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TANGIBLE AND INTANGIBLE PROPERTY IN OUTER SPACE

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1. Introduction

Property in space is certainly one of the most important issues for the future not only in the context of the more classical form of tangible property such as minerals but also intangible property such as orbital slots on the geostationary orbit, frequencies, etc.

As far as the exploitation of mineral resources is concerned the similitude is striking between space law and the law of the High Seas and Antarctica. In studies on the law of the high seas and Antarctica very often reference is made to concepts of property used in Roman Law such as "*res nullius*" , "*res communis omnium*" etc.

A typical example of this is found in one of the most important historical sources of the law of the sea namely Hugo Grotius' "The freedom of the seas"[1] e.g. "....Vergil also says that the air, the sea, and the shore are what Romans call "common" to all men by natural law, or as we have said, "public" according to the law of nations; and indeed they call their use sometimes common, sometimes public. Nevertheless, although those things are with reason said to be *res nullius*, so far as private ownership is concerned, still they differ very much from those things which, though also *res nullius*, have not been marked out for common use, such for example as wild animals, fish, and birds. For if any one seizes those things and assumes possession of them, they can become objects of private ownership, but things in the former category by the consensus of opinion of all mankind are forever exempt from such private ownership on account of their susceptibility to universal use; and as they belong to all they cannot be taken away from all by any one person any more than what is mine can be taken away from me by you. And Cicero says that one of the first gifts of justice is the use of common property for common benefit.....".

Another quotation is, by analogy, to space activities even more relevant: "And in Plautus' Rudens when the slave says : - the sea is certainly common to all persons - the fisherman agrees; but when the slave adds: - then what is found in the common sea is common property -, he rightly objects, saying: - But what my net and hooks have taken, is absolutely my own -."[2]

The similitude between the fisherman and an astronaut removing samples on the moon is remarkable but what about the outcome??

The answer is not straightforward and a closer look to some concepts of Roman Law which are used in this context is desirable for a good understanding.[3]

2. Tangible Property

2.1. "Property" under Roman law

Under Roman Law "*res*" or things are classified into *res corporales* and *res incorporales.*
Within *res corporales* a certain number of things are excluded from trade "*res quarum commercium non est*", normally referred to as *res extra commercium.*[4]
Objects qualified as *res extra commercium* are sub divided into three distinct categories - (i) *res publicae,* (ii) *res divini iuris* and (iii) *res communis omnium.*
(i) Objects qualified as *res publicae* are common property of the roman people subject to governments regulations. This includes public roads, flowing rivers, lakes, water distribution conducts etc.
(ii) Objects qualified as *res divini iuris* are put under the protection of the Gods and include *res sacrae* mainly temples and objects used for worship, *res religiosae* - burial places which were sacred and could not be subject of trade *res sanctae* e.g. the city walls.
(iii) Finally objects qualified as *res communis omnium* are available to all and cannot be owned by anyone not even by a state e.g. the air, rain and flowing river water, the sea and shore. With the exception that over the shore the state exercised certain rights (*litora maris*).
Ownership is normally acquired through effective possession but this is not sufficient in itself, also required is that this possession results from a legal act - *iusta causa possessionis*. e.g. purchase - *pro emptore*, donation -*pro donato* etc. A special way of obtaining property is through occupation - *occupatio* of things which belong to no one. The latter are qualified as *res nullius* and may be subject to appropriation through effective occupation and the will expressed by the [new] owner to exercise ownership (*corpore et animo*).[5] There is thus either an absence of original title which could be transferred as is normally the case from the former owner to the new one, this because no one has ever claimed ownership, or the former owner has abandoned ownership (*res derelicta*). For this kind of acquiring property more stringent rules were applied.

As shown in the example quoted by Hugo Grotius the sea is considered as *res communis omnium* which means that it is not amenable to appropriation but what is in it is, including the water of the sea itself.
For a good understanding of the underlying reasoning a closer look at the meaning and use of the two notions *res nullius* and *res communis omnium* and on how they interact is necessary. At first sight one could conclude that

since the sea is *res communis omnium* which is part of the wider *res extra commercium* it could never become *res nullius*. Since if this would be the case the sea could become at least in theory subject of private ownership through occupation and consequently subject of trade which by definition is excluded.
In practice the Romans looked differently to the issue when considering the sea as a whole or when considering its constituents. In the former case they qualified it *res communis omnium* and in the latter *res nullius*. Or in more general terms "*res communis* differs from *res nullius* in that the source of the resources cannot be appropriated but the resources themselves are amenable to appropriation".[6]
This apparent contradiction finds, inter alia, its origin in the impossibility of satisfying one of the basic conditions for acquiring ownership of goods which belong to no one, namely, effective occupation. It goes without saying that this is for the sea as a whole impossible.[7] On the other hand this condition could be satisfied easily for fish and some quantity of sea water, e.g. "if you bring the sea (water) into your estate for private fish reserves then the interdict *uti possidetis* applies"[8]. These resources were looked at as inexhaustible and their appropriation was physically possible and would moreover only be partial leaving thus the possibility to others for future exploitation and use of the sea.
Hugo Grotius evokes however, though briefly, the possibility that fish could be an exhaustible resource of the sea but in his view this would not alter the legal status of the sea as a whole.

"And if it were possible to prohibit any of those things, say for example, fishing, for in a way it can be maintained that fish are exhaustible, still it would not be possible to prohibit navigation, for the sea would not exhausted by that use."[9]

The contradiction is thus only fictitious since the use of the sea keeps its status of *res communis omnium* untouched.
The freedom of navigation (use) was in the eyes of Hugo Grotius the most important result of the non appropriation thesis which he defended and which is at the origin of his work. It is amazing that this freedom which is essential for all space activities is not mentioned in any of the Outer Space Treaties. Maybe as Hamilton DeSaussure argues "it is so basic to the exploration and use of Outer space that it must be considered as inherent in the launching and orbiting of all space objects".[10]

2.2. Property of Celestial Bodies

What now about Outer Space ? One could consider Outer Space as the combination of interstellar space and celestial bodies. The interstellar space would be similar to the sea and the celestial bodies to *res nullius*. Or one could also assimilate Outer Space as a whole to the sea whereby the celestial bodies are its resources similar as the fish in the sea. In the first case only the interstellar space would be *res communis omnium* and in the second the entire Outer space would qualify for it. It being understood that in the latter case the celestial bodies would be amenable for appropriation similar as the fish of the sea. In conclusion, de facto, in both cases the celestial bodies would be *res nullius*. Notwithstanding this identical qualification there are however some fundamental difference between the resources of the sea as seen by the romans and celestial bodies.
First of all a celestial body, as for example the moon, is closer to the notion of *terra nullius* than *res nullius*.
Terra nullius is usually used for large pieces of land or islands for which no owner was known or recognised. The concept has been alive for centuries and is still used nowadays in disputes or settlements on sovereignty rights over land between states.
Secondly, the number of celestial bodies which could be of interest to men are very limited and thus certainly not inexhaustible.
In other words once ownership is acquired for part or in whole of a celestial body this part will automatically be excluded for others which clearly contradicts the principle of *res communis omnium* and the similarity with the inexhaustible fish in the sea. Remains thus only the first possibility amongst the two i.e. the interstellar space is in legal terms similar to the sea whereas the celestial bodies are *terra nullius*.[11]
Coming back to the *terra nullius* concept. As said this concept is normally used when referring to land although sometimes *res nullius* is also used. The way of acquiring ownership for large pieces of land is ,however, in practice different from movables or immoveables like buildings.
Historically title of sovereignty of *terra nullius* was acquired by a State when it discovered new land followed by effective possession.[12] Or as S. Pufendorf puts it: "The base seeing a thing of the knowing where it is, is not sufficient Title of Possession".[13]
Discovery alone never has conferred a complete title of sovereignty, it resulted only in a inchoate title. Effective occupation was for centuries the overriding principle. It is true that the effective occupation principle has somewhat be dilute over the centuries and that in some cases the mere fact that a State landed for the first time on an island without any further activity was considered sufficient to satisfy the condition of effective occupation.[14]
The Clipperton Island case is a typical illustration of this change. In that case the arbitrator concluded that "if a territory, by virtue of the fact that it was completely uninhabited, is, from the first moment when the occupying state makes its appearance there, at the absolute and undisputed disposition of that state, from that moment the taking of possession must be considered as accomplished and the occupation is thereby completed."[15]
For Outer space by analogy and under the assumption that celestial bodies are terra nullius the fact that a new celestial body is discovered does not give any rights other than the paternity of the discovery itself to the discoverer. An additional act would be necessary for acquiring property rights namely, an act of effective occupation.
A more recent case Denmark v. Norway concerning sovereignty rights over Eastern Greenland diluted even

more the condition of effective occupation. In this case Norway "occupied " in 1931, with a view of establishing sovereignty rights, Eastern Greenland which it considered as *Terra nullius*. Denmark brought the case immediately before the Permanent Court of International Justice. The Court redefined the notion of effective occupation by arguing that effective occupation required both intention and will to exercise sovereignty and manifestation of state activity and thus a contrario effective occupation was not really required.[16] The decision was criticised since it was difficult to accept that it would be possible to acquire sovereignty rights over on a piece of land bigger than Europe as a whole without any act of effective occupation. Or to put it differently "It would be altogether unreasonable if a State, by annexing a portion of such a vast land should obtain sovereignty over the whole country."[17]
In this case the fact that for western Greenland Denmark sovereignty rights were internationally recognised played certainly an important role in the decision making process of the Court. Another important consideration was the physical characteristics of the area which was very hostile and difficult to access.[18]
This case is understandably extremely important for space activities (same hostile place and of difficult access) for if a celestial body would qualify for *terra nullius* it would be sufficient for a state to only have the intention and the will to exercise sovereignty combined with at least some local effective occupation for acquiring sovereignty rights over the celestial body as a whole.
A step further in diluting the effective occupation would be to accept that by dropping an object made by a state on a *terra nullius* followed by a clear expression of that state of its will to establish title of sovereignty it would actually acquire such rights.
For Outer Space the question arose for the first time when a soviet spacecraft carrying a soviet flag stroke the moon as early as September 1959. This event led to considerable discussions notwithstanding the fact that the Soviet Union indicated from the beginning that it had not the intention to seek any claim of sovereignty through this act.
In order to avoid similar problems for the Apollo program when an American flag would be put on the moon a special bill was enacted in the United States. Sec. 8 of the US Law on the Implantation of the United States Flag reads as follows:

"the flag of the United States, and no other flag, shall be implanted or otherwise placed on the surface of the moon, or on the surface of any planet, by the members of the crew of any spacecraft making a lunar or planetary landing as apart of a mission under the Apollo program or as a part of a mission under any subsequent program, the funds for which are provided entirely by the Government of the United States. This act is intended as symbolic gesture of national pride in achievement and is not to be construed as a declaration of national appropriation by claim of sovereignty."

In conclusion there was a time where the qualification of celestial bodies as *terra nullius* was conceivable from a legal point of view and in line with customary international law, claims of sovereignty based on effective occupation could certainly have been recognised.
But already in the mid fifties even before the launch of the first satellite a theory was developed according to which territorial sovereignty should be excluded in Outer Space. "The first step... had been taken at the private level in 1954, on the occasion of the fifth Congress of the International Astronautical Federation (Innsbruck), where a theory was developed according to which Outer Space and celestial bodies should be considered an object of conquest by mankind for mankind. This thesis was embodied in the expression *res communis humanitatis...*".[19]
The extreme competition between the USA and the USSR in the conquest of space and the fact that neither was sure to win the race worked in favour of the exclusion of territorial sovereignty in Outer Space. Also in favour of the concept of *res communis humanitatis* was the profound change of the political scene which took place during the late fifties and early sixties. During that period many countries became independent and the third world started playing an important political role which was equally influenced by the East - West confrontation. It was also for these reasons inconceivable to defend a legal regime whereby one nation would be allowed to establish sovereignty rights in Outer Space. In order thus to avoid any uncertainty as to the outcome of the question of what effective occupation of Outer Space in whole or in part could lead made it necessary to define in a treaty the status of Outer Space. This was done in the Outer Space Treaty with the introduction of the principle of non appropriation of Outer Space, including the Moon and other celestial bodies, laid down in article 2 of the Outer Space Treaty "Outer Space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use of **occupation** or by any other means" (emphasis added). National appropriation in this article clearly refers to the concept of territory and sovereignty[20] which is different from the concept of property in civil law.
The specific phrasing of article 2 clearly rejects, insofar as appropriation by a State is concerned, the qualification of celestial bodies as *terra (res) nullius*. In other words it is not possible for a State to acquire sovereign rights over celestial bodies through occupation.
The Outer Space Treaty changed thus the status of Outer Space celestial bodies from a historical and logical justified *res* or *terra nullius* to *res communis omnium stricto sensu*. [21], [22]
Legal issues are however seldom straightforward and unambiguous this is unfortunately also the case here. The wording of article 2 refers only to national appropriation but is silent as to appropriation by legal or natural persons. This ambiguity kept according to some specialists in space law for some time options open.[23] Nowadays it is generally accepted that appropriation by anyone of parts of outer space is prohibited.
The Moon Treaty is more explicit with respect to the surface and sub-surface of the moon which may not become the property of any State, international intergovernmental or non-governmental organisation, national organisation or non-governmental entity or of any natural person. The

Treaty reaffirms, however, that the Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means. The specific phrasing used in article 11 reinforces the idea that by national, appropriation creation of sovereign rights should be understood.

2.3. Property of extra-terrestrial materials

2.3.1. Resources of Moon and other celestial bodies

A next question concerns the resources of Outer space i.e. celestial bodies are not amenable for appropriation but what about their resources? Stephen Gorove and Aldo Cocca considered that the prohibition of article 2 applied equally to resources from Outer Space, the Moon and celestial bodies. The opposite school of thought includes Daniel Goedhuis and Bin Cheng for whom, by analogy with the rules underlying the freedom of the high seas, the appropriation of natural resources merely formed part of the freedom of exploration and use of Outer Space[24].

The history of article 2 as recorded during the meetings show that it was the intention of at least some of the participants to give a wider scope to this article than its actual reading. At least at two occasion the matter was raised; in the first case explicitly by the Belgian Delegate to the Legal sub-committee and in the second case more implicitly by the French delegate to the committee. The Belgian Delegate stated that "His delegation has taken note of the interpretation of the term "non appropriation" advanced by several delegations -apparently without contradiction- as covering both the establishment of sovereignty and the creation of titles to property in private law.[25] The French Delegate mentioned in a long intervention on several issues that ".... there was reason to be satisfied that three basic principles were affirmed, namely : the prohibition of any claim of sovereignty or **property** rights in space .... ".[26]

Notwithstanding the history of article 2 which supported the views expressed by Gorove and Cocca no consensus was reached on the matter.

The legal status of the resources became a concern for many, once the Apollo program had started and that, for example, mining activities seemed to be feasible in the near future. This concern resulted in the Moon Treaty which contains certain provisions dealing with outer space resources.

The matter is, however, treated differently depending whether the purpose of the mining activities is intended for the immediate support of a space mission or whether it is for activities on earth.

The wording of the Outer Space Treaty is too vague and therefore difficult to be applied to mining directly. From the treaty mining would, according to certain scholars fall within "use" prohibited in article 2; others are, however, of a contrary opinion. Or as E. Galloway puts it "There was an assumption by some commentators that the 1967 Treaty did not cover the exploitation of natural resources because they under estimated the meaning of "use" ...whereas others are certain that the 1967 Treaty made an outstanding contribution to space law by including "use" as well as "exploration" as general terms applicable to all activities in outer space, including the Moon and other celestial Bodies." [27] What is not contested by anyone is the that term "use", when referring to the extraction of ore and other extra terrestrial material for scientific purposes is authorised. The quantity of the extracted material should however be in line with this purpose i.e. very limited. But when would this limit be exceeded? It is mainly this ambiguity which is at the origin of the Moon Agreement. The initiative came in 1970 from Argentina with the submission of a draft to the Legal Sub committee of COPUOS. After lengthy discussions the text was finally agreed on by the General Assembly on December 5, 1979, and opened for signature and eventually ratification by States on December 18, 1979. The Agreement has been signed and ratified by nine countries (Australia, Austria, Chile, Mexico, Morocco, the Netherlands, Pakistan, Philippines, and Uruguay) the minimum requirements for entering in force are thus satisfied.[28]

The small number of States party to the Agreement and the absence of the main space faring nations make, however, that the Agreement does not really became effective international law.

The unwillingness of the main space faring nations to adhere to the Agreement stems from the fact that it contains a number of provisions which are the least to say subject to contradictory interpretations.

Or as Menter puts it "A reading of the Moon Treaty without consideration of its negotiated history, reflects some key words or phrases that are without definition, infer a meaning other than intended, ambiguous or not clear in intend."[29]

Or in other words one should read the Moon Treaty only in combination with all the preparatory documents!

The Soviet Union indicated from the beginning that it preferred an Agreement limited to the moon excluding other celestial bodies. The USA was of the opinion that if an agreement would be concluded the Agreement should then cover all celestial bodies since it would soon be feasible to travel beyond the moon. The compromise reached was that the agreement would cover all celestial bodies until such a time when specific treaties or agreements would be set up to deal with other celestial bodies.[30]

Furthermore, a more theoretical debate took place on the question whether the Agreement should be limited to the solar system or on the contrary apply to the whole universe. Without to much difficulty the former was accepted.

Interesting to note is that the application of the moon agreement extends to orbits around the moon or other trajectories to or around it.

The Moon Treaty deals, regretfully in a controversial manner, for the first time with the exploitation of natural resources.[31]

The qualification of the natural resources as "the common heritage of mankind" is one of the many examples in this respect.

The concept of common heritage of mankind was for the first time used by Pardo during the discussion held during

the Law of the Sea Conference. He wrote in particular that it was the objective to replace the principle of freedom of the seas by the principle of common heritage of mankind in order to preserve a greater part of ocean space as a commons accessible to the international community. The commons of the high seas, however, would not be open to the whims of the users and exploiters; it would be internationally administered. International administration of the commons and the management of its resources for the commons good distinguished the principle of common heritage from the traditional principle of the high seas as *res communis*.[32]

For historical reasons the following extract from Hugo Grotius' Freedom of the seas and the following is certainly worthwhile reading.

"....Two conclusions may be drawn from what has thus far been said. The first is, that which cannot be occupied, or which never has been occupied, cannot be the property of any one, because all property has arisen from occupation. The second is, that all that which has been so constituted by nature that although serving some one person it still suffices for the common use of all other persons, is today and ought in perpetuity to remain in the same condition as when it was first created by nature. This is what Cicero meant when he wrote: "This then is the comprehensive bond that unites together men and men and all to all; and under it the common right to all things that nature has produced for the common use of man is to be maintained." ....Ovid : "Why do you deny me water? Its use is free to all. Nature has made neither sun nor air nor waves private property; they are public gifts" The poet uses public in its usual meaning, not of those things which belong to any one people, but to human society as a whole; that is to say, things which are called public are, according to the Laws of the law of nations, the common property of all, and the private property of none."[33]

The concept of common heritage of mankind as used in Outer Space is however considered as unique and its interpretation totally independent of the concept defined by the same wording in the Treaty of the High Seas.[34] E.g. the statement on the moon treaty adopted by the Section of Internal Law of the American Bar Association.

"c)The meaning of the term 'common heritage of mankind' is to be based on the provisions of this Agreement, and not on the use or interpretation of that term in any other context. Recognition by the United States that the moon and its natural resources are the common heritage of mankind constitutes recognition (A) that all States have equal rights to explore and use the moon and its natural resources, and (B) that no State or entity has an exclusive right of ownership, property or appropriation over the moon and its natural resources in place...."[35]

The insertion of the common heritage of mankind in the Moon Treaty was suggested in the original Argentine proposal [36] but was in fact only at a later stage formally proposed by the United States. The support of the United States was not followed by all, the USSR was in particular opposed to making explicit reference to this concept. In the end a compromise was reached whereby the concept would be limited by only making reference to it in article 11 and moreover limit it further by its sub paragraph 5. Article 11 reads:

"1. The moon and its natural resources are the common heritage of mankind which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article"

.....

"5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement. "

The USSR agreed thus finally to the inclusion in the Moon Treaty of the concept of common heritage of mankind. The way it was done was however not acceptable to the USA who feared that the wording of article 11 would put a moratorium on the exploitation of the natural resources until a time when a special regime would be agreed on. Most, if not all, authors agree that there is no such moratorium but it would of course have been better if this would have been clearly spelled out in the Text.

The declaration by N. Hosenball, US delegate in the COPUOS, illustrates the USA's point of view in this matter:

"The draft treaty, as part of the compromise by many delegates, places no moratorium upon exploitation of the natural resources on celestial bodies pending establishment of an international regime. This permits orderly attempts to establish whether such exploitation is in fact feasible and practical by permitting experimental beginnings and then pilot operations, a process by which we will learn if it will ever be feasible to commercially exploit the mineral resources of celestial bodies. My Government will, when and if negotiations for such a regime are called for under Article XI and XVIII, make every effort to see that such a regime is successfully negotiated."[37]

One of the main shortfalls of the Moon Treaty is that it seems that exploitation of natural resources is acceptable as from now on an experimental basis but that the rules governing real exploitation would be established later. It is clear that such an approach only leads to the non-exploitation of the resources since no government or private enterprise would invest large amounts of money in a venture were the rules of the games will be established later, and by others.

The provisions of paragraph 7 of article 11 of the Moon Treaty makes it even more doubtful that investments will be made under those circumstances.

" 7. The main purposes of the international regime to be established shall include:

a. The orderly and safe development of the natural resources of the moon;

b. The rational management of those resources;

c. The expansion of opportunities in the use of these resources;

d. An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration."

If the same provision would have existed for the geostationary orbit prior to the first feasibility studies on geostationary satellites it is doubtful that they would exist today! Notwithstanding all the shortfalls of the Moon Treaty some provisions are a step forward in the ruling of natural resources of Outer Space.
First of all Article 6 which deals with the freedom of scientific investigation authorises explicitly the removal from the moon of samples of its minerals and other substances. It puts only a "moral" obligation on those who are carrying out such activities a of making samples available to other interested States. It also provides that States may in the course of their scientific investigations use mineral and other substances of the moon in quantities appropriate for the support of their missions.
Secondly the US proposed and obtained an amendment of paragraph 3 of article 11 of the treaty by specifying that only the resources in place are not subject of appropriation by any State, international organisation ....
This amendment is by far the most important one. It means that the prohibition of property rights would not apply to natural resources once they have been removed by States or private enterprises or others. Or in other words no property rights may be acquired in immoveables but once part of an immovable is transformed into movables, e.g. through mining, the latter is amenable for property.
But how much extra terrestrial resources will be needed in the future? In order to set the order of magnitude lets consider the construction of solar power systems. According to O'Neil in order to fill all the US needs for new electric generating capacity in the year 1990 about five power satellites would have to be put in to orbit that year alone, each weighing as much as an ocean liner.[38]
For its implementation O'Neil proposes to use materials, some 600.000 Tons a year, from the moon and bring them in high orbit around the earth. The energy required to do this is of course much less than if one would put this material into orbit from the earth.
It seems that the USA amendment of the Moon Treaty would mean that even for mining activities of this scope i.e. some 600.000 Tons per year this would not be considered as an appropriation of part of the moon.
In the context of the exploitation of resources the case of Spitsbergen (Svalbard) is also worthwhile considering in the sense that the rich natural resources have influenced considerably the legal status of the island. For many centuries the only interest in the island was whaling and fur hunting. For these purposes it was visited by nationals from many countries and was at that time considered as *terra nullius*. Some claims of territorial sovereignty existed but no State really tried to enforce them. By the end of the nineteenth century things changed with the discovery of large coal deposits which rapidly resulted in a conflicting situation. After lengthy negotiations a Treaty conceded the full and absolute sovereignty of Norway over the Archipel of Spitsbergen. The many exceptions foreseen in the Treaty undermined *de jure* the Norwegian exclusive territorial sovereignty. In particular ships and nationals of all contracting parties enjoy equal rights to fishing and must be permitted under the same conditions of equality to establish and pursue maritime, industrial, mining or commercial enterprises both on land and in the territorial waters. No monopoly may be established on any account or for any enterprise. The Treaty provides also that any taxes, dues and duties levied musty be devoted exclusively to the territories of Spitsbergen and not to exceed what is required for the object in view. The special status of Spitsbergen has sometimes be considered by some scholars as a possible model which could be transposed to Outer Space.

2.3.2. Property of asteroids

As an alternative asteroids could be considered as possible mining resource. The existence of relatively rich materials in water and carbon on the surfaces of a large number of asteroids represent, together with the expected deposits in the permanently shadowed areas of the lunar pole the nearest extra terrestrial source of the essential materials to be used in the colonisation of outer space.
Low cost transportation systems including solar sailing may make even relatively distant asteroidal sources competitive with lunar surface.
The production of the materials could either take place on the moon or asteroid or in outer space itself. In the latter case the raw materials would be transported to large manufacturing facilities in space.

The preconised use of asteroids poses the question of their legal status i.e. are asteroids celestial bodies or not.
The issue is rather important since if they are celestial bodies the provisions of the moon treaty would in the absence of specific rules be applicable automatically.
About 100.000 earth approaching asteroids larger than 100 meters in diameter exist. These numbers are probably correct to within a factor of 3 or 4.[39]
Asteroids are especially common between the orbits of Mars and Jupiter.
Brooks in 1966 argued that a medium sized asteroid could be considered as a floating mineral resource? In his opinion no legal impediment would seem to stand in the way of appropriating the entirety of an asteroid".[40] Since then the Outer Space Treaty and the Moon Treaty came about. J.H. Glazer feels, however, that the Outer Space Treaty does not alter Brooks' point of view with respect to movable asteroids since these natural objects are not ordinarily perceived of as celestial bodies.
N. Jasentuliyana [41] is of a contrary opinion; he advocates that the provisions of the Outer Space Treaty and in particular the wording of article 2 excludes that a state or company could claim the property of an asteroid. Notwithstanding this he implicitly agrees that his conclusion based on the interpretation of the Outer Space Treaty could be challenged. "In recognition of the ambiguity of the Outer Space Treaty, on the subject of mining on the Moon and other celestial bodies"

Fasan is inclined to make a difference between asteroids having long known astronomical specifications and/or those who received already a name and other asteroids. These asteroids should be considered celestial bodies whereas smaller ones should not.[42] It is evident that with the quantities of materials quoted above a small sized asteroid would be used entirely for the production of useful materials. In other words the mining of the asteroid would result in its disappearance.
As mentioned earlier the moon treaty excludes property rights in the surface and sub-surface of the moon which by definition are immoveables, but does not exclude property rights in parts of the surface or sub-surface of the moon once removed i.e. movables.
As far as asteroids are concerned large asteroids could be assimilated to the moon for which property rights can only exist in parts once removed whereas small asteroids could be assimilated to a movable and as such subject of property as a whole.

In conclusion, if our astronaut would have removed some samples on the Moon in 1969 he would not have acquired property but if the same astronaut would go back in 1996 he would become the legal owner of these samples. Or the natural resources of the Moon and other celestial bodies went from *res nullius* to *res communis omnium stricto sensu* back to *res nullius*.

3. Intangible property in outer space

Intangible property usually refers to something which is lacking physical existence, which cannot be apprehended by the senses. A typical example of intangible property is intellectual property such as patens, copyright etc.
In the context of space law intangible property comprises property rights in specific areas in outer space other then celestial bodies e.g. langrangian points, orbits including specific slots of certain orbits, trajectories and to a certain extend frequency spectrum. Intellectual property vested in patents or copyright in for example remote sensing data is not covered in this study.

Property rights in orbits and trajectories are not granted by any of the outer space treaties, in fact the Outer Space Treaty of 1967 is silent on the matter. This in itself is not sufficient to conclude that such rights may exist, on the contrary the concept of property in outer space is clearly against the spirit of the Treaty. The moon treaty on the other hand excludes explicitly exclusive rights in orbits around the moon and trajectories to or around it.
Notwithstanding this some form of property has been introduced recently in orbits. These rights find their origin in the application of ITU regulations and national patents the former with respect to the geostationary orbit and the latter for low and medium earth orbits.

Each space mission has its own specific trajectories and orbit requirements be it a transfer orbit or a final orbit.
The importance of trajectories and orbits should not be underestimated in the context of Outer Space exploitation since some of them are crucial for certain applications.
The best known and described orbit is the geostationary orbit, but other orbits are becoming from an economic point of view equally important. Trajectories comprises inter alia minimum energy trajectories for traveling to other celestial bodies and trajectories whereby energy is pulled out from celestial bodies through gravitational swings.

3. 1. Geostationary Orbit
The importance of this orbit was recognised at a very early stage and became with the frequency spectrum one of the main legal issues in Outer space Law.
At the 1971 conference the status of the geostationary orbit was also put on the agenda but ended without any concrete result except that the participants to the conference agreed on the non binding principle of non-discriminatory , equitable access to the geostationary orbit by recognizing that the radio frequency spectrum and the geostationary satellite orbit were limited natural resources that should be efficiently and equitably utilized.[43]
It was on the other hand considered premature to establish repartition criteria for the geostationary orbit.
The question on the legal status of the geostationary orbit was raised again in 1973 but this time at the Plenipotentiary Conference of the ITU which is the highest forum (Malaga - Spain) and progress was made with the formal incorporation of the guidelines as to the use of the geostationary satellites in the ITU Regulations itself.
"In using frequency bands for space radio services Members shall bear in mind that **radio frequencies and the geostationary orbit for satellites are limited natural resources, that they must be used efficiently and economically** so that countries or group of countries may have equitable access to both in conformity with the provisions of the Radio Regulations according to their need and the technical facilities at their disposal."[44]
The formal insertion in the ITU Convention of the principle of limited natural resources applied to the frequency spectrum and the geostationary orbit stems from the fear expressed by the developing countries that the application of the first come first served principle would have exhausted all possibilities at a time when they would have reach a level of technology sufficient to have access to it.
The use of the terms "limited" and "natural resources" is in retrospect not the most suitable.
The qualification of natural resources leads automatically -cf. the Bogota Declaration - to a tendency to apply to the geostationary orbit and the frequency spectrum rules which are applied to what is general understood by natural resources such as oil and mineral resources i.e. tangible exhaustible resources.
Some equatorial countries felt that their interest were not sufficient protected and decide to meet in order to study the matter in more detail and to agree on a common approach. This resulted on 4 December 1976 in the claim of the Equatorial Countries known as the Bogota claim which was formulated at their first meeting with the participation of Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda and Zaire.

"Bearing in mind the existence of sovereign rights over segments of the geostationary orbit, the equatorial countries consider that the applicable legal considerations in this area must take into account the following

The rationale behind this position is that the equatorial states are of the opinion that the geostationary ring as they call the geostationary orbit is an integral part of the earth and as such is not part of Outer space.
"The Geostationary ring is the product of the gravitational attraction of the earth, it is a natural resource, it's origin, nature and existence are inherent to the earth planet, like ground, the air and the water...". The sovereignty arises in the same manner as for other natural resource of earth such as atmosphere, ocean, coal, iron, petroleum, etc since the geostationary orbit is a natural resource and it stays permanently over determinate country.[45]
The US maintained on the contrary that "the geosynchronous satellite orbit is essentially a regime of satellite path not a physical natural resource".
The latter is certainly closer to reality than the thesis defended by the Equatorial Countries. The geostationary orbit in itself is not different from any other location in outer space. If a spacecraft moves on a orbit around the for instance the earth its movement is a result from the equilibrium at any given moment between the forces acting on it. These forces have two main opposite components, the gravitational and the centrifugal force which is the case for any orbit around a celestial body. In addition to these forces additional forces will act on the spacecraft leading disturbances in the orbit. The specificity of the geostationary orbit is that ...
The developing countries requested furthermore an a priori allocation of frequencies and geostationary slots. In other words frequencies and slots would be reserved for future use by developing countries based on their plans.
At a first glance the principle of a priori allocations seems an equitable solution. Unfortunately experience shows that plans seldom materialise as was originally foreseen. It is exactly here where the second part of article 33.2 of the ITU Conventions enters into play i.e. "... that they must be used efficiently and economically." The ITU Convention imposes three conditions on the use of the frequency spectrum and geostationary orbit i.e. equitable access, efficient use, economic use. These conditions are however not independent from each other and in many cases they will even be conflicting conditions. It became therefor clear that special effort had to be made to come to more objective criteria or conditions to allocate frequencies and orbital slots.
At the 1977 WARC on Broadcasting Satellites Services (BSS)[46] an allotment plan for the regions 1 and 3[47] was adopted whereby a certain number of well defined channels and geostationary slots were reserved for domestic satellite broadcasting services. The Member States of Region 2 decided for various reasons not to develop a allotment plan. In particular the fact that the 11.7 - 12.2 GHz frequency band was shared by the BSS and the Fixed Satellite Services (FSS) played an important role.[48] According the Member States a decision at that moment could jeopardize the development of one or the other and it was at this stage not possible to predict which one would justify the largest number of frequencies. The decision to allocate orbit slots and frequencies without any time limit is in contradiction with the provisions of the Outer Space Treaty which specifies that Outer Space is not subject to national appropriation ... by means of use or occupation or by any other means.
It was against this background that the WARC 1979 started its work. After lengthy discussions several non binding resolutions were adopted of which two are at the base of the 1985 and 1988 WARC. Resolution 2 dealt with equal rights of all states to use the orbit and spectrum resources.
Resolution 3 invited participants to convene a WARC to deal with the question of guaranteeing in practice equitable access to the geostationary orbit to all states i.e. first come first served versus a priori allotments.
The initiative came from the developing countries who considered an "a posteriori" approach a justification for the first come first served practice which they contested since many years. The developed countries and in particular the United States of America were opposed to an "a priori" allocation which in their opinion would be detrimental to the evolution of space telecommunications. In the meantime, at the 1982 Plenipotentiary Conference of the ITU the Member States took a next step towards the claims of the developing countries with the amendment of art. 33 by which the last paragraph was replaced by "taking into account the special needs of the developing countries and the geographical situation of particular countries."
The WARC on the use of the Geostationary-Satellite Orbit and the Planning of Space Services following Resolutions 2 and 3 adopted in 1979 took place as agreed beforehand in two sessions the first in 1985 followed by the second in 1988. Both sessions were dedicated to issues related to the use of the geostationary orbit. At the 1985 session it would be decided 1. which space services and frequency bands would be planned; 2. establish principles, technical parameters and criteria for planning; and 3. establish guidelines for regulatory procedures with respect to services and frequency bands not brought under planning. The 1988 session would implement the decisions taken at the first session.
The decisions finally taken at the World Administrative Radio Conference of 1985 and 1988 concerned only the use and exploitation of Fixed Satellite Services. These services are only part of the total satellite services package which exist.
The results of both session can be summarised as follows;
- guaranteed equitable access to specific orbit and frequency resources for a period of 20 years
- existing systems may continue their operations for a period of maximum of 20 years.
The a priori allocation has evolved in granting property rights in certain slots for a limited period in time. Some countries have exploited this possibility immediately by requesting a higher number of orbital slots than really justified for their own purposes.
The Kingdom of Tonga situated in the South Pacific is a typical example already in 1998 it attempted to claim some 30 geostationary satellite slots. INTELSAT reacted

very severely against these claims. In a letter addressed to the ITU and the Chairman and Members of the International Frequency Registration Board (IFRB) INTELSAT pointed out that the slots were in their view not intended for satisfying TONGA'S own needs but rather as a means of financial speculation. " The Administration of the Kingdom of Tonga has initiated the ITU registration process on behalf of Tongasat for these orbital slots. I strongly believe that Tongasat's attempts to convert the ITU registration process into an opportunity for financial speculation in the geostationary orbit constitute an abuse of the ITU Radio Regulations and undermine the intended purpose of such regulations."[49]

INTELSAT's point of view is based on public statements made by TONGASAT and the fact that the latter offered the orbital slots or lease to interested parties. INTELSAT's letter quotes a TONGASAT document ; "In that particular portion of the orbital arc of most value to a communications satellite system, designed to serve most of the Asian countries, in addition to the Pacific and Asian countries and still reach the United States, Tonga has registered and therefore controls the last such remaining positions.

Thus Tonga possess the asset most critical to the establishment of an Asia Pacific regional communications satellite system - namely the orbital arc positions vital to economic success."

In a second letter to the Chairman and Members of the Frequency Registration board the Director General of INTELSAT expressed the view that " the attempt by Tongasat to gain control over an excessive number of orbital slots is contrary to the spirit of Article 29 of the ITU Convention (Nice 1989) ....Moreover, Tongasat's misuse of the publication and registration procedures of the Radio Regulations leads to the subversion of the spirit and intent of article 33 of the ITU Convention (Nairobi 1982)... and the underlying principles of Resolutions 2 and 4 of WARC - 79."

On the 5 July the Director general of INTELSAT informed Tonga's prime minister of the actions undertaken by INTELSAT against TONGASAT'S attempt to obtain the slots. Particular relevant is the argument used by INTELSAT for justifying its action; ".. My actions in this regard have not been intended to embarrass the Kingdom of Tonga, but the actions of TONGASAT, if allowed to be unchallenged, could establish a precedent that would seriously jeopardize the ability of all administrations to gain access to the geostationary orbit on an equal and equitable basis, and make technical coordination and efficient use of the frequency spectrum extraordinarily difficult"

The prime ministers cabinet reacted promptly in stating that it is TONGA's intend to set up an Asia Pacific regional satellite communications system similar as EUTELSAT, INMARSAT, PANAMSAT etc.

The main part of the letter confirms in strong words the feeling expressed at many occasions by other developing countries that the existing monopoly positions of developed countries and INTELSAT should be stopped.

"We do not agree ..that Tonga attempts to convert the ITU Regulation process into an opportunity for financial speculation. On the contrary, Tonga recognizes the past apparent abuse by several countries to lay claim to more orbital positions than they need, to the detriment of the developing countries....

It is no wonder that the INTELSAT signatories would subscribe to the views expressed in your letter. After all, they are anxious to protect their monopolistic positions in their countries, possibly to be challenged by Tonga and TONGASAT....

You speak of preventing such abuse from occurring. Tonga is operating in strict conformance with the radio regulations. The abuses seem instead to be on the side of those who feel threatened by competition.....

You are free to make whatever attempts you wish, to preserve INTELSAT's monopoly position. It is not up to you to judge whether it is likely that your monopolised positions will be perpetuated under the umbrella of the ITU and IFRB regulations."

Tonga nevertheless agreed under the international pressure to limit its claims to six slots only.

In the meantime TONGASAT has leased several of "its" slots to commercial entities such as APT Satellite Co. of Hong Kong.

The present situation is thus far from the noble principles underlying the ITU regulations i.e. equitable access, efficient use and economic use. The rights which are granted are similar to emphytensis which is a real right by which someone is entitled to use something as if it were his own. Interesting to note is that under roman law the shore had somewhat analogue legal status.

As explained above a State exercising sovereign rights over a territory enjoys all rights in the resources existing within the territorial limits of that territory and allowed under certain conditions the existence of private property. The sea and the shore however were excluded and could not become the private property of any one.

Hugo Grotius quotes and defends however an exception "If any part of these things is by nature susceptible of occupation, it may become the property of the one who occupies it but only in so far as such occupation does not affect its common use. Hugo Grotius concluded that it is permissible to build upon the shore if such buildings are without hindrance to public or common use of the shore. The owner of such a building may even become the owner of the ground on which it is build but this ownership will last only as long as the building last and remains occupied by its owner. Once it will be abandoned or destroyed by a will full act or by accident or natural disaster the property ends.[50]

In addition to the "misuse" of the a priori allocation by some states the a priori allocation principle has moreover led to a number of very often bona fide requests largely in excess of the total capacity of the geostationary orbit.

A way out would be to request a fixed deposit and proof that the slot will be used in a reasonable time form the acquisition date of the slot.[51]

Closely linked to the division of the geostationary orbit in slots is the frequency spectrum.

3.2. Frequency Spectrum

As mentioned earlier the frequency spectrum is also considered a limited natural resource and qualifies for *res communis omnium*.

Recent developments whereby part of the frequency spectrum have been auctioned tend to pave the way for a commercial exploitation of the frequency spectrum thereby endangering certain activities unless appropriate actions are undertaken.

A USA representative said he had made some calculations based on recent auctions and he came to the conclusion that the 2 GHz science service allocations would become a non affordable commodity if the same financial rules would apply to it.

The Australian policy in this matter may serve as an example how the spectrum has become an economic asset. The Australian government through its Spectrum Management Agency has initiated a number of actions with the objectives of:

- promoting spectrum efficiency;
- encouraging technical change;
- expanding freedom of choice;
- accelerating economic development;
- optimising the benefit to the general community.

The licenses have a maximum duration of 10 years with a possibility of renewal. The licenses are tradable and may be sold as one block, sub-divided or amalgamated with other contiguous spectrum blocks. In other words the licensee has rights similar to property rights.

The space sciences are for the moment not adversely affected by the new policy as is also the case for internationally operated services.

In the USA the FCC has auctioned only two direct broadcast licenses for some 735 million dollars. In an interview with Space News Donald Gips, the chief of the US Federal Communication Commission International Bureau stated that "Spectrum auctions might work for licensing domestic satellites services, but host of problems makes them unlikely for international satellite services."[52]

The huge amounts of money may encourage some states to try to apply the same approach for international satellite services.

At a meeting of ITU representatives, inter alia, on auctioning the Indian representative recalled that licenses in the international context is ruled by article 24 of the ITU/RR. Moreover the frequency spectrum had to be considered a natural resource available to all mankind. However, if done right, auctioning might be instrumental for arriving at a more efficient use of the spectrum. A delicate balance had to be kept between revenue-providing and non-revenue-providing users.

In order to avoid similar problems as the one encountered with the geostationary orbit it would be advisable to developed a set of rules in this field.

A solution could be to extend to the frequency spectrum the proposal advocated by S. Wiessner for the Geostationary orbit. He considers that the regime of the geostationary orbit goes beyond the *res communis* idea and favours the idea of res publica and given the international character *res publica internationalis*.[53] He proposes that part of the slots would auctioned and the revenue used for space research. Any solution should of course respect one of the basic principles of the Outer Space Treaty, i.e. guaranteeing equal access opportunities for all nations to Outer Space.

Apart from the geostationary orbit other orbits have high potential economic value for example for mobile communication systems; the low and medium earth orbits.

3.3. Low and Medium Earth Orbits (LEO, MEO)

Although it is not sure yet whether low and medium earth orbit systems may be financially viable[54] several companies have started investing money and protecting their intellectual property.

Recently some US patents have been granted TRW which gave a major concern to their competitors. Two of these patents were first published on 16 May 1995 but withdrawn by the Patent Office the same day. According to the Patent Office the withdrawal was a result of a routine quality control procedure; Both patents were finally re-published a few months later.

The TRW patents deal with medium earth orbit systems for wireless telephones. They are a continuation-in-part of a patent application dated May, 28, 1992 which is a continuation-in-part of an earlier patent application filed on April 22, 1991 abandoned.

According to TRW officials these patents would prevent others from using the medium earth orbits as the basis for providing worldwide mobile satellite communications to pocket-sized phones.[55]

If this would be the case the statement quoted by Alan Cane in the Financial Times would be true; "It is bizarre that a company could hope to patent thousands of square miles in space".[56]

The TRW patent concerns a satellite-based cellular telecommunications system comprising a number of satellites placed in a plurality of inclined orbits about the earth at an altitude of between approximately 5,600 and 10,000 nautical miles. The characteristics of the orbits, the number of satellites in earth orbit and the altitude of the satellites are part of the invention.

US Patent 5433726 of July 18, 1995 is of particular relevance, the background of the invention or the state of the art as quoted in the patent relates to low earth orbit systems.

"These proposed cellular telephone systems typically include a large constellation of telecommunications satellites in low earth orbit at an altitude between approximately 400 and 1000 nautical miles..."

This implicitly means that the inventor considers that the use of medium earth orbits for mobile telecommunication systems is not part of the state of the art and therefore new.

The invention itself may be best summarised by the first and main claim of the patent: "A method of providing medium-earth-orbit satellite-based communications be-

tween low-power mobile handsets having an omni-directional antenna and a gateway station through a satellite forming part of a satellite constellation, comprising the steps of:
- launching a plurality of satellites to an orbiting altitude between 5,600 and 10,00 nautical miles, wherein at least one satellite has a reduced antenna field of view (FOV) less than full earth coverage;
- orienting said satellites in a plurality of orbital planes which are inclined at a predetermined inclination angle with respect to the equatorial plane of the earth;
- receiving, by at least one of said satellites, radio frequency (RF) signals from a plurality of mobile handsets which transmit said RF signals using their omni-directional antennas; and
- overlapping a portion of a coverage region of a departing satellite with a portion of a coverage region of an arriving satellite, including assignment means having a predetermined criterion of assignment that calls placed to or from a user located within the coverage overlap region are assigned to said arriving satellite."

The patent contains in total 35 claims of which many include the use of medium earth orbits be it elliptical or circular orbits.
US Patent 5439190 of August 8, 1995 (one of the two patents which were re-published) describes a similar system but its claims do not refer to the medium earth orbit but are more system oriented.
Without going in to too much detail of the technicalities of patent law one can conclude that neither of the TRW patents claim the use "as such" of the medium earth orbit as "the" invention. It is in fact the combination of this kind of orbit and a plurality of satellites functioning in a particular manner which is claimed. It is, however, true that the scope of the claims is rather broad making it therefore difficult to escape infringement when using similar systems in the medium earth orbits or as Bruce Gerding -TRW managing director of the Odyssey programs, says "The scope of the patent protection in the US is broad enough to exclude other service providers deploying a commercial viable MEO system".[57]

The question "is it possible to patent the use of certain orbits or trajectories" should probably be answered affirmatively if the use is specified i.e. the orbits or trajectories in abstracto will in most countries be unpatentable.. This assumes of course that the use of this specific orbit or trajectory is not new and not obvious to the layman. Depending on the country in which the patent application is filed other conditions should be fulfilled for the invention to be patentable. Arthur Clarke could have patented, when for the first time he conceived in the early forties the use of the geostationary orbit for telecommunication by using one or more geostationary satellites. The same would be true for the Hohmann transfer orbit which is an elliptical transfer orbit to go from one planet to the other. The limited duration of patent protection would probably prevented him from making any money out of it. This is unfortunately the case for many pioneer inventions related to space applications, the concept of solar power satellites patented by Peter Glazer is a typical example of this.

Important to note is that patent rights are granted by states and their effect is limited to the territory of the state which granted the patent. In the USA the outer space patent act has extended the US patent law to spacecraft and/or activities on board of spacecraft registered by the USA. For this reason it is difficult to talk about property rights obtained by TRW in medium earth orbits (assuming that the wording of the claims would cover the use of medium earth orbits for mobile telephone communication as such) not only are these rights limited to certain applications, in other words, these orbits could be used for other purposes without infringing the TRW patents. Furthermore any spacecraft not registered in the USA could use the orbits even for mobile telecommunication purposes without infringing the US patent.[58]

The importance of patents in space applications calls for a special regime for intellectual property in outer space, recent developments makes this a matter of urgency. In my opinion the best solution would be to consider, insofar as intellectual property is concerned, outer space as a whole as one territory for which the World Intellectual Property Organisation (WIPO) would be responsible. WIPO would be empowered to deliver patents for outer space, special rules should be established for dealing with infringement issues. This solution would give legal stability which is absolutely needed for enhancing the scope of space applications.[59]

Conclusion

If we wish to enhance Space applications, a clear and precise legal situation including property rights should be established. Property rights were banned from the Outer Space Treaty for social and political reasons. The underlying reasons changed over the years and made it possible to include implicitly in the Moon Treaty the acquisition of property. Since then nothing happened on the international scene but, in the meantime some forms of property were introduced by using legal means not really foreseen for this purpose e.g. the ITU and patent law. Time has therefore maybe come to review the matter and to settle property rights in an appropriate legal form.

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* The views expressed herein are those of the author and do not necessarily reflect those of ESA.

[1] cf. The bilingual edition: Hugo Grotius "The Freedom of the Seas", Oxford University Press 1916.

[2] This excerpt is quoted by several authors e.g. by L.F.E. Goldie in "Is there a general international law of original ownership? The possible relevance of general doctrines governing the possession of deep ocean-bed resources" proceedings of the..... coll. of the IISL, pages 287 - 289 and by Emilio J. Sahurie in " The International law of Antarctica" New Haven Press, page 369.

[3] Not all are in favor of studying Roman Law concepts in relation to Space Law cf. Ryszard Hara in "Space Law and the Roman Law concepts" 27 coll. 1984 of IISL, pp. 51 - 57

concluded that reaching for roman law concepts when analyzing problems of space law is neither necessary nor useful. The absolute necessity may be contested but the usefulness in my opinion certainly not.

4 Kaser & Wubbe Tjeenk Willink 1971, Romeins Privaatrecht.

5 "Res nullius naturaliter fit primi occupantis".

6 supra 2 Emilio J. Sahurie page 369.

7 Supra 1 Hugo Grotius; page 39 "But where in this case is that corporal possession of physical appropriation, without no ownerships arise ? There appears to be nothing truer than what our learned jurists have enunciated, namely, that since the sea is just as unsusceptible of physical appropriation as the air, it cannot be attached to the possession of any nation".

8 "as you possess it-you may keep it" Gaius, IV, 148.

9 Supra 1 page 43.

10 Manual on Space Law , N. Jasentuliyana and R. Lee page 6.

11 This is based on our two possibilities approach one could however imagine other solutions.

12 A prerequisite is of course that the things over which one wishes to acquire title of sovereignty were res nullius or terra nullius prior to the alleged discovery. This assumption is certain valid in most circumstances with respect to Outer Space.

13 S. Pufendorf, De Jure Naturae et Gentium Libri Octo, quoted by Emilio Sahurie.

14 In the Netherlands v. United States over the MIANGAS Islands, Max Huber insists on the inter-temporal basis i.e. the conditions which existed at a given moment are not sufficient to keep the property but they should follow the conditions required by the evolution of law. (A.A. II 829, 4 April 1928).

15 In the Clipperton Island Arbitration the Mexican claim was based on the assertion that Spain had gained the title by the discovery and that title had been transferred to Mexico through state succession. Mexico could however not establish any proof of Spanish sovereignty over the islands whereas France could prove the rediscovery by a French officer who was sent to the island to claim it for France.

16 supra 2 page 259.

17 Smedal by Sahurie supra 2 , page 395.

18 As the acts of sovereignty required to be effectively performed, the geographical circumstances of the are in dispute can be relevant, for it would not be logical to require the same intensity of exercise of sovereignty as elsewhere when an area is uninhabited, inhospitable and/or of difficult access.
Santiago Torres Bernardez "Territory, acquisition", in Encyclopedia of Public International Law, Vol 10 , North Holland, p 499 .

19 S. M. Williams, "Celestial bodies" , Vol 11, p.52.

20 "The supreme, absolute and uncontrollable power by which any independent state is governed", Black's law dictionary.

21 Sylvia Maureen Williams came to the same conclusion in "The exploitation and use of natural resources in the new law of the sea and the law of Outer Space" 29 Colloq. IISL (1986), pp. 198-204.

22 See also Space Lax Committee of the International Law Association (1970), 54 International Law Association Proceedings (The Hague), 430.

23 In fact two opposite views existed for some time and had both its defenders, e.g. according to Gorove: "an individual ... could lawfully appropriate any part of Outer Space", Gorove, "Interpreting Article II of the Outer Space Treaty", (1696), 37 Fordham Law Rev.

24 International and Comparative Law Quarterly, Vol. 36, Jan. 1987, pp. 142-151. The Law of Outer Space and Natural Resources, Sylvia Maureen Williams.

25 Statement made by the Belgian delegate when the matter was raised in the Legal Sub-committee of the UN and quoted in Manual of Space Law , Volume III, page 65.

26 Emphasis added - Statement made by the French Delegate on December 17, 1966 and quoted Manual of Space Law in volume III page 95.

27 see Eilene Galloway; "Issues in implementing the agreement governing the activities of states on the moon and other celestial bodies " , proceedings of the 23 rd colloquium on the law of outer space , 1980, pp 19-24.

28 Article 19 of the Agreement provides that it shall enter in force on the thirtieth day following the date of deposit of the fifth instrument of ratification.

29 Martin Menter " Commercial Space Activities under the Moon Treaty " 23 rd colloquium of the IISL, 1980 , p 35 - 47.

30 Article 1 reads " The provisions of this Agreement shall also apply to other celestial bodies within the solar system, other than the earth , except in so far legal norms enter into force with respect to any these celestial bodies ".

31 e.g. preamble of the Moon Agreement; "Bearing in mind the benefits which may be derived from the exploitation of the natural resources of the moon and other celestial bodies."

32 quoted in Emilio J. Sahurie "The international Law of Antarctica", Martinus Nijhoff Publishers, 1992.

33 supra 67 page 27. The introduction also contains on page 2 an interesting passage "Now, as there are some things which every man enjoys in common with all other men, and as there are other things which are distinctly his and belong to no one else, just so has nature willed that some of the things which she has created for the use of mankind remain common to all, and that others through the industry and labor of each man become his own."

34 see for further information J.F. Galloway "Political Philosophy and the Common Heritage of Mankind concept in International Law ", 23 rd colloquium of IISL, 1980, pp 25 - 28; and S.M. Williams" The Exploitation and Use of Natural Resources in the New Law of the Sea and the Law of Outer Space ", 29 th colloquium of IISL, 1986, pp. 198 - 204.

35 Section of International law report to the House of Delegates, American Bar Association, April 1980. The understanding (A) is similar to one attached by the US Senate when ratifying the 1967 Outer Space Treaty.

36 UN Doc. A/AC.105/C2/L71; "The natural resources of the Moon and other celestial bodies shall be the common heritage of all mankind".

37 UN Doc. A/AC.105 PV.203 dated 16 July, 1979.

38 Gerard O'Neil "Directions for Research" space manufacturing facilities space colonies 2 proceedings of the third Princeton/AIAA conference may 1977 pp 27-32.

39 O'Leary "Mass driver retrievals of earth approaching asteroids " in Space Manufacturing facilities II, proceedings of the third Princeton/AIAA Conference 1977, pp 157-168.

40 see Brooks, National Control of Planetary Bodies, 32 Journal of Air Law and Commerce.

41 N. Jasentuliyana "International space law and cooperation and the mining of asteroids". Speech delivered to the

International Space University, 30 July 1990, Toronto, Canada.

[42] Ernst Fasan "Some legal Problems regarding the Moon", 23 rd colloquium of the IISL, 1980, pp 9 - 11.

[43] cf. Resolution Spa 2.1.

[44] Article 33 of the ITU Convention (emphasis added).

[45] (UN General Assembly Resolution 1721 (XVI), December 20, 1961) (R. Lauria White et al. "Evolving principles of space communication regulation in the ITU: 1959-1985" 31st coll 1988 pp 304 -311 .

[46] According the ITU Radio Regulations the Broadcasting Satellite Services provides signals intended for reception by the general public. through either individual or community reception; Fixed Satellite Services are intended for reception by a limited number of receivers such as telephone, telex, facsimile, video etc...

[47] Region 1 covers essentially Europe, Africa and the (former) Soviet Union , Region 2 North, Central and South America and Region 3 South and East Asia and the Western Pacific basin.

[48] The allocation of the frequency band for certain activities differs from one region to another and is subject to revision.

[49] Letter dated 8 June 1990 from Dean Burch, Director General of INTELSAT , addressed to the ITU and letter dated 12 June 1990 to the Chairman and Members of the IFRB.

[50] page 30 "It becomes therefore the property of the occupier, but his ownership lasts no loner than his occupation lasts, inasmuch as the sea seems by nature to resist ownership."

[51] This is already in the USA where the FCC to weed out spurious applications requires an 80.000$ deposit from all satellite proposals and also demand proof that the system developers have the money needed to build, launch and operate their system for at least one year. - Space News September 16-22,1996, p.4.

[52] Space News, Vol. 7 N°29, July 22-28,1996, page 1.

[53] S. Wiessner "access to a *res publica internationalis*: the case of the geostationary orbit" 29 th coll. 1986 pp. 147-153.

[54] Space & Satellite Business, December 1994/ January 1995, p. 28; "Can LEO systems be a roaring success?".

[55] Space News, May 1-7,1995, Vol. 6, N° 17, page & and page 20, "TRW's Patent Claim Stuns Inmarsat Unit".

[56] Financial Times, 8 May 1995, Alan Cane; "Clash over patent on space looms for telecoms groups".

[57] Infra 55.

[58] For a more in depth study on these issues, see "Patentability of orbits and trajectories" R. Oosterlinck, Lectures at the International Space University, to be published end 1996.

[59] R. Oosterlinck "Intellectual Property and Space activities", Proc. Of the 26th Coll. of IISL, 1983 pp. 161-164.