Critical Legal Issues Associated with Current and Future Spacefaring Endeavors

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Over fifty years ago the "space race" was comprised of two participants – Russia and the United States (US). During the last twenty years the means of attaining spaceflight goals has changed dramatically as multiple nations have and are collaborating to more efficiently achieve various goals; the International Space Station (ISS) is a prime example. Additionally, other countries are singularly developing and reaching their own spacefaring goals. With multiple nations currently or nearing participation in space exploration-including manned and unmanned space activities-numerous legal issues associated with the pursuits have arisen and will continue to be critical issues requiring attention. Orbital debris has increasingly become a concern for space agencies including the National Aeronautics and Space Administration (NASA). A key legal concern regards the liability for damage caused by the debris as well as the preemptive responsibility of space debris prevention. Additionally, as extra-terrestrial exploration continues to evolve, the ownership rights and the allowable usages of the material must be defined. Finally, with so many entities continuing and preparing to participate in space activities, the sensitive issue of protecting national assets in space must be addressed. The present paper focuses upon the status of the aforementioned key legal issues with respect to current and proposed governance principles. Additionally, via expert opinions and personal communication with a key space industry leader, namely a former NASA Administrator, alternative options and solutions to the various legal dilemmas are presented.

I Introduction

Former US Deputy Secretary of Defense, William J. Lynn III, characterized the current status of outer space as "congested, competitive and contested" [1]. Outer space is increasingly *congested* as more than 60 nations have a presence in space. It is also becoming fiercely *competitive* as evidenced not only by the differing spacefaring aspirations of the multitude of nations, but also due to the emergence of commercial companies that are actively engaged in space activities that were previously under the sole purview of a nations' government - such as in the US. Outer space can also be characterized as *contested* to the degree of which the stability, sustainability and access to space can no longer be automatically anticipated.
With the increasing number of spacefaring nations and the occurrence of their interplanetary undertakings, the continued and evolving governance of space

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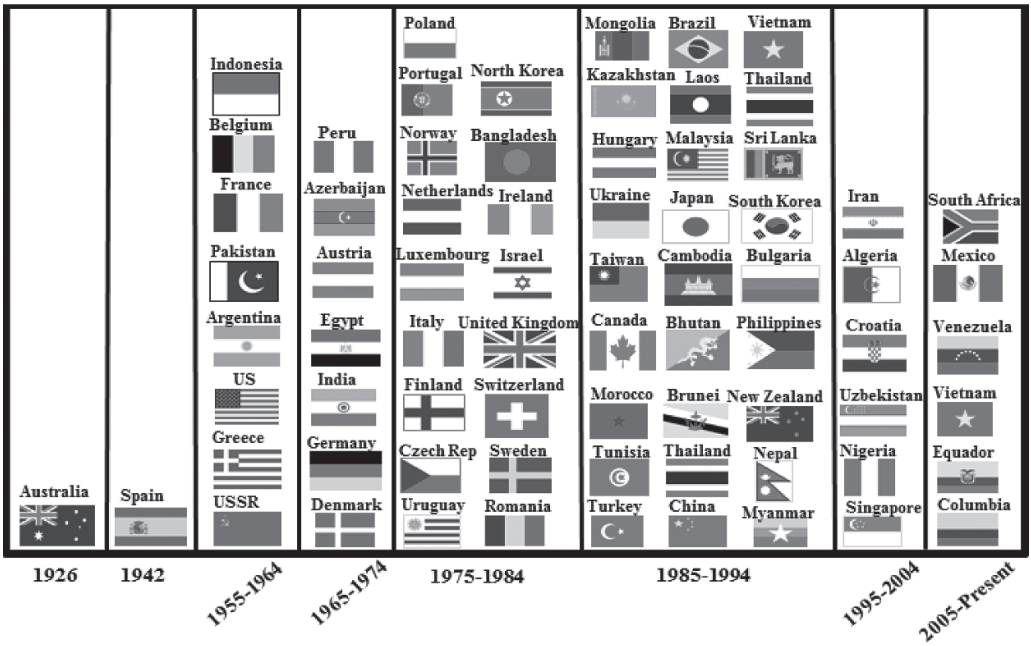
endeavours is critical in order to maintain a peaceful and collaborative coexistence in space. It is essential for there to be a cohesive demand among the participating nations to cast aside potential differences in ideology or action and function together harmoniously in order to attain their goals and objectives and to "improve national capabilities, share costs, build common interests, and eliminate the duplication of effort"[2].

"Space law" - a phrase typically used to refer to the governance and regulation of space activities - was ignited by the launch of the first artificial satellite in 1957. Russia's launch of said satellite, Sputnik 1, was a product of the Cold War and marked the commencement of the extensively broadcasted "space race" between the US and Russia. These two superpowers strived to acquire space dominance and more knowledge about the outer world in an attempt to achieve the most immediate goal at the time: to land a man on the moon. Although the achievement of this goal by the US in 1969 was instantly impactful, the reverberations brought by the space race stretched well beyond this particular accomplishment. The various launches and technological innovations during this race divulged the need to institute governance of space activities for the assurance of future peaceful excursions. Legalities regarding spacefaring endeavours became even more critical as the influx of countries into the spacefaring arena occurred following the Apollo 11 lunar landing and will continue to evolve and develop as long as the infinite frontier of space exists. However, responsible creation and implementation of various space governance measures requires proactive initiation as the result of foresight and not hindsight.

In 1959, in order to ensure the continued peaceful exploration and use of space, the United Nations (UN) established the Committee on the Peaceful Uses of Outer Space (COPUOS) as a body that would "review and foster international cooperation in the peaceful uses of outer space"[3, 4]. COPUOS provides the primary venue for the discussion and development of international laws regarding space activities. The ISS provides the optimal scenario of international cooperation to achieve and maintain a peaceful and highly productive endeavour for the advancement and benefit of all nations. Due in large part to the ability of its participating states to solve various legal concerns, the ISS has and will continue to serve as a regulatory framework for future space ventures.

While the ISS can provide a governance basis, the details of other legal issues still need to be addressed in order to promote international understanding and agreement. Uncertainty regarding the space goals and activities of some nations can hinder the development of a cohesive governance scenario. Unfortunately, COPUOS has not yet managed to eliminate all of the foreseeable deterrents to international cohesion and cooperation. The time has come for the inauguration of international regulations that will address potentially problematic uncertainties. While there are a multitude of legalities that need to be addressed regarding various space activities and occurrences, the present paper will focus upon three: orbital debris, extra-terrestrial ownership rights and the protection of national assets in space. This paper will also address the possibility of using current national and international law principles as a guide for developing laws that could handle these issues. Additionally, expert assessment from a former NASA Administrator will be provided.

Figure I Nations involved in space activities.

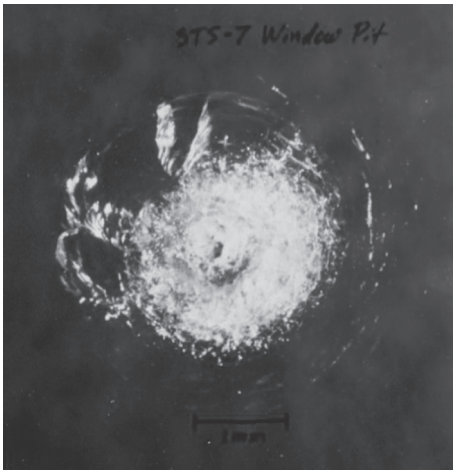


II Space – The Multiple Nation Frontier

The first few decades of space travel were dominated by Russia and the US. Until the 1990's the US space program was, essentially, isolationist in nature. US space endeavours were achieved via NASA and the US military. However, during the last 20 years, due to the end of the Cold War, increased costs, and decreased budgets, the US has increasingly partnered with other spacefaring nations. In June 2010, US President Barack Obama released the US National Space Policy [5], which specified a new emphasis upon international cooperation. Additionally, an influx of other nations into the realm of space activities has resulted in US companies now representing 30–40% of the global space services market; a drastic decrease from nearly 75% of the market [1]. Multiple nations are now active in space activities, as shown in Figure I. Note that the nations shown in Figure I are listed according to the year they were first involved in some type of space endeavour; whether it was the initiation of a national space agency or involvement in space research. Additional nations partaking in the Committee on Space Research (COSPAR) and COPUOS - organized in 1958 and 1959, respectively - are not listed.

The ever increasing involvement of additional nations in space activities is exciting and can lead to greater technological, social, economic, and diplomatic advancements. However, the increased multitude of spacefaring nations can exacerbate currently existing problems. For example, it is estimated that there will exist over 9000 active satellite transponders by 2015; further increasing space debris which has reached a dangerous level [1]. Figure II shows the serious damage

Figure II Space Shuttle window damage due to orbital debris on mission STS-007 [6].



that resulted from the impact of debris less than 1 millimeter (mm) diameter upon a NASA Space Transportation System (STS) – or space shuttle - window in 1983. Satellite activity underwent a climactic surge between 1960 and 1970, with a more steady increase between 1970 and 2000 [7]. Starting in 2000 another period of extreme satellite activity initiated. In addition to an overpopulation of satellites in space, there exist other areas of contention. For example, the political and military aspirations of some nations are troublesome; as demonstrated by the fact that certain nations are jamming satellite signals to censor news [1]. While the present paper will focus upon three particular areas of concern regarding the use and exploration of space by a multitude of nations, the goal is to present these issues with the hope that they will continue to be addressed and ensure the continuation of peaceful space activities. Enabling nations to collaborate and agree upon the proper governance of space can lead to more cost effective partnerships among nations and promote peaceful relations - not only in space but also on Earth.

III Governance of Space

III.I United Nations *COPUOS*

COPUOS was established in 1959 with the intention of ensuring long-term international space cooperation. It was created by the UN General Assembly and had 24 original members. The now 71 member committee has become the primary regulatory and peacekeeping body of international space law, with the following mission [4]:

– To review the scope of international cooperation in peaceful uses of outer space,

– to devise programs in this field under United Nations auspices,
– to encourage continued research and the dissemination of information on outer space matters, and
– to study legal problems arising from the exploration of outer space.

COPUOS established two subcommittees in order to support these complex goals. The COPUOS Legal Subcommittee has been the primary forum for debate and negotiation of international settlements that pertain to the utilization of outer space. The COPUOS Scientific and Technical Subcommittee deals with the technologies of outer space research such as nuclear power sources and remote sensing activities. Together, COPUOS and its two subcommittees work toward the goal of overall consensus of all member nations on any matter that the committee brings up for discussion and negotiation.
COPUOS has drafted five international treaties that were extensively negotiated by its member nations and all of which were ultimately agreed upon. The five treaties and details associated with each are identified in Table I. The "Outer Space Treaty" has been accepted by 101 participants while the "Moon Treaty" is the least accepted with only 13 participants. The five treaties have had their successes and failures, but they ultimately succeeded in covering each of their stated objectives.

III.II ISS Regulations

The ISS is the most successful international spacefaring accomplishment and, as a result, the governance of this habitat deserves close scrutiny when developing future legal agreements for other endeavours. The primary ISS legal agreement that governs how the participating nations interact is the "Inter-Governmental Agreement" (IGA) that was signed on January 28, 1998. Fifteen governments signed the IGA, including the eleven members of the European Space Agency (ESA), Canada, Japan, Russia, and the US. The IGA basically created a foundation of collaboration among international partners that would enable them to operate cohesively on the design, development, operation, and utilization of the ISS, as stated in Article 1 of the agreement. The IGA was, and continues to be, the foundational document that guides all countries involved in the on-going operation of the ISS.
There were also three separate Memorandums of Understanding (MOU's) between NASA and the Canadian Space Agency, between NASA and the Russian Space Agency, and between NASA and Japan. The MOUs are used to identify and clarify the obligations of each partner in more detail. The MOU's exemplified the changes that were occurring in activities, especially the significant increase of Russian participation in international space cooperation.

III.III Maintaining the Peaceful Use of Outer Space

In 2008, the European Union (EU) drafted a *"Code of Conduct for Outer Space Activities"* that deals with threats such as space debris and sets up security measures that would increase international space cooperation. The overall goal of the draft was to foster transparency and trust among all spacefaring nations. In 2010, the EU gathered 110 participants from more than forty countries for

Table I The five UN COPUOS treaties.

COPUOS International Treaties		
1967	"Outer Space Treaty"	• Governs the activities of nations in exploring celestial bodies • Bans the use of nuclear weapons • Allows usage of celestial bodies for strictly peaceful purposes • Declares that celestial bodies are the common heritage of mankind and cannot be claimed
1968	"Rescue Agreement"	• Declares obligation of member nations to provide all possible assistance to rescue the personnel of a spacecraft that crashed within their jurisdiction • Requires that any nation(s) aware of a spacecraft in distress must notify the UN Secretary General
1972	"Liability Convention"	• Deals with the liability of nations and their space objects • States that any nation (or collection of nations) that launches a space object is fully responsible for the possible damages that said space object could cause
1974	"Registration Convention"	• Requires nations to inform the United Nations of the space objects they have in orbit
1979	"Moon Treaty"	• Declares that the Moon and other celestial bodies should be used for the benefit of all nations • Bans weapon testing, altering of environment, colonization, and extra-terrestrial property ownership

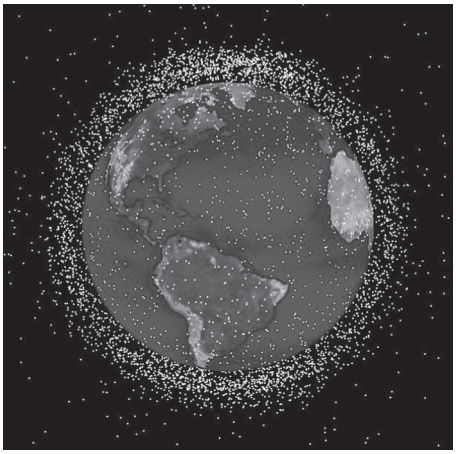
the purpose of debate and discussion of the proposal. Based on the feedback received, the EU modified the draft and scheduled future conferences for further negotiations. The multi-faceted proposal set forth by the EU depends on accountability and understanding. It calls on member nations to create policies they determine will minimize the possibility of accidents and to discontinue any activity that is not for the common good of all nations. Although this code is not legally binding and has no body of enforcement, there is still vehement opposition from some members of US President Obama's administration and, as a result, the US has yet to sign it. Ellen Tauscher, the US Undersecretary of State for Arms Control and Proliferation, dismissed any US participation in the Code of Conduct and stated that it is too restrictive [8]. While no further elaboration was provided, the US has made it clear that they believe the EU Code of

Conduct lays a solid foundation for the formation of a voluntary international code that would create guidelines for conscientious aeronautical behaviour and preserve the space environment for all nations as well as future generations.
The military use of space is a particularly intricate faction of space activities. The more transparency that exists with respect to all usage of space, the more international cooperation will exist to ensure future peaceful exploration. The US is particularly mindful of the importance of establishing a military space presence that encourages trust among other nations and not skepticism. As of 2010 - as outlined in the US National Space Policy - the US military has placed particular emphasis upon embracing international partners in the design and/or operation of military space systems [1]; thus attempting to eradicate the prevalent mistrust with respect to US military space activities and discouraging a build-up of other nations maintaining a secretive military space presence.

III.IV Regulating Commercial Space Activities

Typically, new spacefaring countries follow the space program model of the US and Russia; government-run and government-regulated. However, around the globe, space programs have become more commercialized and the private sector has played a pivotal role in human and non-human spaceflight missions. Many nations depend on partnerships between their government and the private sector. As a result, more stringent emphasis must be placed upon the assurance that commercial entities also understand and abide by space legalities. According to Article IV of the UN Outer Space Treaty, even commercial entities are presumed to act on behalf of their nation or state. Even so, several nations have created laws regulating commercial space activities within their state; these include the Australia, Brazil, France, Norway, Russia, Sweden and the US [9]. A troublesome prospect regards nations that do have launch sites that can be offered to private space companies and maintain no regulatory laws overseeing such activity. Singapore and the United Arab Emirates are primary examples and each nation has expressed serious interest in such endeavours [9]. Unlike commercial space entities, space tourism is presumed to act completely independently of any nation or state; thus is not overseen or regulated. However, utilization and implementation of existing non-space related laws can expedite the formation of the governance of space tourism and, perhaps, provide more specific regulations for the commercial space sector as well. For example, the US has a plan in place to use the US Deep Seabed Hard Mineral Resources Act of 1980 as a model for commercial lunar ventures. This act created a plan to "regulate the activities of US nationals and firms" and established federal protection of the "legal rights that firms had to resources recovered from the ocean floor" [10]. The US witnessed the success of this legislation with respect to oceanic activities and believes that it can bring forth the same results to commercial lunar ventures. Innovative development of space legalities via the use of currently existing laws that govern non-space flight activities may provide alternative options to govern and allow for the immediate participation of additional commercial sector entities.

Figure III LEO is the most concentrated region for orbital debris.



IV Orbital Debris

Traversing space at over 46,600 kilometers (km) per hour, space debris poses serious collision threats to the ISS and the approximately 1000 active satellites in Low Earth Orbit (LEO). The NASA Orbital Debris Program Office is the primary NASA center that conducts orbital debris research. Located at Johnson Space Center in Houston, Texas, the office is recognized around the world as the international lead in conducting measurements of the orbital environment and in developing technical consensus for implementing mitigation measures to protect the environment and its users [11].

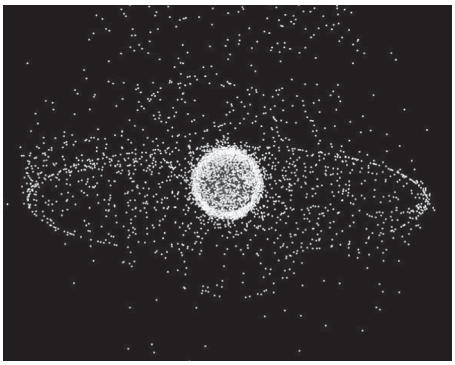
NASA measures near Earth orbital debris using the following methods: analysis of spacecraft surfaces returned from space, ground based radars and optical telescopes, and space-based telescopes. A NASA image of orbital debris in LEO is shown in Figure III. LEO is defined as the region within 2,000 km above the Earth's surface. Another NASA image of orbital debris in Geostationary Earth Orbit (GEO) is shown in Figure IV. GEO extends to 35,786 km above the Earth's surface and maintains much less debris than what exists in LEO.

The NASA GEO image was generated from a distant oblique vantage point in order to provide a good view of the object population in the geosynchronous region. It is interesting to observe that the high concentration of objects over the northern hemisphere is due primarily to Russian objects in high-inclination, high-eccentricity orbits [11].

IV.I 1972 Liability Convention

Even before the existence of the vast array of space artifacts that currently orbit the Earth, the issue of space debris was debated and discussed by COPUOS. In 1972, COPUOS established the third of its five treaties: the Liability Convention. The treaty established a system of rules and regulations regarding space liability situations. The basic purpose of the Liability Convention was to

Figure IV Orbital debris in the geo-synchronous region.



produce a general assertion of what constitutes liability and damage; one that would be universally accepted by all countries involved. As far as the primary purpose was concerned, the convention accomplished its prescribed task. The Convention states that if a nation's launched space object causes damage, the nation is "absolutely liable," and that nations are "jointly and severally liable" for any damage if more than one nation launches the space object [12]. The treaty also states any nation partaking in illegal orbital activities is automatically liable in the event of damaging debris.

The 1972 Liability Convention clearly established foundational liability governance and accounted for any foreseeable scenario at the time it was developed. Many space experts believe the Liability Convention has become outdated and does not account for private entities, advanced space technologies, and the increased multitude of space faring nations. Due to the profound changes in space activities, the broad Liability Convention provisions that enabled the maintenance of peace in space for four decades has now become too broad and has various nations extrapolating different meanings from the ambiguous wording. The wording of the convention may have been sufficient for the time that it was written, but a much more specific set of liability guidelines is direly needed and will be necessary for future space advancement.

IV.II 1974 Registration Convention

The UN Office for Outer Space Affairs (UNOOSA) is responsible for promoting the peaceful uses of outer space and serves as the Secretariat for COPUOS. Since 1962, UNOOSA has maintained a registry of all objects launched into outer space and the UN's 1974 Registration Convention required all nations to report to the UN any space object they have in space. As of January 1, 2011, 56 participants have accepted the registration treaty and the UN reports that approximately 93.5% of all functional space artifacts have been registered. The Registration Convention requires the following information from the launching state [13]:

- Name of launching state
- Date and location of launch

- Space object registration number or designation
- Function of the space object
- Orbital data including nodal period (time between 2 northbound crossings of the equator), inclination, Apogee (highest altitude above the Earth's surface), and Perigee (lowest altitude above the Earth's surface)

While the UN Registration Convention provides a means for maintaining a good record of active space hardware, it does not endorse the limitation of the number of space objects nor address space debris liability. Again, the 1972 Liability Convention is well intentioned, but it does not address treaty enforcement or penalties for violations.

IV.III Beyond the Liability Convention

In the early 1990's, several space faring nations began to realize the need for a more modern approach and governance of space debris. The critical need for solutions to the issue led to various forums being held from 1994 to 1998 in the Scientific and Technical Subcommittee of COPUOS. The discussions and debates eventually resulted in a critical document on space debris: the 1999 UN *Technical Report on Space Debris*. This document was the result of years of intensive research and negotiation. While it provided a solid foundation for the development of future space debris regulation, it provided very little substantive solutions and it was not brought forward to the UN Legal Subcommittee. However, it has proven to be useful for space experts from around the globe attempting to formulate space debris regulation. For example, the Indian Space Resource Organization has been a leading entity in proposing space debris regulation and they use the *Technical Report* as the basis for their efforts.
In 1995, NASA was the world's first space agency to develop a thorough set of orbital debris guidelines [11]. In 1997, based on the NASA guidelines, the US government created the *Orbital Debris Mitigation Standard Practices*. Others, such as ESA, France, Japan and Russia have followed suit with their own guidelines. In 2002, the Inter-Agency Space Debris Coordination Committee (IADC), comprised of 10 national space agencies and ESA, created guidelines to curb the growth of space debris. In 2008, the UN endorsed COPUOS space debris mitigation guidelines that were very similar to the IADC's.
In the summer of 2011, the Council on Foreign Relations (CFR) International Institutions program gathered US and international policy creators in order to discuss space debris as well as other space policy issues. At this meeting it was stressed that even though 11 nations can launch satellites and over 60 nations or governmental entities own and/or operate active satellites, no single nation, or group of nations has the authority or is tasked to regulate space [14]. As a result, the oversight of this dilemma is essentially under the sole purview of nations - individually, or via international cooperation - and their goodwill gestures to address the problem. International cooperation has, indeed, been the modus operandi to control and mitigate the inherent dangers associated with the increase in orbital debris. It has already been demonstrated by efforts such as those of the US Department of Defense (DoD) Strategic Command (StratCom). For many years StratCom has been tracking debris and will alert other

nations when a potentially hazardous scenario arises; such as debris colliding with a spacecraft. The US will even notify China when space debris created, ironically, by the Chinese themselves as a result of a 2007 anti-satellite test, is dangerously close to colliding with their own Chinese satellites [14].

IV.IV Proposed Space Debris Regulations and Solutions

The 1999 UN *Technical Report on Space Debris* as well as the other space debris mitigation guidelines have had a great amount of value and will continue to do so. But many space experts were, and are, left wondering: "what's next?" There still exists a clear and present danger of damaging space debris. Many experts have specific theories regarding future space regulation. Experts from India have formulated an elaborate, wide-ranging proposal that emphasizes the need for a well-defined description of space debris, access to space debri databases from every country, liability allocations for accidents involving space debris, and an "International Guarantee Fund" [15]. The fund would be comprised of contributions from each country based either on launch cost or amount of debris creation. The proposed regulation would focus on restraining "countries from creating harmful space contamination of the outer space environment" and providing "for damages of accidents involving space debris and operational spacecraft"[15]. This multi-faceted plan extracted criteria from both the Liability Convention and the 1999 UN *Technical Report on Space Debris* and greatly expanded upon them, while simultaneously accounting for currently existing advanced space technologies.

While regulations are important, they are only effective if accompanied by one vital component: enforcement. Former NASA Administrator (2005–2009) Dr. Michael Griffin, conveyed an example of a Russian satellite's accidental re-entry into Canada in 1978 [16]. The Canadians had to clean up the spilled radioactive material contained within the satellite. Russia never paid for the expenses incurred by Canada even though the nation was made aware of the associated costs. It is clear that Russia did not follow the Liability Convention's principles in this particular case. This incident demonstrates that the real issue is the need to have "nations sign up and live by those principles." Therefore, in Griffins view, the problem is "not the principles, it is the enforcement."

Space experts have determined that in addition to stringent space debris regulations, additional solutions can be realized via another method: preventing the creation of debris. Griffin stated that it is unnecessary for the rocket stages that place satellites into orbit to even become an orbital debris threat. The rockets can be designed such that they re-enter the Earth's atmosphere and are passive until they do; meaning that their fuel tanks are depressurized, their batteries are de-energized, and that they will not explode. Satellites themselves, if they are at relatively low altitude, can exist for decades or even centuries. The time has come for international conventions requiring active means of taking satellites out of orbit as they approach the end-of-life. The prior practice, over the first five and a half decades of space travel, whereby satellites are placed into orbit and then allowed to remain in orbit after the cessation of their lifespan is unacceptable. Design measures should be required that force low and medium altitude satellites out of orbit at the end of their functional life. A negative

aspect of this requirement would be the burden placed on satellites designers as the packages that will take the satellites out of orbit would add mass to the satellite – an expensive proposition.
Another major space debris issue concerns the geo-stationary belt which has become very crowded and nations need to respect the fact that the geo-stationary belt is an immensely valuable piece of real-estate. Satellites in the geo-stationary belt that are approaching end-of-life must be required to be boosted out of the belt and into higher elevations. There, they will be less likely to hit one another and, if they do, the debris will not be in the geo-stationary ring. Griffin stressed that the aforementioned satellite design requirements have been discussed among space professional for decades, that they are well recognized, many of the principles have already been codified, but nations must simply act to make them a reality.

V Extraterrestrial Ownership Rights

The issue of extraterrestrial ownership rights has arisen frequently throughout the years for many reasons. One particular reason regards the depletion of natural resources on Earth due to an increase in the world's population and the desire to attain more of these resources elsewhere in order to sustain the population. Other reasons include the lucrative aspect of the vast amount of resources in space as well as the human desire to discover unknown treasures in the infinite realm of space. Scientists have verified the existence of resources that could prove to be extremely beneficial to the Earth's population; water and ice, fuels for fusion power, and land. Whereas these resources are becoming, or may become, increasingly limited on Earth, the Moon and Mars have proven to have an abundance of all three.
There is no doubt that space exploration has taken great strides due to the incredible technologies that have been produced, the collaborative international agreements that have been formed, and the increased number of space faring nations. As a result, there is no question that the ability to claim property rights in space exists and will be desired by many nations. A very tricky dilemma results when trying to determine how to regulate a movement of awakened imperialistic fervor that would certainly be more competitive than collaborative. Space treaties that have long been the foundation of the space age do not support competitive and exclusionary colonization of the outer world. The existing regulations instigate contention with respect to space colonization among many space experts. Therefore, it is clear that the time has come for there to be a set of guiding regulations that would prevent competitive and, possibly, hostile procurement of space property.
While extraterrestrial property ownership may be a desire of many nations, the acquirement of extraterrestrial resources may become a necessity for all of Earth's inhabitants. Scientists and specialists have recognized the depletion of many of Earth's resources for the past fifteen to twenty years. There may come atime in the not so distant future where humans will need to search elsewhere for many resources; primarily due to significant environmental problems

coupled with the steady, uncontrollable increase of the Earth's population. B.C. Gruner expressed the concerns as follows [12]:

> *"Consider that each day, about 250,000 people are added to the more than 6.2 billion who already exist. Moreover, the world's population doubled during the past forty-five years, and it is projected to double again within the next fifty years. Many economic theorists are now worried that if the world population continues to rise, the Earth will be depleted of all of its resources and the ecosystem will not be able to support the number of people needing supplies."*

The quote is a clear expression of the direness of the situation. Additional problems such as overgrazing, deforestation, pollution, and urbanization are ever present, and will continue to deplete the Earth's natural resources. Utilizing the rich and unused resources of celestial bodies such as the Moon, asteroids, and planetary bodies is one obvious solution. With the advanced technologies of the modern space age, water and various fuels can be extracted from these celestial bodies. Land may be a resource not required for another couple of centuries, but with the continuing increase in global population and no foreseeable means of reversing it, the time will come when land will be needed. Some scholars believe that this issue is being exaggerated, but there are many experts who believe that the time is indeed coming and mankind would be wise to prepare for this possible scenario.

Dr. Michael Griffin believes that the resources found in space will, in the long run, be used to build up an economy in space. He does not foresee that, from an engineering economics point of view, the acquisition of resources in space can be a utility on Earth. He does assert there will be exceptions made. For example, if an asteroid with large deposits of iridium is found, some of that iridium will makes its way back to Earth and be utilized. The resources found in space will be utilized in space to make it easier to develop space. Griffin elaborated with the following:

> *"The North American colonies and South American colonies were developed by Europe with the idea that they were going to bring all of these valuable things back. While some of that was done - tobacco and beaver hats weren't native to Europe-by and large the resources in the new world were used to develop the new world. The huge majority of economic activity that went on in the new world, in the 500 years plus since Columbus, was in the new world. It did not involve shipping resources back to the old world. As technology has improved over that 500 year period, especially in recent decades, we now find ourselves shipping items all over the world. Oil is shipped around the world, you can buy fruits and berries in the winter that we could never grow here because we ship them up from South America. It has now become economically feasible to move things around in ways that our ancestors could never have imagined. But that is a two way proposition. Items ship back and forth from all over the world; from providers to consumers. It is not a one way transfer of economic material from, say the new world to the old world. I think if you fast forward 1000 years, which is a blink of an eye in human history, I think you will see technological improvements to the point where there is not just an Earthly economy,*

but a solar system economy. And you will see things going in both directions. But I don't think you can ship enough resources from the solar system in an economic way to sustain growing populations on Earth. I think we will need other strategies."

Regarding the possibility of colonization of celestial bodies, Griffin provided the following assessment:

"I think we will but that is speculation, and the speculation depends on the answers to two key questions and the two key questions are as follows: the first question is "can we, in fact, establish human settlements on other celestial bodies using extra-terrestrial resources?" If we always have to take everything with us, that is not going to be an economically viable proposition. I'll just assert that it will never be economically viable from fundamental physics principles to create a space settlement by bringing everything from Earth. The question is can we learn to utilize extra-terrestrial energy and resources. I believe the answer is yes. But the question remains to be settled. The second question is "can we find or develop things in space which are economically useful for human beings to do?" It is one thing to say "I can live off the land," but there must be something important to do. So in order for space settlements to take place en masse, the way humans migrated from the old world to the new world, the answer to both of these questions has to be yes. Right now in 2012, those questions are both still questions. One of the reasons I have been such a strong advocate of space exploration is that I believe the nation or society which first and best answers those questions will be better positioned as history unfolds."

Griffin has stated that he does not believe nations have to claim celestial bodies in order to allow colonization. On Earth, history has shown that when nations tried to claim bodies of land larger than they could effectively control, other nations were able to gain control of the land. Therefore, the ability of a nation being able to claim the Moon, for example, and enforce that claim, is remote. Griffin stated the following:

"So, whereas, planting a research base on the Moon like we have done in Antarctica, it might over a century or so, grow into a colony. That doesn't prevent another nation from doing the same thing in another location. The Moon is a big place. Mars is a big place. There are many, many, many asteroids. The Moon has a surface area the size of Africa and look at how many different nations over the course of western civilization claimed different pieces of Africa and developed it."

As a result, the former NASA Administrator does not believe that the UN Outer Space Treaty will inhibit the effective use of celestial bodies and that the primary issues are more financial and technical than they are regulatory. Griffin added the following thoughts:

"Certainly, human beings, being what they are, when some nation or block of nations, for example, lands at the lunar south pole or the lunar north pole and finds a valuable deposit of ice that can dramatically reduce shipping costs from Earth - because you can use it to make propellant - certainly you are going to see a lot of

interjection by other nations who are not involved in that effort. Other nations will be upset that the nation that got there first is using up that resource and there won't be any left for others. So I think there are going to be many arguments about the use of extra-terrestrial materials when that becomes technically possible. But it won't have anything to with whether or not people are claiming the whole body. At least that is my read on the future."

Human life in outer space depends on the answers to two key questions: "can we establish human settlements on other celestial bodies using extra-terrestrial resources" and "can we find or develop things in space which are economically useful for human beings to do?"[16]. These two questions can be answered and in the distant future a thriving solar system economy with human beings living off of extraterrestrial resources in extraterrestrial locations can become a reality. Many space experts believe that in order for outer space resource extraction to occur, there is a need for new treaties that allow national appropriation of extraterrestrial lands. The existing treaties dealing with the governance of outer space have been ineffective, due to their prohibition of national appropriation. This makes space exploration less rewarding and may hinder the willingness of countries to submit so much effort for so little in return. With proper regulation, specification of extraterrestrial property rights will create more of an incentive to send expeditions to celestial bodies in search of vital resources that can used for the benefit of humans on Earth.

VI Protection of National Assets in Space

The protection of national assets in space is a segment of space law that has remained largely untested throughout the fifty year period of the space faring age. However, as we enter a more modern space age with more advanced technologies and a larger amount of space faring countries, it is absolutely critical that strict regulations are established to ensure the safety and security of humans and property in space. Thus far, there have been no purposeful outer space attacks that could constitute an act of war, but contradictory motives and a higher volume of weapons could alter this fact.

Therefore, it is critical that the regulatory bodies of the UN impose strict rules that would prevent future conflicts, particularly if extraterrestrial property procurement and space colonization become a reality.

Over the past half-century, many of the most significant advances in the space age have been due to fierce competition among nations, whether allies or rivals. The Soviet Union and the US formed the foundation of this competitive nature, and that competitive nature has taken us to unthinkable new heights. Even though international competition has resulted in extraordinary achievements, total international cooperation will be the critical component needed to ensure the protection and sustainment of national assets and ultimately prevent war in space.

The 1967 UN Outer Space Treaty has been the most prominent example of an attempt to prevent conflict among nations in space. The architects of this hallmark treaty purposefully took a very cautious stance on space activities by prohibiting

property rights and the use of nuclear weapons. By instituting these two expansive bans, the treaty architects made it extremely difficult for competing space faring nations to claim what each nation may view as their property to utilize for their own good. Thus, the 1967 treaty lessened the likelihood of international tension and diminished the chance for retaliatory acts of war to be committed. The Outer Space Treaty has been beneficial during the space age as a whole, but there are many elements that make it difficult to follow in the future. The modern space age is not the same as the space age under which the treaty was established. As technology continues to develop and countries are growing more anxious to flex their technological power, this treaty is turning more into a frustration than a peacekeeper. One expert pointed out an interesting fact in that the technologies we utilized to reach space were technologies bred from war, so it is ironic that "the law of peace should govern the sciences of war" [17]. This paradox can be a potential danger, and the Outer Space Treaty does not take this into account. Thus, once again, the 1967 Outer Space Treaty is proving to be a bit outdated and in need of editing. As multiple countries are indirectly developing more methods of space warfare, the maintenance of peace in space is becoming more complex and many experts believe that the time has come to establish a new treaty that would accommodate for this evolution in space technologies, without binding the pursuits of the countries involved.

VII Conclusion

International cooperation in space endeavors has proven to be transformative with respect to technological, economic, social and political advances. The development of numerous treaties over more than 40 years has also derived from international efforts via discussion and debate. The treaties have aided in the maintenance of peaceful space pursuits and the goal is to continue such. However, with increasing numbers of nations partaking is space activities as well as a tremendous increase in the number of space artifacts, the need for continued developed and refinement of space regulations and governance is mandatory. The issue of space debris is a current and ever-present risk that needs to be mitigated. Extra-Terrestrial ownership rights and the protection of national space assets are also issues that require attention in order to properly assure that future situations in these two realms will result in the continued peaceful and cooperative use of space. Therefore, multilateral partnerships and agreements need to be executed to ensure the perpetuation of the peaceful use of outer space. There are clearly many different educated theories on how to best to answer the questions associated with these critical topics. However, the most important result of these discussions should be that now is the time to address the issues.

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