety of experts about their visions of space exploration, including priorities for research, but did little to form a coherent international agenda. Rather than a go-it-alone approach, a first priority for the NASA Vision for Space Exploration program should be the establishment of an international space partnership. With US

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[5] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 (1967) [hereinafter Outer Space Treaty].

[6] Press Release, NASA, No. 05-361 (Dec. 2006).

national funding commitments to the space program constrained by domestic and international funding priorities and with the potential for cost overruns over long time-scales and multiple political administrations, any real potential for human exploration of Mars will likely require international cooperation.

This international space partnership should include a multilateral agreement between the participating states to establish policies for levels and types of participation, information sharing, handling dual use technologies, remote sensing, and the allocation of legal liabilities. While a pragmatic multilateral agreement would build upon both the common and civil law traditions, it should also be based on a broad vision of contract as a way of establishing clear boundaries and obligations between signatories.[7]

As clear and transparent contracts typically create the least friction between signatories and, as multilateral agreements may sometimes have a normative, almost "aspirational"[8] character to them, we propose that any such Agreement be guided by what we refer to as "the Openness Principle" at its core. The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

A Multilateral Agreement regarding joint exploration of space will have to cover potential problem areas concerning the

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[7] Basing a multilateral agreement on contractual relations will allow signatories to regulate one another rather than relying purely on state apparatus to do so. International legal regimes have been roundly criticized for having weak enforcement mechanisms and few courts that are willing and able to effectively assume jurisdiction over disputes. Provisions for arbitration and other alternative dispute resolution procedures can create an environment of stability amongst signatories who would otherwise be unwilling to submit themselves to another sovereign's jurisdiction. *See, e.g.*, Louis Henkin, *Politics of Law-Making*, *in* INTERNATIONAL LAW: CLASSIC AND CONTEMPORARY READINGS 17, 18-20 (Charlotte Ku & Paul F. Diehl eds., 1998) (noting lack of enforcement in international human rights law); *see also* Laura A. Dickinson, *Public Law Values in a Privatized World*, 31 YALE JOURNAL OF INTERNATIONAL LAW 383, 385 (2006); *see generally* Tseming Yang, *International Treaty Enforcement as a Public Good: Institutional Deterrent Sanctions in International Environmental Agreements*, BEPRESS LEGAL SERIES 1136 (2006), *available* at http://law.bepress.com/cgi/viewcontent.cgi?article=5381&context=expresso.

[8] *See generally* the discussions regarding multilateral trade agreements and human rights.

ways and means of getting to Mars, such as technology research and development, cost sharing, potential environmental degradation and protection, and security concerns. We must also consider the possibility of discovering new and valuable Martian resources – requiring clarity between the domestic private property regimes and public resource and environmental stewardship for the planet, which in the spirit of the Outer Space Treaty should include developing nations that would otherwise not have the standing to participate.[9]

Thus far no State has been willing to commit the resources necessary to send a human mission to explore Mars alone. This has forced those States that would like to explore Mars to think creatively about which States to invite to participate in order to get funding and technologies needed to make the mission a success.[10] National security and corporate economic concerns regarding "dual use technologies" increase the difficulty of getting nations or corporations to buy-in.[11]

A fully developed principled structure for law of space would provide legitimacy and credibility for concepts ranging from international cooperation to security, but it would also begin to provide structure and incentives within which multilat-

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[9] *See* Outer Space Treaty, *supra* note 5, at arts. I, II, IX, X, XI, & XII. The Outer Space Treaty generally spells out something more than merely non-exclusive use, it contains a spirit of cooperation, sharing of knowledge, and equality of access, even to those States that do not have the resources to go it alone.

[10] Thus, the NASA Global Exploration Strategy is a first step in coalescing international support for a joint exploratory mission or series of missions to Mars. *See* Press Release, NASA, 06-361 (Dec. 4, 2006), *available at* http://www.nasa.gov/home/hqnews/2006/dec/HQ_06361_ESMD_Lunar_Architecture.html.

[11] "Dual-use technologies" refers to the technologies necessary for space exploration that also have potential military uses such as remote sensing equipment, guidance systems and rocketry. For a partial list of technologies the United States military views as dual use or "militarily critical," *see* the Militarily Critical Technologies List, *available at* http://www.dtic.mil/mctl. A second type of "dual use" technology could involve proprietary technologies produced by private firms or state-run space monopolies that are shared as part of the mission's common cause and but that raise intellectual property concerns for their makers. These national security and intellectual property concerns underscore the need for a developed body of law that will equitably allocate liabilities and rewards for space exploration and encourage participation. These are being developed through NASA's "Innovative Partnerships Program" involving university and private partnerships to develop technologies that are economically viable and useful both on Earth and in space. *See* Frank Schowengerdt, *Space Exploration: The Role of the Innovative Partnerships Program*, 12 TECHNOLOGY INNOVATION No.1 (2005).

eral agreements could set forth policies for the treatment of space by humans. It would also recognize the increasingly important issue that near-space is becoming crowded with debris and satellites[12] and that outer space, especially within our solar system, is becoming an increasingly likely destination for humans and spacecraft. Thus, the space regime could have both a private law element and enforcement mechanism on Earth, especially in contract and tort, and an international "federalist" spirit that coheres in a central body of space law.

Such a legal regime that encourages exploration and research sharing would be ahead of the curve, as space utilization is increasing with many new Nation-States and many private entities and even private individuals joining the space-faring order. New applications for orbiting satellites are only the first steps in developing greater scientific, economic, and potentially military uses for near space and many private firms are establishing a near-Earth presence with satellite communications and monitoring systems. Without an agreed upon law of space at the outset that ensures that space will continue to be jointly held, the exploration of which may remain in the aspirations of peoples all across the Earth, we could be face a "tragedy of the commons" situation in which resources, real estate (whether actual land or orbital paths), and waste disposal could be based on the strongest and wealthiest on earth exerting their authority in space, and thus perpetuating the rich-stay-rich fears of

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[12] U.N. Peaceful Uses of Outer Space [COPUOS], Sub-Comm. Scientific and Technical, Technical Report on Space Debris (1999), *available at* http://www.unoosa.org/pdf/reports/ac105/AC105_720E.pdf. Note also that the Chinese anti-satellite missile test in 2007 produced more than two thousand fragments of "trackable" space debris and over one million smaller than a millimeter in size. *See* The Center for Space Standards & Innovation, *Chinese ASAT Test*, *available at* http://www.centerforspace.com/asat/. A Russian satellite broke apart in orbit over Australia in 2007 creating an additional several thousand pieces of debris. *See* Ker Than, *Rocket Explodes Over Australia, Showers Space with Debris*, SPACE.COM (Feb. 21, 2007), *available at* http://www.space.com/news/070221_rocket_explodes.html. A space law regime would account for both types of events, intentional and accidental, if space is to be preserved for safe scientific practices. *See also*, Brian Berger, *NASA's Terra Satellite Moved to Avoid Chinese ASAT Debris,* SPACE.COM July 6, 2007, http://www.space.com/news/070706_sn_China_terra.html (where NASA moved a U.S. satellite out of the orbital path of debris created by the Chinese test.).

nations that would otherwise like to take part in space activities.

Numerous existing bilateral agreements have established procedures and guidelines for transferring potential "dual use" technologies and sharing space platforms, underscoring the increasing legalization of space activities under contract law. But contract is private law between two or more parties, and without both an enforcement mechanism on Earth and without a voice that speaks for the space environment – including its resources, its pristine biological and chemical "environment," and the scientific discoveries that loom there – the agenda will be dominated by those with Earthly power.

As space exploration and research continues on an upward trend, safe and secure technology sharing and transfer, including the protection of intellectual property and patents, is growing increasingly important. Joint ventures into space, whether as partnerships between Nation-States or corporations, require strong treaties or agreements between participants and often are the product of concessions given by all parties at the negotiating table to reach a workable agreement. Multilateral agreements and the joint ventures they support further encourage technology sharing, forcing reciprocal recognition of the rights and laws of additional Nation-States.

However, bilateral or mutual recognition constructs cannot be "multilateralized" automatically, because, based on assessing the current equivalence of regulations, concessions are not interchangeable. Even bilateral agreement protocols must take into consideration national public and private law, including agreements that are carried out by private entities for commercial purposes, often reducing the number of enforceable conditions in agreements. Under multilateral agreements, the mutual recognition of rights and restrictions is more difficult than under bilateral agreements because of the greater incompatibility of laws, regulations and enforcement regimes creating a pressure for even fewer conditions to be considered. Multilateral agreements have a great many benefits in practice, one of which includes customized rights of access obtained through an expanded sense of recognition. In going to Mars, governments negotiating multilateral arrangements should carefully balance

a detailed equivalence of practices with a broad balance of concessions.[13]

At a minimum, a preliminary multilateral space law agreement should be based on three broad applications:

1) Nondiscrimination in sharing space resources – including scientific discoveries; natural resources; new information, including biological history, archaeology, and other forms of knowledge we learn about cosmology;

2) Indivisibility of the agreement (collective arrangement); and

3) Diffuse reciprocity in honoring one another's legal rights, liability allocation, and remedies/enforcement procedures between the space exploring nations.

Our focus is the third of these concerns. The problems of multilateral legal reciprocity make forging agreements difficult: in coordinating an agreement with multiple countries as diverse in their laws as the USA, Japan, and Russia for example, whose strategies should be pursued to further space exploration? How much of a role should government space agencies have in a joint venture? How will the parties apportion liabilities and rewards for the mission and who can or will enforce them? One solution is to choose, wherever possible, policies that encourage open idea-sharing with minimal government intervention and place well-defined limits on the types of "dual-use" technologies and intellectual property governments and corporations want to protect, while clearly apportioning liability and describing enforcement mechanisms.

Contract law provides an ideal model for this type of agreement because signatories spell out conditions and rewards at the outset and agree to bind themselves to the terms of the agreement. Because contract is private law, it avoids many of the pitfalls of harmonizing otherwise dissonant public laws and legal regimes that differ from state to state. Since strong centralized enforcement mechanisms are still lacking in international private law, effective multilateral agreements will have

[13] Lisa L. Martin, *Interests, Power, and Multilateralism*, 46:4 INT'L ORG. 765-92 (1992).

the Openness Principle at their core. Openness and transparency in contract design reduces the likelihood of later breach or conflicts over interpretation, thus obviating the need for centralized enforcement mechanisms. Rather than try to create a new and binding enforcement regime, though one should also be in the works, we propose devising contracts to be transparent from the outset.

To be effective, multilateral agreements must provide adequate benefits and protections to all participants that can be exchanged for the costs of sharing technologies and rewards.[14] Thus, pragmatic multilateral agreements that apply to space travel and exploration should include The Openness Principle, an approach that will foster cooperation, collaboration and transparency in ventures into space and will be based on the United Nations Treaty regimes that are currently in place.

A. The Openness Principle as Applied to Multilateral Agreements for Space Exploration

The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

In the common law tradition, every contract has an implied covenant of good faith and fair dealing, which holds that parties to a contract are to keep their word and not try to escape their obligations in the contract.[15] To that end, the Openness Principle has a normative dimension to it. Openness suggests at the outset that the signatories to any such contract agree that they do not intend to later breach or call well understood, negotiated terms into question. Openness also serves to reduce worries that other signatories are silently breaching the Agreement.

The ideal long-term contract should anticipate and address potential challenges from the beginning and then set forth a

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[14] Kaylpso Nicolaidis, *International Trade in Information-based Services: The Uruguay Round and Beyond*, *in* WILLIAM DRAKE, THE NEW INFORMATION INFRASTRUCTURE 297-98 (Twentieth Century Fund Press, 1995).

[15] *See* RESTATEMENT (SECOND) OF CONTRACTS § 205 (1981).

principled way of responding to inevitable scenarios that are not contemplated when the parties negotiate initially.[16] An ideal multilateral agreement also sets forth individual parties' liabilities and obligations, along with how to handle intellectual property, dual-use technologies, security concerns and military build-out.

The three elements at the core of the Openness Principle also carry with them the aspirational character of space exploration itself, presuming that the principles behind existing United Nations' treaties, such as "the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,"[17] space being "the common heritage of mankind,"[18] and environmental treaties that provide for equitable access to resources and knowledge will be the continued goal of any joint mission to Mars. As a result, the Openness Principle, as we define it, leans toward a reduction in private corporate agenda setting and an increase in the role of a centralized private law system of creating and enforcing obligations between Nation-States.[19] Our goal in this paper is to outline a

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[16] Thus, a good multilateral agreement would include dispute resolution processes as well as anticipating unknowns such as research applications, resource allocation, etc.

[17] Outer Space Treaty, *supra* note 5, at Preamble.

[18] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature Dec. 18, 1979, 1363 U.N.T.S. 21 [hereinafter Moon Agreement]. *See also* Daniel C. Turack, *Concept of the Common Heritage of Mankind in International Law*, J. OF THIRD WORLD STUDIES (Fall 2002); KERNEL BASLAR, THE CONCEPT OF THE COMMON HERITAGE OF MANKIND IN INTERNATIONAL LAW (Martinus Nijhoff Publishers, 1998). The latter studies compare the concepts of the Common Heritage of Mankind in the law of the sea, outer space law, environmental law, human rights, humanitarian law, and its place as a general principle of law as it pertains, for example, to territory and sovereignty.

[19] In an era in which "efficiency," "privatization," and "globalization" are the dominant forces in the world economy, the goal of reducing private corporate agenda setting should give some pause. This statement is not meant as a polemic against international trade regimes or even reducing the power of the private sector. What is meant is that the private sector, focused on markets, has little incentive to take the aspirational approach to space exploration. The corporate agenda – to maximize profits for shareholders – has little room for basic scientific research and information sharing. Further, the express goals of the Space Treaties were to provide access to space information, if not space itself, for nations with less access to capital for exploration. The purpose of developing a strong centralized system for private contract enforcement is to encourage participants to continue to do scientific research in space and to share data and information with the developing world.

set of principles that can be applied broadly in multilateral space exploration ventures that will encourage participants to be good citizens, both on Earth and in the cosmos.

i. Open Source Resources and Technology Licensing

Open source resources and technology licensing is a key step in the creating of a vital and vibrant system of space exploration. Our conception is derived from open source software systems. Open source is a software development method that utilizes distributed peer review and transparent processes. The promise of open source "is better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in."[20] The open source development and decision-making model is used primarily for software development, but this process itself comes from the scientific method. The notion is that information, to be valuable, must be freely shared so that it may be subjected to falsification and peer review. This model is taking hold in open source decision-making, which allows for a number of different agendas, approaches, and priorities to be inputted concurrently.[21] This provides a contrast to command and control systems where the single agenda (such as profit maximization) dominates all development and operations' processes. Thus, in open source culture, the agenda is jointly created and jointly followed. It relies heavily on transparency and sharing of intellectual property, whether through licensing or through other means of information sharing, so that people may work concurrently in developing the target. The collective approach also provides for a second layer of "checks" at the process level, which moderates ethical concerns regarding conflicts of interest or failures to meet contractual obligations. Open source has become a critical strategic component for the development of new technologies and it has played the decisive role in the creation of scientific knowledge.

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[20] Open Source Initiative, *available at* www.opensource.org.

[21] ERIC S. RAYMOND, THE CATHEDRAL AND THE BAZAAR (3d. ed., 2000) (quoting Linus' law, "given enough eyeballs, all *bugs* are shallow").

Co-participants in international space exploration ventures would be necessarily sharing information and technologies. The synergies that come from sharing and cooperation are a particular strength of joint missions and bring together each of the participants' specialties and produce an amplifying effect on the resources available to the mission. Recognizing that information and technology sharing may produce anxiety in both national security and corporate contexts – the former being concern about the possibility of sharing sensitive information with potential Earth adversaries and the latter with corporate competitors, the latter facing the further challenges of the blurred lines between national space programs and private concerns that are increasingly competing for market share – it is important that sharing of dual-use technologies and intellectual property be accompanied by transparency which acts as a control.

Since a critical feature of joint exploration mission success is a move from competition to cooperation amongst participants, the open source model of information exchange would require that participants share or license information and technology to other participants for the mission or mission-related activities only.[22] Concerns about dual use technologies and intellectual property could be at least partially remedied through licensing agreements and transparent markets for such technologies and information, with partners agreeing to share whatever synergies emerge from bringing such technologies and information together.[23] Participants would license their technologies for the opportunity to participate in whatever rewards were garnered during the mission. Thus, they would be able to "charge" only a nominal fee (or none at all) for the use of the licensed technology

[22] Recall that the model for joint missions into space is a scientific model where openness of and access to scholarship, research and data is a key element of increasing scientific knowledge. A limitation on this type of partnership is the dual nature of missions in general, in which there are both scientific and resource acquisition agendas.

[23] *See*, *e.g.,* University licensing agreements; especially those where there is partnership with industry, i.e. the newly created British Petroleum – University of California, Berkeley partnership for biofuels research. Loosely, the partnership allows basic scientific research to be "kept" and published by UC Berkeley researchers while economically viable research is to be "kept" by British Petroleum. This arrangement is new as of 2007 and the ability of a public university to successfully partner with a private firm remains to be seen.

during the joint venture into space, but would reap the benefits of uses developed while on space missions.

While licensing could solve a portion of the intellectual property issue, it probably would not resolve dual-use technology concerns. The dual-use technology issue is a major one especially as military strategists eye space as a resource. However, there are institutions that monitor dual-use technologies such as chemical weapons[24] and nuclear weapons – such as the International Atomic Energy Agency – for nuclear reactors that suggest dual-use technology will not be a deal-breaker. Biological weapons are proving more difficult for which to create a monitoring and enforcement regime.[25] Openness is one common theme among all of the dual-use monitoring regimes; under the chemical and nuclear weapons treaties, each of the signatories provides access to the technologies, with agreements that limit access to proprietary technologies.

A possible enforcement mechanism would require that ongoing participation be conditioned on honoring open source agreements with participants monitoring themselves.[26] Still another way of enforcing licensing and open source agreements is to offer participants opportunities to use resources available in space in exchange for their participation in a cooperative information and technology-sharing regime.[27] The goal is at once

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[24] The Organisation for the Prevention of Chemical Weapons was created by the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction. *See* Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Jan 13, 1993, 32 I.L.M. 800 (entered into force on Apr. 29, 1997).

[25] *See* Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 164. It does not provide for monitoring or enforcement, however, and though there has been much interest in creating an enforcement and monitoring regime, the most recent attempts were undermined by the Bush Administration's worry that it would interfere with legitimate commercial biotechnology research.

[26] *See* Richard Schwartz, *Social Factors in the Development of Legal Control: A Case Study of Two Israeli Settlements*, 63 YALE L.J. 471-91 (1954), for the argument that in small societies the need for developed legal rules is much less pronounced than in larger societies because smaller societies are more able to monitor and enforce social norms.

[27] Anthony Rutkowski, *Multilateral Cooperation in Telecommunications: Implications of the Great Transformation*, *in* WILLIAM DRAKE, THE NEW INFORMATION INFRASTRUCTURE 223-250 (1995).

to encourage participation and research (private law) and to create a law of space that provides environmental protection and assures access to information (public law).

There is precedent for sharing ownership and/or control of technologies as when the European-built Cupola observation module for the *International Space Station* (*ISS*) was officially transferred to NASA on 7 July 2005. Under this agreement the European Space Agency provided the Cupola in exchange for NASA's transportation of ESA's equipment and experiments to the Space Station. Cupola's development came as a process of cooperation between six European companies, from Spain, Switzerland, Sweden, Germany, and Belgium and ESA's prime contractor Alenia Spazio. The transfer concluded ESA's obligations for the Cupola's development as part of a bilateral barter agreement between ESA and NASA six years later.[28]

ii. Open Access and Non-Discrimination Policies Among Nations

When agreements are bilateral or small multilateral conventions, partners can be selective about who is allowed to participate and under what circumstances. The Openness Principle requires that new policies for cooperative space ventures require open access and non-discrimination, allowing nations who meet certain criteria to participate automatically in space exploration joint ventures as the equivalent of equity partners. For nations that do not meet the set of criteria, we propose either a benchmarking system with well-defined participation goals and/or a rotating participation system that will allow all nations who wish to participate in the space exploration program to do so.[29]

This will further amplify the understanding reached in the 1967 Outer Space Treaty that:

> The exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries, irrespective

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[28] *See ESA Transfer Ownership Of European-Built ISS Observation Module To NASA*, PHYSORG.COM (Jul.27, 2005), *available at* http://www.physorg.com/news5452.html.

[29] This could be based in part on the UN Security Council model.

> of their degree of economic or scientific development, and shall be the province of all mankind.
>
> Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.
>
> There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.[30]

There is precedent for the development of large technical systems with large infrastructure costs being leapfrogged by more advanced technologies with lower costs via open network access. For example, for over a century, telecommunications networks were managed by select national monopolies that carefully designed complex systems of rules intended to control markets. As telecommunications went to microwave and satellite systems, multilateral sharing of satellite space changed the selection process allowing new countries to participate via the production of viable launch and satellite systems. It also allowed nations for which the build-out of reliable land-based transmission systems was not considered cost-effective by large telecommunications companies to completely bypass that step and go straight to satellite based telecommunications systems. Thus, nations, such as India, Brazil, and Norway, which had been left out of the industry by powerful national monopolies, were given an opportunity to compete.[31]

Good agreement design would encourage future-thinking nations and corporations to participate in joint exploration missions by creating systems to set out participation in terms of benchmarks toward meeting the criteria for participation in the program

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[30] Outer Space Treaty, *supra* note 5, at art. I.

[31] Matthew Jude Egan, *Anticipating Future Vulnerabilities: Increasingly Critical Infrastructure-like Systems*, 15:1 J. OF CONTINGENCIES & CRISIS MANAGEMENT 4-17 (2007).

iii. Open Agreements: Creating Transparency through Multilateral Agreements

The purpose of a new Multilateral Mars Agreement would be to affirm the common needs of developing countries to use orbital and ground data to both better build out their own critical infrastructure and to make use of global, intellectual, and technological resources needed for the first manned mission to Mars. Again, there is precedent for sharing space data as the United Nations Office for Outer Space Affairs (UNOOSA) has sponsored several programs aimed at using remote sensing data to aid the developing world, especially African nations, with sustainability, water resources, and environmental health.[32]

As involving more entities reduces the likelihood of covert cartel-type arrangements,[33] having a dozen space-faring nations with rotating leadership depending on particular strengths and rotating participation for States that do not meet their benchmarks, would work toward ultimately making information and technology available to all. Only a handful of countries have so far demonstrated outer-space competence, but the list is growing, and with benchmarking so States can qualify or rotating limited participation for States that do not qualify, the list will expand further.

A basic list of such Established Space Competent States (EtSC) inevitably includes the USA, the European Space Agency (ESA) as an organization in its own right as well as most of its individual Member States, the Russian Federation, Canada, and Japan.[34] Yet other States such as Australia and China are moving into the commercial space arena.[35] Other nations either

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[32] *See* the UNOOSA Programs on Space Technology and Disaster Management and Natural Resources and Environmental Monitoring.

[33] The balance required in the outer space technology context is between having a large enough number of actors to reduce the likelihood of agenda-setting and price-fixing on the one hand and few enough members that the appropriate benchmarks and standards can be assured.

[34] *See* Gasparini Alves, The Transfer of Dual-Use Outer Space Technologies: Confrontation or Co-operation? (2001) (dissertation thesis for the University of Geneva, Institut Universitaire De Hautes Éstudes Internationales), *available at* http://www.unige.ch/cyberdocuments/theses2001/GaspariniP/these.html.

[35] *Id.*; *see also* Gerald Steinberg, *Satellite Capabilities of Emerging Space-Competent States*, *available at* http://faculty.biu.ac.il/~steing/military/sat.htm.

are developing or have developed qualified outer space technologies, some with the aim of joining the ranks of EtSC States and becoming suppliers of technologies and services within the next two decades such as Argentina, Brazil, India, Israel, and Pakistan.[36] To a lesser extent, other States having the capacity to manufacture systems or sub-systems for crucial space technologies, such as South Africa, Indonesia, and South Korea, all have announced their intention to initiate outer space activity sometime in the future.[37]

II. ISSUES FOR PRELIMINARY AGREEMENTS FOR OUTER SPACE

Ultimately, joint space exploration, including a human mission to Mars, would require many agreements and memoranda of understanding (MOUs) of different types including among others: describing detailed space activities and the creation of international institutions involved in this process; the exploitation of space resources; the legal status of spacecraft including international registration; liability for damage to the objects and payloads caused by space activities; assistance to astronauts and spacecraft in distress; licensing requirements for launch activities (as well as launch services); space insurance and liability apportionment; licensing requirements for telecommunications; intellectual property rights under domestic laws; national export controls on space products; financing of space ventures; law and contracts related to materials procurement, leasing of equipment; as well as contractual relationship between space agencies and space industry. There would also have to be agreements regarding dual-use technologies, militarily sensitive technologies and private intellectual property rights.

Bilaterally, as well as multilaterally, there would also need to be agreements established amongst suppliers and recipients, to enable mutual scientific objectives to be complemented by compliance and enforcement procedures, especially important for scientific technology such as remote sensing radar that

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[36] *See supra* note 34.
[37] *Id*.

would be used for ground and orbital surveying of Mars. If these agreements embrace the Openness Principle discussed above, they will allow for limited sharing and licensing but would provide protections for intellectual property concerns.

A draft multilateral agreement would compile aviation, *Space Shuttle* and space station agreements, conventions, and MOUs. The usefulness of a draft agreement compiled from existing agreements is twofold: first, it would show how existing agreements can be reworked to create a workable agreement for joint ventures and second, it would provide a text that can be modified or added to create a working document.[38]

One of the first similar space agreements was the Intergovernmental Agreement (IGA) of 1988 on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned Civil Space Station which provided the mechanism for multi-national use of a space station.[39] In 1993, the original participants to the agreement, the United States and Japan, and to an extent Canada, and certain member states of the European Space Agency (Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, and the United Kingdom), took an historic step toward advancing the peaceful exploration of space by inviting the Government of the Russian Federation to join the International Space Station Program.[40] In reaching this decision, the partners recognized that including Russia would represent important progress toward their shared objective of establishing broad cooperative relationships in building the International Space Station Program.[41]

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[38] We have proposed draft agreement language to be published. *See* J.J. Hurtak & M. Jude Egan, *Draft Multilateral Agreement for a Manned Mission to Mars* (forthcoming 2009) (on file with author).

[39] 1988 Agreement Among the Government of Canada, Governments of the Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station [hereinafter IGA], http://www.jaxa.jp/library/space.law/chapter_3/3-2-2-9/index_e.html.

[40] The Signatories to the IGA extended an invitation to the Russian Government to join the Agreement on December 6, 1993 and the Russian Government accepted on December 17, 1993. *See id.* at Preamble.

[41] Including Russia and potentially China would be important strategically as well as scientifically. With both nations raising concerns about the US' attempts to "strategically dominate" space with space-based weapons, a "silent" arms race could begin to

The United States had decided that because of its lead role, the 1988 IGA would need to be based on a series of bilateral agreements. Through the initial negotiations, the US followed this line. Halfway into the original IGA negotiations, in the summer of 1987, the US agreed with other participating States that the agreement should be a multilateral "Executive Agreement" because it would expedite the acceptance process.[42] However, the "executive agreement" route also meant that the US negotiators were not in a position to agree with language that would require changes to US laws. Since multilateral agreements do not require Senate approval, they do not have the same status as international treaties and are only enforceable in the US to the extent that they comply with US domestic law; this issue will likely remain an important consideration as participating countries attempt to negotiate new multilateral agreements.

The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) is the primary international forum for space laws and treaties, especially in the field of joint management or control of objects in space. One of the early treaties it developed was the Outer Space Treaty (1967), a document that could provide a model in terms of international agreements that allow State signatories to retain jurisdiction over aspects of their projects, but given the increasing multilateralization of space missions, the model will need to include provisions for sharing resources as well. According to Article VIII of the Outer Space Treaty:

> 1. A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction

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reemerge. Russia has stated publicly, in cooling ties with Washington DC, that it would place "retaliatory weapons" in space. *See* Vladamir Isachenkov, *Russia Warns against Space Weapons*, ASSOCIATED PRESS (Sept. 27, 2007). China has also indicated that its demolition of a space satellite was to let the United States know that it would not tolerate space-based weapons. Making Russia and China partners could reduce the potential for a new space race while making use of the great wealth of experience and scientific knowledge in the Russian and Chinese portfolios.

[42] A. Farand, *Space Station Cooperation Framework*, 94 ESA BULLETIN 3 (May 1998).

> and control over such object, and over any personnel thereof, while in outer space or on a celestial body.
>
> 2. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth.
>
> 3. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.[43]

This treaty establishes the principle that the management of and jurisdiction over objects put into outer space remains with the State that owns the objects. This provides for both the basis of terrestrial tort liability for accidents and the return of objects to their State owner. However, in light of the steady pace of space missions launched by a variety of States and private entities and the anticipated growing number of robotic missions to Mars, missions are increasingly shifting from single State and private involvement in space stations and colonies to a sharing of resources and equipment. Thus, new agreements will require multilateral components and liability sharing provisions.

A multilateral agreement for Mars exploration should require governmental and/or private entities that participate in and benefit from space activities to accept technology sharing and, ultimately, a possible limited, shared liability structure. It is still debatable how to share such ownership responsibility and which aspects should remain with the relevant State in terms of supervision.

In addition to IGAs there are several MOUs that need to be drawn up. COPUOS, or an International Mars Space Committee (IMSC) under the legal guidance of COPUOS, should address judicial review and the means to safeguard the integrity of in-

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[43] Outer Space Treaty, *supra* note 5, at art. VII.

ternational agreements on the control of operations on a trip to Mars. The Committee would provide political guidance as an international body to better orient international cooperation and technology transfer. An open and transparent agreement would remove the need for a strong enforcement and interpretive body at the outset, but for such a document to retain its binding legal force over the several decades needed for development of long-term mission goals, such an oversight body will be necessary. Early agreements should strive for some technical specificity, but should also create working principles that anticipate such issues as future participation by Nation-States as well as private entities, methods for resolving conflicts including international arbitration proceedings and require long-term commitments from participants that will ensure its ongoing nature.

The right of any State to develop outer space technologies is, in principle, unquestionable. In practice, difficulties continue to center around technological development and technology sharing, especially when the equipment has both civil and military application. Any technology transfers must therefore consider the relevance that access to these technologies will have on global security.

III. TECHNOLOGY TRANSFER AND INTELLECTUAL PROPERTY PROTECTION

The focus of multilateral teamwork crosses traditional supplier/recipient relationships. Co-operation on transfer issues especially must be reinforced by agreements that embrace the Openness Principle and thereby ensure transparency and predictability on issues directly affecting the security and development of individual States or groups of States.[44]

Space technology transference and sharing agreements apply directly to equipment, applications, and services between suppliers and recipients. However, outer space, beginning with the question of the difference between outer space and air space,

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[44] *See* dual-use nuclear agreements such as the Nuclear Proliferation Regime run by the Nuclear Suppliers Group; *see also* benchmarking programs that encourage and foster open participation and self-monitoring (i.e. Australia's nuclear program).

is not particularly intuitive to legal scholars. UN documents make clear that no nation may appropriate outer space for its own, while nations may claim sovereignty over the airspace above their terrestrial borders. This makes the issue of where airspace ends and outer space begins highly contentious. Scientists note that outer space begins approximately 90-110 km above the Earth's surface.[45] Legal regimes, however, have stalled on whether to use a functionalist approach (outer space is defined by the sorts of activities taking place in it) or a "spatial theory" approach (outer space boundaries begin at a certain altitude).[46] Diplomatic attempts to define space boundaries have been largely unsuccessful – the Soviet Union in 1979, 1983, and 1987 attempted to model the legal definition on the scientific and proposed the spatial theory at somewhere between 100 and 110 km above the Earth.[47]

Pertinent to this article are the definitions of near-earth orbits such as LEOs which function at 500 and 1,500 km above Earth, MEOs which function at 5,000 to 12,000 km above Earth, and GEOs at 36,000 km above Earth.[48] This variation of boundaries creates the need for legal definitions and rules that will apply to particular operations and technologies at varying distances from Earth – it may not be enough to treat any location outside the Earth's atmosphere as "outer space" for legal purposes when technological, scientific, and economic realities define boundaries in a finer level of detail.

Without strong legal categories in place, agreement signatories must work backward such that any technologies that function at GEO level or beyond such as on the Moon and other celestial bodies, are to be considered outer space technologies, e.g., rocket boosters, satellites and their components, and Earth-

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[45] Bin Cheng, *The Legal Regions of Airspace and Outer Space: The Boundary Problem,* 5 ANNALS OF AIR & SPACE L. 323-356 (1982).

[46] A. Patterson, New Space Technology: Regulatory Challenges for the International Telecommunication Union, 5 (1998) unpublished LL. Master's thesis, McGill University Institute of Air and Space Law), *available at* http://www.collectionscanada.ca/obj/s4/f2/dsk1/tape10/PQDD_0026/MQ50957.pdf.

[47] *Id.*

[48] Alexander Keller, *Towards CORBA-based Enterprise Management: Managing CORBA-based Systems with SNMP Platforms*, SECOND INTERNATIONAL ENTERPRISE DISTRIBUTED OBJECT COMPUTING WORKSHOP: EDOC'98 (Nov. 1998).

based control and tracking systems. Critical infrastructure subsystems contributing to these applications that go into space could be considered "related outer space technologies," making the ultimate destination of the mission the ultimate arbiter of legal jurisdiction.[49] Another option would follow the spatial theory approach, with jurisdiction and liability apportionment changing based on the location of the technology – thus, a mission going into GEO and beyond would pass through multiple jurisdictions along the way.

The question of restructuring outer space technology transfer is irrelevant without a better understanding of the present relationship among States and a firm definition of where sovereign airspace ends and outer space begins. The quest for improved relationships in respect of technology transfer must first start with an assessment of the political, military, technical, and economic implications of outer space technologies.

The United States is the country with the largest, and perhaps most comprehensive national legislation among the major suppliers of outer space technologies, and it aggressively seeks to maintain its ownership and intellectual property rights for its technology. The United States is also among the most protective of dual use technologies, and in an era of increasing nuclear proliferation and the possible militarization of space, this protectiveness is likely to increase.

The ESA's own rules and procedures indicate that it may propose specific provisions to protect Member States' interest and its own objectives with regard to technology transfer from State to State.[50] According to its current rule system, ESA must inform Member States of pending or proposed technology transfers. Member States are then given six weeks to request a delegate meeting if they judge that the proposed transfer needs to be examined.[51] If a delegate meeting is required, the transfer requires a two-thirds majority of all Member States for approval, depending on the case. An account of the transfer is made and included in the Agency's Director General Report to

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[49] *See supra* note 34.
[50] *Id*.
[51] *Id.*

Council and to the Committee on transfers of inventions, technical data, and assets, thus ensuring some degree of transparency of the knowledge of requests for transfers.[52] This may provide a model for other State space agencies to participate in technology transfers.

Another key potential sticking point in these arrangements is the protection of domestic and international patents. Use of the Openness Principle can help give private industry the confidence necessary to develop space technology that will be used in multilateral joint ventures. The participants in multilateral space exploration agreements can build clarity into contracts and agreements with regard to the application of international intellectual property law in securing proprietary rights in space activities while providing a trade-off in terms of knowledge gain and access to new uses for these technologies. This creates transparency and protects intellectual property.

In the most beneficial scenario, supplier States would realize that the spirit of international outer space exploration is based on the stimulation of cooperation – that large-scale exploration, including applications for new technologies and the discovery of new resources, will be limited without international joint ventures.[53] The possibility of developing technology synergies that will only emerge through cooperation and the possibility of sharing in the benefits of and discoveries from space exploration for private companies and State-sponsored space agencies alike should create a drive for equal access to technologies and, in some cases, a sharing of rights.

In terrestrial private property regimes, property is a commodity belonging to an individual, institution or State who owns the rights to use, exclude others from or dispose of it how they

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[52] *Id.*

[53] One's hope that private firms may also be taken up by the "spirit" of the enterprise fades when one notes that the duties of corporate officers and directors to the corporation are fiduciary in nature and thus it is a violation of those duties to use the corporate entity for purposes not expressly linked to making a future profit. However, if there can be a showing that either a) such technology sharing will, in the end, create a financial benefit (or the chance of one) or b) at the very least not impose a cost (i.e., the technology transfer is not into a "market"), this fiduciary duty may not be implicated.

see fit.[54] In a free international community, a given commodity may be sold, transferred or provided in any other way to a third party only according to the owner's free will. Those involved in technology transfer can be individuals, private firms, States, or any other type of enterprise. Technology developed by a State, for example, is also a commodity and hence a State's property. Therefore, a State can, of its own will, decide whether or not to supply this technology in the international market.[55]

IV. PRIVATE LAND CLAIMS

Several international instruments have abandoned the "first come, first served" principle with regard to cross-boundary natural resources in favor of "equitable access" to natural resources especially with regard to the developing world where resource access can often be a life or death situation for citizens.[56] There is still, however, much to be done to increase access equity. The examples on Earth such as water rights from transboundary flowing rivers and air and water pollution that moves through transboundary basins, can inform natural resource decision-making in and for the space frontier before it becomes a problem of wealth and scientific knowledge distribution.[57]

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[54] *See, e.g.*, STANFORD ENCYCLOPEDIA OF PHILOSOPHY ("[p]rivate property" refers to a kind of system that allocates particular objects like pieces of land to particular individuals to use and manage as they please, to the exclusion of others (even others who have a greater need for the resources) and to the exclusion also of any detailed control by society.") This is the definition of property that is more or less in use throughout the world's property regimes.

[55] Jannat C. Thompson, *Space for Rent: The International Telecommunications Union, Space Law, and Orbit Spectrum Leasing*, 62:1 J. AIR L. & COM. 279 (1996).

[56] *See* International Telecommunication Convention, ch. III, art. 33 Nov. 6, 1982, S. Treaty Doc. No. 99-6 (discussing radio frequencies and the geostationary satellite orbit); *see also* African Convention on the Conservation of Nature and Natural Resources, art. IX Sept. 15, 1968, 1001 UNTS 3 (discussing genetic resources and species biodiversity).

[57] There is an increasing body of national institutional support for helping impoverished peoples and nations keep their access to resources developed in their properties. The International Development Research Centre in Canada and the US Department of Agriculture through its Conservation Security Program (CSP) have funded programs devoted to providing and maintaining resource access for local peoples and tribes at home and abroad. *See*, Environmental and Natural Resource Management, *Enhancing Equitable Access and Use Rights*, http://www.idrc.ca/en/ev-81162-201-1-DO_TOPIC.html (last visited May 16, 2009) and United States Department of Agriculture Natural Re-

With regard to space orbits and the potential exploration of celestial bodies, access to land areas for human research or settlement requires expanding and putting in place "equitable access" agreements, especially for both basic and applied scientific research. Equitable access provisions would provide for special areas or "zones" for research where the term "access" does not grant ownership. We note the term "access" does not create ownership of a position or segment of the orbit in the space frontier, but only gives the possessor the right to use it. In balancing equitable access, efficiency, and the needs of the developing countries, the authors of this paper have suggested in previous publications that the creation of a tax-free "economic zone" or "research zone" on Mars could be the key to how a few hundred inhabitants from a score of Earth Nation-States could maintain a multilateral balance covering tens of thousands of hectares on Mars.[58]

A multilateral agreement should set forth the necessary attributes of an efficient and equitable approach to respect the property of celestial bodies – notably Mars and the Moon – as a common property that cannot be claimed by any one State or consortium of multinationals doing research on a spacecraft or on the surface or subsurface of celestial bodies. However, such a system of multilateral management must provide for the allocation of rights, and the power to exclude, use, and dispose of property interests. All of these rights require the protection of sovereign power for the provision of which the Nation-State has been developed and is suited according to space laws that have been evolving since 1967. The current and developing space property laws and adjoining issues of liability are not completely incompatible with such a system, but are vague and in-

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sources Conservation Service, *Conservation Security Program,* http://www.nrcs.usda.gov/programs/csp/ (last visited May 16, 2009). These programs range from equitable access to farmland to freshwater. The United Nations program Secure and Equitable Access to Land (SEAL) has similar goals for sub-Saharan Africa. *See* Partnerships for Sustainable Development, *Secure and Equitable Access to Land,* http://webapps01.un.org/dsd/partnerships/public/partnerships/23.html (last visited May 16, 2009).

[58] James Hurtak & Matthew Egan, *Consequences for Space Law-Making of Water Discovery on Mars*, 29 ANNALS OF AIR & SPACE LAW 393-422 (2004).

consistent with respect to new situations, e.g., competition for water resources on a foreign planet, finding of other life forms, extraordinary events, etc. This could be because such events, until the recent press releases regarding the strongest evidence to date of flowing water on Mars and the tantalizing possibility that such a potential discovery will yield a biological historical record in the form of fossils, had seemed farfetched. It seems time to be ahead of the curve in developing an environmental and research agenda that will provide adequate protections and still create incentives for exploration.

We believe a very good strategy would be to amend existing laws and, by treaty, explicitly approve a system of multinational rights – such a system could apply only to space travel or could, more generally, become positive international law. Better yet, however, due to the gamut of issues and the new terminology needed for possible near-Earth orbital zones and environmental protection zones for Martian resources,[59] we suggest a series of new agreements with a framework of responsibilities, trade-offs, and language that sets forth a research and policy agenda that provides for information-sharing and environmental protection. Such a course of action would highlight the importance of Mars and the Moon as future exploration zones and would be based on the concept of "reasonable use" of Martian and lunar properties as a basis for protecting national and non-national property rights and govern property appropriation issues.

V. CROSS-WAIVERS OF LIABILITY

The notion of "absolute" or "strict" liability, the duty to compensate not subject to exoneration or a determination of fault, has become an important part of space launch and exploration.[60] Without relying on the traditional notions of fault or

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[59] *Id*.

[60] Sections 519 and 520 of the Restatement (Second) of Torts define strict liability for "ultrahazardous activity" a standard adopted by many of the states in the United States. Section 519 provides: (1) One who carries on an abnormally dangerous [or ultrahazardous] activity is subject to liability for harm to the person, land or chattels of another resulting from the activity, although he has exercised the utmost care to prevent the harm. (2) This strict liability is limited to the kind of harm, the possibility of which makes the activity abnormally dangerous. Section 520 contains a list of "the factors to be

negligence, recent instruments provide for certain exceptions to liability resulting from acts of God.[61] The Convention on International Liability for Damage Caused by Space Objects (hereinafter "Liability Convention") was the most important document for establishing a system for apportioning liabilities for accidents regarding space activities.[62]

Under the Liability Convention, if a space object causes damage on the surface of the Earth or to aircraft in flight, absolute liability attaches to the launching state.[63] This is based on the notion that space launch involves "ultrahazardous activity" a rule of tort law that requires that entities that engage in activities that entail potential harms that cannot be mitigated are strictly liable for the harms they cause.[64] The launching state is defined as the "State which launches or procures the launching of a space object . . . [or] . . . a State from whose territory or facility a space object is launched."[65] In cases of accidents occurring in outer space or Earth orbit ("elsewhere than on the surface of the Earth"), liability is determined by fault. If there is more than one launching state, joint and several liability exists

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considered in determining whether an activity is abnormally dangerous." RESTATEMENT (SECOND) OF TORTS § 519, comment b (1997). These factors include the risk of harm, its likely scope, ability to eliminate the risk, whether the activity is uncommon, whether the activity is inappropriate to a particular place, and the value of the activity. Moore v. R. G. Indus., 1984 U.S. Dist. LEXIS 24010 (N.D.Ca.1984); *see also* Manfred Lachs, *Challenge of the Environment*, 39 INT'L & COMP. L.Q. 663 (1990); Manfred Lachs, *Views from the Bench: Thoughts on Science, Technology, and World Law*, 86 AM. J. INT'L L. 673 (Oct. 1992) [hereinafter *Views from the Bench*]; M. Spada, *Risks of space market and liability in commercial space ventures,* IEEE AEROSPACE CONFERENCE 159-166 (Mar. 5-12, 2005); Henri A Wassenbergh, *International Space Law: A Turn of the Tide*, 22 AIR & SPACE LAW 334, 339 (1997).

[61] Paris Convention on Third Party Liability in the Field of Nuclear Energy, July 29, 1960, 956 U.N.T.S. 251 [hereinafter 1960 Paris Convention]; Brussels Supplementary Convention to the Paris Convention on Third Party Liability in the Field of Nuclear Energy, Jan. 31, 1963, 1041 U.N.T.S. 358; Vienna Convention on Civil Liability for Nuclear Damage, May 21, 1963, 1063 U.N.T.S. 265.

[62] Explicit cross-waivers of liability with regard to the Space Station Freedom were adopted in the United States in 14 C.F.R. § 1266, et. seq.; *Views from the Bench*, *supra* note 60.

[63] Lara L. Manzione, *Multinational Investment in the Space Station: An Outer Space Model for International Cooperation?,* 18 AM. U. INT'L L. R. 507 (2002).

[64] GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 303 (2d ed. 1997).

[65] Manzione, *supra* note 63.

between or among them, and a standard of comparative negligence may be employed, if appropriate.[66]

Reading the Liability Convention in concert with the Outer Space Treaty requires State liability for all activities in outer space, whether undertaken by governmental, non-governmental organizations, or private entities acting within their territory. A State may thus be liable for the acts of a corporation registered in its territory that procures a launch in a different State, irrespective of the host State's knowledge or involvement in the launch.[67] This creates incentives for States to either regulate the commercial launching enterprises located within their boundaries or to monopolize space launch and exploration.

Commentators have suggested that the absolute liability inhering from the Liability Convention makes private investment in space exploration too risky. In order to promote space exploration, use, and investment, governments have allowed entities to use cross-waivers to contract around the liability requirements, at least as they stand between contractors, subcontractors, users or customers, and suppliers of any kind. A good example of this is contained in Article 16 of the IGA, which reduces liability in and between participating States and their contractors.

The Liability Convention applies to situations not specifically covered by the cross-waiver and requires claimants to present their claims through diplomatic channels. The extent of liability is to "be determined in accordance with international law and the principles of justice and equity."[68] This is to say that while participants in a joint venture can contract with one another regarding personal liability, they cannot contract around international law that holds them absolutely liable for damage done to non-participants or the public.

Cross-waivers provide protections against liability between participants, thus greatly reducing the risk of liability between partners and their contractors. NASA agreements involving

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[66] *Id*.

[67] *Id*.

[68] Mary B. McCord, *Responding to the Space Station Agreement: The Extension of U.S. Law into Space*, 77 GEO. L. J. 1933 (1989).

Space Shuttle flights are required to contain broad cross-waivers of liability among the parties and their related entities to encourage participation in space exploration, use, and investment. The purpose of this clause is to extend this cross-waiver requirement to contractors and related entities under their contracts. This cross-waiver of liability is broadly construed under US domestic law to achieve the objective of encouraging participation in space activities.[69]

The cross-waiver utilized by the Space Station Agreement is similar to that used by NASA in its Launch Service Agreements with private commercial entities.[70] It requires partners to waive all claims against other partners, their related entities, or employees of the other partners or their related entities, for damage arising out of protected space operations. For purposes of the Space Station Agreement, protected space operations include "all launch vehicle activities, Space Station activities, and payload activities" whether they occur "on Earth, in outer space, or in transit between Earth and outer space," as long as these activities are conducted in furtherance of implementing the Space Station Agreement.[71] Protected space operations do not include "activities on Earth which are conducted on return from the Space Station to develop further a payload's product or process for use other than for Space Station related activities."[72]

> The cross-waiver does not apply to:
> (1) claims between a Partner State and its own related entity or between its own related entities;
> (2) claims made by a natural person, his/her estate, survivors, or subrogees for injury or death of such natural person;
> (3) claims for damage caused by willful misconduct;
> (4) intellectual property claims.[73]

Since these exceptions create openings for future claims for which the Space Station Agreement does not provide guidelines, future cross-waiver provisions for joint ventures in space explo-

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[69] NASA F.A.R. Sup. 5228-41.
[70] *See* McCord, *supra* note 68.
[71] *Id.*
[72] *Id.*
[73] *Id.*

ration should be modified to be as inclusive of new situations as possible.

Adequate cross-waiver provisions for international joint ventures for a Mars expedition or other space exploration should be based in part on the NASA and the Space Station Agreements' cross-waivers, but should either be modified to account for the issues raised by several commentators cited above, or COPUOS or another of the UN space governing bodies, such as the International Mars Space Committee (IMSC) suggested below, should be responsible for apportioning liability between partners in space faring activities that fall outside the specific contract provisions of the cross-waivers.

Cross-waivers should also not be extended by international instrument to deprive innocent parties of just compensation for accidents they had no part in creating. Thus, if a space mission is lost shortly after takeoff and natural people are, for example, injured by debris or nuclear fallout, absolute liability should inhere. Having a rule of absolute liability for those injured by space launch accidents or returns creates a strong incentive for safety and works to protect people from accidents over the long term. If participating governments want to reduce liability, they can indemnify the entities that participate in launch activities up to a certain liability level as the United States had done with nuclear power plant operations.[74] This is a subsidy of sorts, but if practiced carefully, it can also work to increase mission safety.

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[74] An example of this is the United Sates' Price-Anderson Act (42 U.S.C. § 2210). The Price-Anderson Act requires civilian nuclear power companies to purchase the maximum amount of insurance available to them (roughly $300 million). Then, the civilian nuclear power companies are each liable for an amount that would be paid into a fund in the case of an accident. Currently, the contributions are roughly $100 million and the fund itself is roughly $10 billion. Beyond that, the United States government agrees to indemnify the nuclear industry for the cost of an accident above and beyond the $10 billion threshold. The Act has been criticized as a subsidy on the cost of safety for nuclear power plants, but was used as a way of stimulating civilian production of nuclear power. The United States Supreme Court upheld the Act's constitutionality in Duke Power Co. v. Carolina Environmental Study Group, 438 U.S. 59 (1978). In *Duke Power*, the Court held that the Act bore a rational relationship to the goals sought by Congress, namely to support the development of nuclear power. This overrided the fact that the indemnification agreement would subvert victims' tort claims and treat them differently than other industrial accidents.

VI. IDENTIFYING A NEGOTIATING FORUM

Our proposals for a multilateral agreement would also call for the establishment of an International Mars Space Committee (IMSC). Establishing this Committee in a non-partisan area venue like the United Nations for major negotiations would expand the multilateral context of decision-making used for outer space technologies and exploration. The UN permanent Committee on the Peaceful Uses of Outer Space (COPUOS) in Vienna, Austria, we believe, should be the origin of the IMSC.

Even given the longstanding worries about submitting civil matters to an international institution, creating an organization like the IMSC and allowing it jurisdiction over civil, environmental, and biological affairs (if any) on Mars would be a step toward having a governing body of scientists, policy-makers, and explorers in place before arrival. This would create an environment for exploration within a legal framework and with the Openness Principle at the heart of international instruments, would also create a cooperative working arrangement between participants.

VII. NON-PROLIFERATION OF MILITARY TECHNOLOGY AND SECURITY ISSUES

There is a growing necessity to guarantee the security of all participating States that have renounced the possession of delivery of military technologies into space that could lead to the eventual weaponization of Mars and/or the Moon. An incentive mechanism for States to renounce the movement of weapons into space could include:

a) An international monitoring committee to observe and resolve technology and confrontational issues that might arise, probably governed by COPUOS;

b) Either a requirement that participants renounce weaponization of outer space, including any future landings on or settlement of Mars, or a system that allows full resource-

sharing and other benefits to come from such a renunciation;[75] and

c) International assistance in the development of bases and settlements on the Martian frontier so long as they do not contain weapons of any sort.

For multi-national space expeditions, each Party would have to agree on a common list of items and recipients that would be consistent with regional and international security concerns. A human mission to Mars should not allow any nation the opportunity to develop military capacity in the space mission, particularly capacity that could lead to military dominance or control of resources. This would keep in line with the 1967 Outer Space Treaty and would relax possible worries that some nations may have about ulterior motives for space exploration. A joint venture involving former or potential military rivals, as many of the EtSC states are, could be scuttled by the possibility that one nation would seek to dominate others by controlling the near space regions around the Earth. Any multilateral agreement on this subject would require transparency to ensure that shared dual-use technologies would not be misused and that all participants would be comfortable with the other nations' positions. Many multilateral arms agreements have allowed some oversight by rival nation's inspectors or respected third parties; in this case COPUOS seems an ideal organization to provide such oversight, especially because of its physical and philosophical proximity to the International Atomic Energy Agency. These agreements could be used as a baseline to ensure that the joint venture could not be used for ill motive by

[75] This could be based on agreements such as those promulgated by the Nuclear Suppliers Group, which lays out guidelines for methods by which Nuclear States can trade both nuclear and non-nuclear materials with non-nuclear states. Essentially, this is a trade organization that works to reduce nuclear weapons proliferation while helping non-nuclear states develop civilian nuclear power. The NSG guidelines are located in: *Guidelines for Nuclear Transfers*, INFCIRC/254, Part 1, and *Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software and Related Technology*, INFCIRC/254, Part 2.

any of its participants and could remove potential problem areas before they arose.

CONCLUSIONS

The increasing drive to privatize, commercialize, and promote outer space activities operating in and out of the Martian planetary environment needs to be addressed by the international community before it becomes a regular reality. We are in the position now of being able to look forward fifty years and see that human exploration of, and even potentially human settlement, on Mars and the Moon will be a likely reality. To that end, it is important to create a legal framework for exploration, liability allocation, environmental protection, property regimes, natural resource allocation, biological archaeology protocols and information sharing, and scientific research, before the status quo of no legal rules has been set.

To satisfy this need, the space community should be drafting preliminary international agreements to standardize requirements for governmental entities that intend to become active on Mars. In 2008, the *Phoenix* spacecraft landed on Mars' North Pole to search for water and organic molecules, only months after solid evidence had emerged that water has been flowing on the Martian surface within the last five years.[76] In 2009, the most ambitious mission in the queue, the mobile *Mars Science Laboratory (MSL)* will launch with a very impressive payload of experiments. The *MSL* will travel a kilometer or more from its landing site carrying a suite of sophisticated instruments for sniffing out the chemical evidence for a biological record of "life" on Mars. These missions, with a host of others to follow, will pave the way for astronauts to visit Mars within the next several decades.

By its very nature, space exploration shrinks distances both extraplanetary and intraplanetary, integrating disparate cultures, economies. Hopefully, the shared understanding that, as

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[76] *See* NASA, *NASA Images Suggest Water Still Flows in Brief Spurts on Mars* (Dec. 6, 2006), *available at* http://www.nasa.gov/mission_pages/mars/news/mgs-20061206.html.