

PRIVATE ENTERPRISE LIABILITY FOR SPACE SERVICING*

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Abstract

A satellite may orbit the Earth at different altitudes. At the altitude of 35,786 km (22,300 miles) the satellite's orbital period matches the period of the earth rotation. Such satellites are called geosynchronous. When the orbit lies entirely over the equatorial plan the satellite remains stationary relative to the Earth's surface and it is called geostationary. Another type of geosynchronous orbit is the Tundra elliptical orbit that is a highly elliptical orbit with an inclination of 63.4° and orbital period of one sidereal day. A satellite placed in that orbit spends most of its time over a chosen area of the Earth, a phenomenon known as apogee dwell. Due to the numbers of GEO satellites orbiting the geostationary belt, there is increasing concern about the destiny of those satellites once their lifetime is over. Dead satellites become space debris. They not only occupy a place in orbit for nothing but can in the future cause in-orbit accidents by crashing into other spacecraft. The same risk exists for dead satellites in low earth orbit (LEO) due to uncontrolled re-entry. The amount of space debris in LEO is much larger than that for GEO satellites. With the assembly of the International Space station (ISS), there is an increasing concern about the damage debris may cause to it. ISS is a large space target for any kind of debris. The potential risks of in-orbit and on-Earth accidents due to space debris increased in such a way as to become the object of international treaties and space laws. In this context the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies states regulations to prevent and to point liabilities on organizations involved in space explorations. Brazil has subscribed the treaty and stated internal regulations under which the Brazilian Space Program is executed. A Brazilian Federal Executive Law states the civilian liability enforced in all the country for possible damage caused by non-governmental institutions in space exploration. The state party liability regarding organizations involved in space technology as, for example, outsourcing enterprises is accounted for in the Convention on International Liability for Damage caused by space objects. Brazil also is a state party of that convention, regulated in the country by Treaty Promulgation via Federal Executive Law. By following the Public International Law of interstate liability it is important to note that non-governmental entities would be free of direct liability even when many of them have economic conditions to pay for the damage. The treaties blame the state only when the action is for fault, in opposition to the premise that, in the activities generating the risk the agent

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responsible for the damage should be in charge on the base of the developed activity and not just on the basis of eventual negligence. On the other hand, the treaties while in charging only the state in terms of by fault actions opposes the premise that in activities which cause the risk, the agent responsible for the damage should be charged on the basis of developed activity instead. In this sense it is worth thinking of a clear separation line between private and public liability in front of the powerful control of the world big corporations, in particular those of the space segments. In spite of the expenses related to space coming mostly from public source or governmental decisions (apparently state-sovereignty decisions) those decisions are often taken under strong pressure of private enterprises where the particular interests triumph over the public benefit, which should in principle be closely linked to the technological development and the associated return. A corollary of these comments above is the need to analyze and discuss the implications of space servicing activities related to retrieve, de-orbit, repair and treat space debris in general when space operations are under private enterprise responsibility.

Introduction

In 2007 we commemorate the fiftieth anniversary of the space age. 1957 was the year the former Soviet Union launched the Sputnik. The first artificial satellite had nothing to do with the peaceful use of outer space. It was a subject of military power associated with the cold war, the environment of fear and aggression the USA and the former USSR got involved in since the end of the World War II. At that time if a country could launch a satellite into orbit it would at least raise a question of whether that country could use a missile to deliver an atomic bomb. Despite the fears and tension of the cold war days, the Sputnik marked the beginning of a golden age in the human understanding of the universe. The use of spaceflight for politics and propaganda purposes soon grew up into much more as scientists began to realize the potential of such an insightful change in perspective. Mankind's vision of the universe and of our blue planet from space has changed significantly since the year 1957. Remote sensing, telecommunication applications, Earth resource and environmental protection, scientific research and in-orbit engineering and biological experiments gave birth to a new view of space exploration. Since the sputnik hundreds of space vehicles have populated the space environment around the Earth and beyond. The remarkable progress of the space era has accomplished the ancient human dream to go to the Moon, the space stations, the space telescope, the

sending of robots to Mars and automated vehicles beyond the solar system. Enormous quantities of new information and communication technologies have been evolving alongside the space era. New sensors and several electronic devices populate the new technologies related to space. New disciplines were born in the shadow of the challenges scientists have faced to go through space. Man got to know and learn about working in the zero-g space environment. Spacecraft advanced in size and complexity while applications spread into many areas. The orbital environment has become known and specific orbits were planned for several different missions. The geostationary orbits (GEO) were found to be the perfect place for telecommunication spacecraft. Thousand of missions in low earth orbit (LEO) result in a large number of spacecraft orbiting the Earth in the range of 200 to 2000 Km altitudes. After fifty years of space exploration, however, mankind has found out that the orbital environment is getting more and more polluted by space debris risking other space missions and also life on the ground. The fears of satellites uncontrolled reentries risking contaminating the Earth with nuclear radiation (from nuclear powered space ships) and the growing probability of spacecraft crashing with space debris have contributed to the birth and evolution of international space law. Several other reasons motivate space activities regulation. One of them concerns the GEO belt. Once the satellite reaches the end of its life, it must be replaced to avoid discontinuing

telecommunication operations, essential, for instance, for television transmissions all over the world. However, ending the lifetime does not mean that the satellite will fall down to reenter the atmosphere. On the contrary it may remain there as trash for centuries. The solution to these problems shall come with space activities regulation. It is common sense today that every GEO satellite to be launched must reserve part of its fuel to deorbit the spacecraft when its lifetime ends. International space law is just a response to problems and risks caused by space exploration. Law must define liability and crimes. The human technological and scientific development with cars, aircrafts, ships and an enormous variety of revolutionary inventions, discoveries and scientific advances were and are still the object of liability and regulations. It will not be different with space exploration activities. Past experiences have demonstrated a strong tendency of mankind to use everything for both good and bad. It happened with aircraft, nuclear energy and uncountable other human accomplishments. It is necessary to preserve the space environment against damage, pollution, military applications and many other actions that may risk the future of space missions as well as human life on the ground. It is very difficult to prevent all the bad things that may arise from space exploration. However, attention must be directed to the fact that space activities are increasingly involving private initiatives with market pressure on the weak body of regulation already in force by the countries that had signed some international space treaties. Space servicing exploration is motivating private companies to develop space tugs and associated strategies to do business in space. Also space tourism with focus on space business is emerging. All these aspects press for the development of international space law with the goal of establishing liabilities of Institutes, companies, entrepreneurs, and national governments for their future space activities. The space law development and implementation is directly linked with the potential danger of large space vehicle uncontrolled reentry, the usage of nuclear energy for satellites in space missions, space debris, and military space applications. Also there is concern to avoid any space domination for any specific country. The idea

is to assure the same rights to every country in space activities, independently of their culture and present technical development. According to Monserrat Filho¹ the set of regulations of the international space law (*Corpus Juris Spatialis*) is a consequence of space race in a bipolarized world environment having on one side the USA and on the other the former Soviet Union. After the destruction of Berlin wall in 1989 and the subsequent end of the Soviet Union the world lost its power bipolarity and the center of the economic and politics power became Washington. However, what the world saw after the fall of the Berlin Wall was a strong increase in cooperation between the USA and Russia in the space area. The same cannot be said about the space activities regulations. This is an area that involves not only scientific and technological development. In the USA the area is always tied to business with strong participation of private companies in space activities. By principles and philosophy the USA government regulates the economic activities but does not control them. This is not the case of several other countries in the world where the government interferes in the economic and business areas. Space legislation has been characterized by the massive influence of the USA since the end of the former USSR. The present scenario in the space law area calls for a new body of legislation that does not satisfy only the bipolarized world of the cold war nor the USA world polarization after the end of the cold war. A question arises as to whether the *Corpus Juris Spatialis* is adequate for the XXI century space scenario. At this point it is worth repeating here the Louis Assier-Andrieu² teaching about changes "the successive adaptations to the facts that determine social life: those adaptations make obsolete old laws, give birth to new ones which in turn are defeated by the course of social change". Presently the private side of space exploration is coming about with some initiatives in tourism and orbital services areas. The involvement of private companies in the space activities requires regulation not coded so far. Nowadays we have recommendations and agreements from countries and state agencies mostly based on the Outer of Space Treaty. To avoid problems in a new future regarding the use of outer space by private organizations we need

specific international coded legislation ratified by all the countries whose technologies make them eligible to be involved in space exploration. It is necessary to guarantee that business does not do what it is doing with our rain forests and rivers uncontrolled exploitation. What if a private organization starts making unethical use of outer space exploration for one's own advantage or profit? In a world characterized by globalization contracts may involve different states possessing particular legislation about space exploration. Question arises when two or more countries implement joint projects. Who is who in terms of liabilities for the activities involved in joint multi national projects in the space area? What legislation prevails? Does that legislation conform to the international recommendations of Outer of Space Treaty and other similar international agreements? Junqueira³ discusses this problem and a question coming from the Brazilian Space Agency regarding a NASA cross-waiver of liability in a bilateral cooperation contract. Would be that cross-wave of liability valid under Brazilian law? What if Brazilian Law does not recognize that clause coming from the USA law in the bilateral cooperation agreements? By that principle of cross-waiver of liabilities each country waives the other for liabilities regarding joint cooperation in the space activities.

In the sense of the cross-clause it is not difficult to envisage private companies from different countries joined in international projects to provide space services and/or space tourism. If countries have different legislations (if any) regarding space activities, what legislation would prevail? If one part inserts in a contract a cross-waive liability clause, would it be in conformance with the signatory country' law? Do we have an international recommendation to take into account such a scenario in bilateral or multi lateral contracts? It is necessary that the International Space Law envisages situations like that and establishes recommendations to input liabilities in an ethical and fair way. In addition to the legal aspects there is also a risk that parties technologically less developed be compelled to accept countries technologically better developed impositions in contract with clauses such that of cross-waive of liability.

It is worse to point out here that space services to clean the orbital environment may

become much more attractive because of ISS assembling in orbit, becoming the largest target for space debris ever built by mankind. A look at the numbers may indicate the possibility of private business in space: it is estimated that there are at least 8000 trackable objects in near-Earth orbits. Those objects are baseball size or larger and can be tracked by ground-based radars. Of those 8000 objects about 400-500 are operational spacecraft. The others are space junk! This space junk or orbital debris includes things such as hatches blown off space modules, garbage discarded into space from past space stations, or dead satellites. In addition to the 8000 trackable objects, there are millions of flecks of paint, metal or plastic that are currently in space. Much of this smaller space junk has come from the explosion of rocket stages or the explosion of satellites and their parts. The space servicing market has been the subject of studies to give direction to enterprises interested to make business in space. The work of Kalina K. Galabova⁴ computes, classifies and analyzes in-orbit satellites to provide enterprises with elements for cost/benefit estimation and the conclusion is that the market promises to become very good for business. Galabova's work offers a different approach to space tug architecting that is based on realistic and need-driven mission scenarios. Also, it quantifies the economical feasibility of space tugging in orbit services. One of the strongest initiatives to explore the outer space business possibilities refers to the public-private Orbital Recovery System (ORS) involving ORL (private), ESA, and DLR space agencies (publics). The ORL intends to provide life extension and other services from 2009 onwards for geostationary communications satellites suffering from propellant depletion. The orbital services to be provided by ORS are clearly by the orbital environmental preservation side against space debris orbital pollution. In this sense the ORS public-private initiative is welcome. However concerns are addressed towards this new open window for other companies all over the world may look for different outer space business opportunities that may risk the space environment and even risk life on the ground.

One new segment of the private exploration of space refers to so called space tourism. Space tourism is the recent phenomenon of individuals paying for space travel, primarily

for personal satisfaction. The idea is not new and what is interesting is the greater impact space tourism has in the public mind. The space tourism is nowadays frequently the subject of printed and broadcast media. The idea of space tourism is not new⁵.

In 1950s we had the first wave of optimism about rocketry designs for space stations and Moon-bases. The first private company appeared in the scenario of space exploration, the Aeroneutronic Ford and the American Rocket Society. That initial dream gradually evaporated as the cold war took over. In 1967 Barron Hilton and Kraft Ehrlicke⁶ published a paper about space tourism dealing with Space Hotels. The abstract of the paper states, "The possibility of an orbiting or lunar hotel is discussed. It is suggested that when space scientists make it physically feasible to establish hotels in space and to transport people, the hotel industry will meet the challenge."

In 1984 David Ashford of Bristol Spaceplanes in England published the first of a series of papers on 2STO HTOL vehicles for space tourism.

In 1996 it was announced the Ansari X Prize. \$10 million dollars was offered to the first privately financed team to fly at least one person to an altitude of 100 km twice within 2 weeks in the same vehicle, which must be capable of carrying 3 people. The prize attracted 16 teams to announce their intention to compete in mid-1997.

Market Research has shown that the idea of space tourism is very popular. And so, just like aviation, the launch industry is going to find that most of its business will be carrying passengers. The possible size of the market for space tourism was discussed in a number of papers in the 1980s (B Citron, P Collins and D Ashford⁷) and again in a study by a group of US aerospace companies (CSTS) in 1994. But the first actual market research was carried out in Japan in 1993. The results of this survey were extremely positive - some 70% said they would like to travel to space, and almost half said they would pay 3 months' salary to do so. In 1995 small surveys were carried out in Toronto and Berlin, followed by a nation-wide telephone survey of 1020 people in Canada and USA. These surveys⁸ all found that the idea of space tourism is massively popular. In 1997 the US "National Leisure Travel Monitor" survey included questions on space tourism

for the first time. Of 1500 Americans surveyed, 42% said they would be interested in flying in a space cruise vessel, and would be willing to spend on average \$10,800 for the trip.

These data allow us to infer that private companies will be coming into the scenario in the near future to explore space tourism. Those flights will carry people into space. So it is reasonable to question carry coded laws to regulate those activities and establish the liability for private companies involved in space tourism.

Papers, symposium, colloquia and a lot of other activities have been engaged in analysis and research of the business possibilities with space tourism.

In 2001 a billionaire businessman from California has become the first paying passenger to go to outer space. South African businessman Mark Shuttleworth did the same in April 2002 becoming the 'First African in Space'. Greg Olsen became the third private citizen to travel to the ISS in October 2005, followed by the first female space tourist, Anousheh Ansari, who completed her 10-day orbital mission in September 2006. Microsoft co-founder and creator of Word and Excel, Charles Simonyi, became the world's fifth space tourist in April 2007.

What do we have nowadays towards space law regulations for space tourism?

As always new areas of mankind actuation not regulated by law require coded regulations. One example refers to Internet use. There were no regulations for example for liability of web use. Nowadays hackers and Internet abuse are under law in several countries. One area that has been consolidating the private actuation in space activities refers to satellite launchers.

In the information society, as national and international tourism is offered at travel agency sites, so space tourism is equal offered by private enterprises. In the words of Barreto Júnior "*the contemporary society is going through a true digital revolution where are solved the frontiers between telecommunications, mass media and informatics. There is a convention naming this new historical cycle as information society*"⁹. As Barbosa well illustrate: "*it is possible to conclude that there is still a gulf which divides the information society. It's inequal, unfair, with an obvious imbalance*

between the inhabitants of the two hemispheres of the planet and even between different groups in the same country"¹⁰.

The British National Space Centre (BNSC)¹¹ is preparing regulations that will affect space tourism companies in England. To formulate a regime for licensing UK companies' space tourism activities as Flight international reports, BNSC will be looking at proposals over the next few months and asking "stakeholders (which could be space law firms, insurance companies and relevant government departments), their views on space tourism for the manned suborbital flight licensing system. Note that the regulation of the space tourism activities and enforcing nations to be responsible for the space activities of their citizens is in accordance with the article VI of the Outer of Space Treaty that states "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty".

In the USA, December 2005, the Flight Aviation Administration (FAA)¹² released a report containing the Human Space Flight Requirements for Crew and Space Flight Participants. If adopted the rulemaking would establish requirements for crew qualifications, training, and notification. It would also establish training and informed consent requirements for space flight participants. The rulemaking would also modify existing financial responsibility requirements to account for the FAA's new authority for space flight participants and crew, and to issue experimental permits. The requirements are designed to provide an acceptable level of safety to the general public, and to notify individuals on board of the risks associated with a launch or reentry. This would regulate the referred space activities in the USA. This year the FAA¹³ proposed revisions to amateur rocket regulations and activities (Federal Register Vol. 72, No. 114 Thursday, June 14, 2007) to preserve the level of safety associated with amateur rocketry. This national legislation cannot be applied internationally but can play a role of good and correct example to other countries.

As we can see countries are aware about regulating private initiatives to do business with space activities. The main framework for the international space law is recommendations of the Outer Space Treaty. Some the complaints against the lawyer as we can see in the abstract of the following publication¹⁴: "...With space tourism and law it is a typical situation. Every time somebody develops a vision and plans to make it feasible, it is just a question of time until lawyers show up to complicate the situation". Space tourism promises to become a multi-billion-dollar-business, and it is certainly a challenge to create or arrange a legal environment for this undertaking. As of 2007, space tourism opportunities are limited and expensive, with only the Russian Space Agency providing transportation. The price for a flight brokered by Space Adventures to the International Space Station aboard a Soyuz spacecraft is now \$30 million dollars. Flights are fully booked until 2009.

Private organizations must conform to their respective national law for any space activities. The several different national legal situations will require a great effort to state a body of international law to regulate the space tourism activities and the space tug orbital services.

The private enterprises that perform space tourism and those targeting space servicing in outer space also must at least conform to international regulations, since international interests are touched. It is not new that private enterprises participate in space activities. That participation mainly takes place in an indirect way, which means that governmental or non-governmental entities delegate certain tasks on private enterprises. In this case the governmental recommendations and legislation for space activities prevail. However, space tourism will require another dimension: direct or leading participation. Therefore the legal conditions regarding private activities in outer space must be examined. Considering that national states are responsible for any activities in outer space carried out by their governmental entities or private enterprises, a state must choose between two options: no direct private activities in outer space at all - or establishing best-possible regulations and control-mechanisms to avoid damage from private enterprises activities.

Brazil has subscribed the treaty and stated internal regulations under which the Brazilian Space Program is executed. A Brazilian Federal Executive Law states the civilian liability enforced in all the country for possible damage caused by non-governmental institutions in space exploration. Also, Brazil is a state party of the Convention on International Liability for Damage caused by space objects, regulated in the country by Treaty Promulgation via Federal Executive Law. The country has two collecting data satellites and two Earth Resource Satellites (Chine-Brazil Earth Resource Satellite, CBERS) operating in a LEO orbit. Whether countries go through space in national or multinational projects, it is necessary for the governments and national laws to regulate and point liabilities for the outer space activities.

The Outer of Space Treaty recommendations impose responsibilities on countries or governments involved in space activities for damages and space environment pollution. The private companies must be in accordance with their country laws. Indirectly, when a government regulates space activities for their private companies it is in fact charging private organizations for the damages and risks their activities may cause to people or to the space environment. We have focused the space services in this paper on space tugs and space tourism activities. In this sense tourism space ships shall work in accordance with the regulations valid for other space missions. An accident with any space vehicle can generate space trash and can also risk areas on the ground that may be inhabited. In the scenario of private organizations in space activities we shall consider the impact of the private initiatives by pressing the state policies regulations for the space area.

Conclusion

This paper focused on the international space law question related to private companies' initiatives toward the exploration of the space services, including space tourism. The paper discussed briefly the Brazilian position with respect to the Outer of Space Treaty and other international recommendations for the use and the exploration of space and the problem of cross-clause inherent in some bilateral and multi lateral contracts. The

space services to be provided by space tugs and space tourism are discussed in the light of the international space law. The authors suggest that international space law recommend directions to overcome the problem of cross-waive of liability in the context of world globalization, characterized by bilateral and multilateral agreements with respect to the space activities

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