Orbiting under the Radar: Nano-Satellites, International Obligations and National Space Laws

Neta Palkovitz[*] *and Tanja Masson-Zwaan*[**]

Abstract

Nano-satellites are small size, lightweight satellites, used mostly for scientific and educational purposes. They are usually launched into low Earth orbit as an auxiliary payload, thereby reducing the cost of the launch significantly. Thus, nano-satellites are an ideal platform for peaceful exploration of outer space for states and educational organizations that are lacking in resources. Additionally, these satellites are increasingly used by the space industry to test newly developed products, components and technology in outer space, thus lowering the financial risk for a mission's failure when introducing these innovations into commercial missions. While there is no reason why these satellites would not be considered as "space objects" under international space law, they are in practice excluded from the scope of some national space laws. The reason for such exclusion lies in the interpretation of the words "national activities in outer space" in Article VI of the Outer Space Treaty. It is argued by some states that, since (some of) these satellites cannot be maneuvered once deployed in orbit, they are in fact not "active" in outer space, and hence do not constitute a space activity subject to the obligations set forth under the international space treaties. The above-mentioned exclusion from national space laws has led to a practice where the launch and operation of nano-satellites is not licensed by any of the "launching states" involved. This also usually implies a refusal to register the satellite in the relevant national and international registry of space objects. On the other side of the legal spectrum, some national space laws do consider the launch of

* ISIS- Innovative Solutions In Space B.V., The Netherlands, npalkovitz@isisspace.nl.
** International Institute of Air and Space Law, The Netherlands, t.l.masson@law.leidenuniv.nl.

nano-satellites as a space activity, and impose licensing and sometimes also insurance requirements. While taking out insurance may be suitable for commercial missions, scientific-educational missions carried out by universities generally lack funding for insurance. These situations create a regulatory obstacle that calls for a solution, especially since this niche-market within the space sector is gaining in popularity amongst a broad group of stakeholders, both new and established in the space domain. In order to secure the long-term sustainability of the nano-satellite segment, a legal compromise has to be reached between affordable peaceful exploration and use of outer space and fulfilling international obligations. The aim of this paper is to raise awareness about these issues by discussing practical examples from The Netherlands and Belgium, and to propose ingredients for a solution.

I Introduction

Nano-Satellites and Cubesats: Definition, Benefits and Concerns

Nano-satellites are small size, lightweight satellites.[1] Standardized nano-satellites are referred to as "CubeSats" as the standard measurements of such satellites take the shape of a cube.[2] They are usually launched into low Earth orbit as an auxiliary payload, reducing the cost of the launch campaign significantly. Nano-satellites are often used for scientific and educational purposes.[3] They are used by organizations based in space faring nations, but additionally, practice shows that the use is initiated by universities and scientific institutes from states that are yet to develop space capacity, or assets. At times, these satellites are the first space objects to be launched by such nations.[4] Therefore, the accessibility and affordability of this kind of satellites

1 The common classification of small satellites according to their weight is as follows: between 100-1000 kg: mini-satellite; 10-100 kg: micro-satellite; 1-10 kg: nano-satellite; and 0.1-1 kg: pico-satellite.

2 K. Woellert et al., *Cubesats: Cost-effective Science and Technology Platforms for Emerging and Developing Nations*, 47 Advances in Space Research 663 (2011). Available at: <www.gwu.edu/~spi/assets/docs/Woellert_cubesats.pdf>; this site, as well as all other sites mentioned in this paper, was last accessed and verified on 23.10.2012.

3 For examples of CubeSat scientific projects see: J. Foust, *CubeSats Get Big*, The Space Review (10.09.2012). Available at: <www.thespacereview.com/article/2155/1> See also F. Morring, *Small satellites, doing more with less*, AWST, July 30, 2012, 36 ff.

4 Such is the case of Austria. Information relating to the pioneering mission is available at: <http://space.skyrocket.de/doc_sdat/tugsat-1.htm>; *see* also: O. Koudelka, *TUGSAT-1: The First Austrian Satellite*, *in* C. Brunner, E. Walter (Eds.) Nationales Weltraumrecht, National Space Law: Development in Europe- Challenges for Small Countries 133 (2008).

promotes space activities by all nations, and are not within the exclusive reach of space faring nations.[5]

Apart from educational and scientific uses, the low cost of the mission makes nano-satellites a perfect tool for technology demonstrations. This fact takes these satellites to the commercial domain. It is much more productive to test new space technology and components on an affordable fast-decaying platform than to risk a bigger more expensive space asset with longer life in orbit, to verify that the new technology functions, and that it is space qualified.

In the near future, these satellites will increasingly be used for commercial missions as scientists are working on innovative miniaturized payloads. An additional popular use relates to the ability to launch a constellation of these satellites, and receiving data as they communicate with earth and with each other.[6]

When it comes to standardized CubeSats, it is easier to initiate international collaboration in space using the industry's acceptable standards. One example is the QB50 project, funded under the FP7 Programme of the European Union, which will host 50 CubeSats form various states in one launch, forming a constellation that will be used for scientific research.[7]

The most prominent concern with respect to these satellites is the risk of collision. The small size and relatively low cost of the satellites result in the lack of onboard propellant systems. Therefore, most nano-satellites cannot be "manoeuvred" once deployed in orbit. The operator of the satellite receives data from it, and may control the satellite to some extent, however it will not be possible to cause the satellite to move or change its location to a different orbit. This lack of "manoeuvrability" poses concerns relating to collisions with other space objects in low orbits, even though up to this day no such incidents have been reported. Nano-satellites usually burn up upon re-entry and therefore do not pose any risk of causing damage to persons and property on the ground.

International Space Law and National Space Laws

The international space treaties[8] provide the main legal framework for activities in outer space. The most relevant provisions with respect to private activities

5 And in that respect these activities fulfill the objective of Article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 610 *U.N.T.S.* 205 (1967) (Hereinafter: "Outer Space Treaty" or "OST"). It is also noteworthy that by engaging in nano-satellite projects, states that hitherto were not active in space have become more motivated to ratify the UN Space Treaties, see for instance *South Africa's CubeSats Promoting Space Ambitions*, 5.2.2012, available at: <www.africanglobe.net/business/south-africas-cubesats-promoting-space-ambitions/>.

6 See Foust, *supra* note 3.

7 QB50 Project's website: <https://www.qb50.eu/>.

8 Outer Space Treaty; Convention on International Liability for Damage Caused by Space Objects, 961 *U.N.T.S* 187 (1972) (Hereinafter: "Liability Convention"); Convention on Registration of Objects Launched into Outer Space, 1023 *U.N.T.S.* 15 (1975) (Hereinafter: "Registration Convention").

in space (such as those involving nano-satellites) are Articles VI, VII and VIII of the Outer Space Treaty, and the Liability and Registration Conventions. In summary, these provide that states parties to the treaties are responsible for "national activities in outer space", including those performed by non-governmental entities.[9] Furthermore, launching states are liable for damage caused by space objects; liability is absolute for damage caused on the surface of the Earth (including "aircraft in flight"), and is based on fault for damage caused elsewhere (e.g. in space).[10] Also, the state that registers a space object retains "jurisdiction and control" over that object while in outer space, and it is the launching state that must register an object that is launched into earth orbit or beyond.[11]

While this regime seems straightforward at first sight, many of its key terms were not defined and hence, create difficulties in interpretation by states in practice.

The term "national activities in outer space" contained in Article VI of the Outer Space Treaty has yet to be clarified in international law, as neither the Treaty itself nor the subsequent treaties include a detailed definition of "activities" in the context of outer space, nor of "outer space" itself, for that matter. Some authors are of the opinion that space activities must be associated with control or remote navigation of the space object.[12] Hence, an "activity" would have to have some sort of "active" element in outer space. In reality there are activities in orbit that may be remotely controlled to a very limited extent, but that nevertheless must be characterized as "activities" in space. This is the case for non-maneuverable nano-satellites.

Notwithstanding the fact that nano-satellites will likely be considered as "space objects" under international space law[13], and hence are subject to legal provisions on state responsibility and liability[14], the absence of a definition in the treaties and the subsequent (narrow) interpretation of the term "activities in outer space" in some national laws leads to legal gaps and discrepancies.

As a consequence, when examining state practice, it becomes evident that the operation of such satellites may be excluded from the scope of definition as a "space activity" under some national space laws, or such application may be unclear under the present terms of national legislation.

---

9 Article VI of the Outer Space Treaty.

10 Article VII of the Outer Space Treaty and Articles II and III of the Liability Convention.

11 Article VIII of the Outer Space Treaty and Article II of the Registration Convention.

12 See for example a list of space activities: "The operation and control of a satellite […]" in: S. Hobe, B. Schmidt-Tedd and K.U. Schrogl (Eds.), Cologne Commentary on Space Law, vol. I, Outer Space Treaty 109 (2009).

13 Under the assumption that satellites are space objects in the sense of the international space Treaties.

14 According to Articles VI and VII of the Outer Space Treaty and according to the Liability Convention and Registration Convention.

For example, the Netherlands included elements in the definition of a "space activity" in its national space law, which are interpreted as excluding space activities employing nano-satellites from its scope of application. According to the Dutch Space Activities Act,[15] the "space activities" covered by the Act are: "the launch, the flight operation or the guidance of space objects in outer space." The term 'launch' does not require any explanation, and it is clear that the Netherlands will not be launching space objects anytime soon. The terms 'guidance' and 'flight operation' are further elaborated in the Dutch Act's explanatory memorandum:

> "The term "flight operation" is understood to mean the navigation, tracking and control of a space object during the flight phase, i.e. the phase between the launch of the space object and the time at which it takes up a position in outer space. Such activities can be performed from facilities, bases, earth stations or other control centres established on Dutch territory.
> This likewise applies with regard to the guidance of space objects in outer space (outer-space activities in the broad sense). This includes all command and control activities in relation to a space object (usually a satellite) – e.g. the execution of major and minor manoeuvres designed to keep a satellite in its position in outer space or to adjust its position/orbit, checking that there is no space debris in the vicinity that might cause problems, and monitoring the fuel level of geostationary satellites, etc., so as to ensure that satellites can be decommissioned when they are no longer in use (by placing them into a "decommissioning orbit" around 200 km higher than the geostationary orbit)."[16]

These definitions of 'operation' and 'guidance' in the Dutch Act effectively exclude nano-satellites from its scope of application, as these satellites can usually not be navigated, manoeuvred, or controlled in the sense of orbit correction.[17] According to Article VI of the Outer Space Treaty, states are responsible for "national activities in outer space", and lack of manoeuvrability means lack of activity in outer space. In a way, these satellites are simply not considered to be sufficiently "active".[18] As a consequence, they are not 'authorized' and 'supervised' by the Netherlands, despite considerable activity by private entities in the field of nano-satellites.

---

15 Rules Concerning Space Activities and the Establishment of a Registry of Space Objects, 24 January 2007 (Hereinafter: "Dutch Act"). An English translation is available at: <www.oosa.unvienna.org/oosa/en/SpaceLaw/national/netherlands/space_activities_act E.html>.

16 Explanatory Memorandum, Space Activities Act at 12 (13 June 2006) (English version).

17 Unless they include a propellant system.

18 See: T. Masson-Zwaan, *The (non-) Applicability of the Netherlands' Space Activities Act to certain 'Dutch' Space Activities*, 6th Eilene Galloway Symposium, Washington D.C. (1 Dec. 2011) slide 11, available at: <www.iislweb.org/docs/2011_galloway/Masson-Zwaan.pdf>.

The Belgian "Law on the Activities of Launching, Flight Operations or Guidance of Space Objects"[19] covers, as the Dutch Act: "the activities of launching, flight operations and guidance of space objects."[20] As in the case of the Netherlands, Belgium is not expected to launch objects from its territory in the near future. The Belgian Law further defines the relevant terms as follows:

> ""operator" means the person that carries out or undertakes to carry out the activities referred to in this law, by ensuring, alone or jointly, the effective control of the space object. The activity carried out by an operator may be carried out pursuant to a specific contract for that purpose;
> "effective control" means control of the means of control or remote control and the related means of supervision, necessary for the implementation of the activities of launching, the flight operations and guidance of one or more space objects;
> "flight operation" and "guidance" mean any operation relating to the flying conditions, navigation or evolution in outer space of the space object, such as the control and correction of its orbit or its trajectory."[21]

Although nano-satellites might not fall under the Law if one adopts a strict interpretation of these terms, in practice, the Belgian Government interprets the term "operator" quite broadly, to allow nano-satellites to fall inside its scope of application. Thus, Belgium considers that a party that orders the launch and the orbital positioning of a satellite has "effective control" of the satellite, and should therefore be considered as operator. Hence, nano-satellites do fall under the current Belgian Law. However, clarification of the Belgian Law is needed to avoid the need to resort to this broad interpretation.
The legal gap between the international obligations of states under Articles VI, VII and VIII of the Outer Space Treaty and the Liability and Registration Conventions, and the narrow or imprecise implementation of such obligations at the level of national space laws carries more than a theoretical significance. As will be illustrated below, this gap creates legal challenges in practice as well.

II Legal Challenges

Lack of Authorization & Supervision of Private Space Activities – Article VI OST

The above-mentioned non-applicability of national space legislation to nano-satellites results in the lack of an obligation to obtain a license for conducting such "inactive" space activities by Dutch private operators that launch their satellites from launchers abroad. In fact, currently The Netherlands does not consider

19 Law on the Activities of Launching, Flight Operations or Guidance of Space Objects, 17 September 2005 (Hereinafter: "Belgian Law"). An English translation is available at: <www.belspo.be/belspo/space/doc/beLaw/Loi_en.pdf>.
20 Article 2(1) of the Belgian Law.
21 See Article 3 of the Belgian Law.

itself as responsible for such space operations under Article VI of the Outer Space Treaty. They are not licensed, and are not 'authorized' and supervised'.[22] For Belgian private operators, although nano-satellites are covered by the law, for this to be the case an extended interpretation of the term "operator" has to be applied, by defining the party that orders the launch and orbital positioning as "operator" because it has "effective control". It is desirable to clarify this, in order to avoid confusion and provide a clearer legal framework for private (commercial) entities.[23]

At present, both governments are taking action to remedy the above-described undesirable situations. The definition of "space activities" which excludes nano-satellites from the scope of the national law is being reconsidered by the Dutch administration. It is clear that the exclusion of the operation of nano-satellites from national space laws so that these activities do not fall under the scope of "national activities in outer space" (Article VI), which results in states not taking responsibility for these activities, is undesirable. It is therefore a positive development to see that The Netherlands is making provisions in its national law to undertake its obligations under Article VI of the Outer Space Treaty. The Belgian administration is also currently reconsidering its Law in order to clarify and confirm its applicability to nano-satellites. Both developments will be further discussed in section III.

Non-Manoeuvrability and Liability - Article VII OST / Liability Convention

The biggest concern with respect to non-manoeuvrable nano-satellites is the risk of collision with another space object in low earth orbit. Of course while "responsibility" can be accepted on the diplomatic level, without any financial implications, the case of assumption of "liability" is different and carries much more risk for the state.[24]

---

22 See: Masson-Zwaan *supra* note 18.

23 J.F. Mayence, *Granting Access to Outer Space: Rights and Responsibilities for States and their Citizens: An Alternative Approach to Article VI of the Outer Space Treaty, Notably Through the Belgian Space Legislation,* in R.S. Jakhu (Ed.) National Regulation of Space Activities 74 (2010). See at 121: "We are aware that such an "interpretation" may raise concerns. Non-operated space objects may cause damage and constitute potential risks for other spacecraft. They put the burden of avoiding the collision exclusively on the shoulders of satellite operators who have the technical means to execute manoeuvres. […] But a large number of space objects in orbit remain beyond human control and are therefore not subject to any 'space activity' as far as their flight and trajectory are concerned. Responsibility and liability for the damage they may cause are actually borne by the whole space community and not only by the 'appropriate State' or the 'launching State(s)'. To that extent, the principles governing outer space activities do not seem to correspond to the current reality of space activities".

24 B. Cheng, *Article VI of the Outer Space Treaty Revisited: "International Responsibility", "National Activities", and "The Appropriate State"*, 26(1) Journal of Space Law 7, 9 (1998).

According to Article VII of the Outer Space Treaty and the Liability Convention, state parties are liable for damage caused by space objects. Taking into account the increasing congestion in outer space, states are more and more concerned that they might be held liable for damage caused by a collision between space objects, especially if it concerns a nano-satellite, which cannot be guided to avoid a predictable collision. As a consequence of its qualification as a "launching state" of a private nano-satellite, a state might be exposed to the obligation to compensate another state in case of damage arising from a collision, if it is found to be at fault.

As is well known, the definition of a 'launching state' in Article I of the Liability Convention includes the state that 'procures the launching', but states interpret this in different ways. To illustrate this, consider the case where a private operator and satellite owner from state X procures the launch of its satellite from a foreign launcher in state Y. In this situation, since the launch will be performed by and from the territory of state Y, the latter will be a "launching state". The state of nationality of the private entity, state X, that owns the satellite can also be considered as a launching state under Article VII of the Outer Space Treaty, because one of its subjects, a private entity, ordered and paid for the launch of the satellite and hence "procured" it. This interpretation would imply that both states X and Y are joint launching states, and may be held jointly and severally liable for damage caused by the space object, in accordance with Article V of the Liability Convention (of course, under that same Article, they may conclude an agreement on the apportionment of liability).[25]

In practice however, a different interpretation is adopted by states such as Belgium and the Netherlands. They do not consider state X as a launching state automatically. They consider that launch procurement has to be issued by a government in order for the state to consider itself as a launching state. *Private* procurement is in their view not sufficient to cause an assumption of liability of the state.

Nano-satellites are so small that they will burn up during their re-entry into the Earth's atmosphere and will not cause damage on the surface of the Earth. Rather, the relevant risk in case of nano-satellites is damage caused *in* outer space by collisions, and the liability regime that will apply in such cases is fault liability.[26]

Several questions may arise in the context of collisions involving (a) nano-satellite(s):

– Which state would be at fault in case of a collision between a manoeuvrable and a non-manoeuvrable space object?
– Which state would be at fault in case of a collision between two operational non-manoeuvrable space objects?

25 Cf. GA Res 59/115 of 10 December 2004, on Application of the concept of the "launching State", which reads in paragraph 2: "Also recommends that States consider the conclusion of agreements in accordance with the Liability Convention with respect to joint launches or cooperation programmes."

26 Articles III and IV of the Liability Convention.

In other words: does the (non-) manoeuvrability of a space objet play a role when establishing fault for a collision?
These questions remain unanswered because the space treaties do not provide any definitions of the terms used. The basic rules enshrined in the UN treaties need to be developed further. In any case, practice shows that collision risks are not exclusive to nano-satellites. The Iridium – Cosmos collision in 2009[27] illustrates that even when collisions are predictable and at least one satellite is capable to perform a manoeuvre to avoid the collision, a collision may nonetheless occur. Hence, it is incorrect to characterize collision risks as unique to nano-satellites and CubeSats. Of course they are smaller in size and there may eventually be many of them, but in essence they pose – and are exposed to – the same collision risk as large satellites. Moreover, the space treaties do not make any distinction whatsoever between manoeuvrable and non-manoeuvrable space objects.[28] A launching state is just as liable for damage caused by a nano-satellite as it is for damage caused by a geostationary satellite!

Registration Practices – Art. VIII OST / Registration Convention

In most cases, and especially in cases involving international scientific cooperation employing nano-satellites, there will be more than one launching state. Only one of those launching states may register the space object, and will hence be the most 'visible' launching state, although identification of the liable state is not the main purpose of the Registration Convention. In accordance with the 2007 'Registration Resolution'[29], States from whose territory or facility a launch takes place should contact states that could qualify as 'launching states' to jointly determine which state should register the object, and they should encourage the launch service provider to advise the operator / owner of the satellite to address the appropriate states regarding registration.
In the case of The Netherlands and Belgium, nano-satellites are not registered because these states do not consider themselves as the launching states, as explained in the previous paragraph.
The very practical problem that has arisen recently is that some launch service providers have begun making the launch of an auxiliary payload (such as a nano-satellite) conditional on registration of the space object in the appropriate national registry, pursuant to Article VIII of the Outer Space Treaty and the Registration Convention. This practice is certainly praiseworthy, as it will reduce the number of non-registered payloads in outer space. However, if the state where the private entity is established refuses to register the space object

27 See for instance: <www.orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv13i2.pdf>.
28 See also: L.J. Smith and Z. Valic, A Regulatory Roadmap for Small Satellites, 4S Symposium, Slovenia (5 June 2012), at 5: "Under international law, small satellite missions are not treated any differently than other space activities".
29 Cf. GA Res 62/101 of 17 December 2007, on Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects, paragraph 3.

because it does not consider itself as a ('procuring') launching state, the private entity runs the risk that the foreign launch service provider will not accept to launch its satellite because of this refusal to register. This would have undesirable effects for the economy, and might ultimately lead to companies deciding to move to another country that is willing to register their satellites, leading to so-called "flags of convenience".

III Solutions

A situation in which a legal barrier may prevent or obstruct scientific, educational and commercial activities in outer space is undesirable. Solutions must eventually be found for the three issues discussed above: responsibility, registration and liability. A step-wise approach may be preferable.

Responsibility

As indicated, Belgium and The Netherlands are currently considering solutions to respectively assume or clarify their responsibility for nano-satellites. The first step towards a solution will be to broaden and clarify the domestic definition of space activities.

In August 2012, the Dutch Minister for Economic Affairs, Agriculture and Infrastructure agreed to broaden the scope of the Dutch Act, so that guidance and operation of non-manoeuvrable nano-satellites from the Netherlands become a national space activity within the scope of the Dutch Act. The implementation of this decision to extend the application of the Dutch Act is currently underway. Similarly, the Belgian Law is currently being revised. The draft law revising the 2005 Law is expected to be signed by the King and to be passed before the Belgium Parliament by the end of 2012. It will redefine terms like 'guidance', 'operation', 'operator' and 'effective control' so that it is clearer that nano-satellites fall under the Law and require a licence. Belgium will specify the definition of "operator" by providing that when an object is not "operated" or "guided" once in orbit (i.e. the case of nano-satellites), the party that orders the launch and orbital positioning of the satellite will be considered as the operator – and that party needs a license. It will therefore be the notion of 'final authority' rather than that of 'actual control' of the flight operation that will determine whether a license is required.

In addition to these planned reforms, we should also mention the adoption of the most recent national space legislation, the Austrian Space Act in December 2011.[30] The catalyzing event that led to the adoption of the Act was the expected launch of the two first Austrian satellites into outer space. Both are nano-satellites, to be launched by a PLSV Indian launcher to low Earth orbit

30 Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry, as adopted by the Parliament on 6 December 2011 (Hereinafter: "Austrian Act"). An English translation is available at:

in 2012[31] and will require a license. The Austrian Act does not exclude nano-satellites from its application by adopting a narrow interpretation of the term 'national activities in outer space' of Article VI of the Outer Space Treaty, as the initial Dutch Act did. Hence, operators of nano-satellites will have to apply for a license. However, as stated in Article 4 of the Austrian Act, insurance conditions are different for activities in the public interest, i.e. if they serve science, research or education. Commercial nano-satellites are not excluded from the obligation to insure.

Registration

The second step will be to address registration.

The Netherlands adopted a pragmatic approach to registration that is quite unique. It has created a national part and an international part of its national registry. In the latter, it registers satellites for which it does not consider itself as a launching state but wants to register them in order to enhance information on the presence of objects in outer space. In the international part, it registers satellites for which it does consider itself as a launching state – and hence accepts liability in case of damage.

After the planned reform, nano-satellites will be licensed, and included in the national part of the register. The Dutch government is not expected to change its position about 'procuring a launch', and will continue to hold that a launch by a private entity from abroad does not make it a 'state procuring a launch', and thus a launching state that may face liability for damage, under the space treaties.

It must be noted that this solution is not accepted by all other states, and whether it will be considered as sufficient by a foreign state that is planning to launch a Dutch nano-satellite remains to be seen.

Liability

Lastly, liability may be addressed. Ideally, states would reconsider their approach to the concept of 'procuring a launch', by accepting the view that a private entity buying a foreign launch service for its satellite makes the state a 'launching state' under the space treaties, but this does not seem very realistic in the short term.

<www.oosa.unvienna.org/pdf/spacelaw/national/austria/austrian-outer-space-actE.pdf>. For preparatory work see: I. Marboe, *Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Registry (Austrian Outer Space Act)*, 2011 Proceedings of the International Institute of Space Law, 530 (2012); E. Walter, *The Constitutional Basis for an Austrian Space Law, in* C. Brunner, E. Walter (Eds.) Nationales Weltraumrecht, National Space Law: Development in Europe- Challenges for Small Countries 157 (2008); S. Stadlmeier, *What's in a Register: Austria (Not) doing Her Homework?, in* C. Brunner, E. Walter (Eds.) Nationales Weltraumrecht, National Space Law: Development in Europe- Challenges for Small Countries 148 (2008).

31 See *supra* note 4.

Since the liability concern related to the operation of nano-satellites is financial in essence (no risk of damage caused to persons on Earth, as explained above), the solution should be one that distributes the financial risk in the most efficient, equitable and effective manner. The following solutions could be considered:

- *Governmental endorsement*, i.e. the state takes the risk; this option is suitable when there is a strong national interest to develop space capacity. This is a pragmatic solution that Belgium considers to adopt for the satellites participating in the QB50 project. In order for Belgium to assume liability as a launching state which "procures the launch", the government would issue a statement in which it associates itself with the launch, and therefore 'co-procures' the launch of the space object. As such, the government would accept liability for the launch of the satellites. This solution could be considered by other states such as the Netherlands as well, but remains somewhat artificial.
- *Insurance* may present a balanced solution, provided that the sums insured are in proportion to the value of the mission and take into account the reduced risk (no loss of life or property on Earth which is covered by a regime of absolute liability). Insurance is in many cases, including in The Netherlands, required as a condition for obtaining a license, and is then automatically also an obligation for nano-satellites if they fall under that legislation. In Austria, the obligation to insure may be waived or the insured amount may be reduced for nano-satellites that serve the public interest, such as science, research and education (Article 4). However, this does not mean that the liability is also waived. The Belgian Law does not contain an explicit insurance obligation. In France, a financial guarantee may be given *in lieu* of insurance.

Therefore, it may well be that Dutch nano-satellites, commercial Austrian nano-satellites, and Belgian nano-satellites on which an *ad hoc* insurance obligation is imposed must seek insurance in order to obtain a license. The problem is that there is currently no market for insurance of nano-satellites, and this gap will have to be filled. To keep the cost at a manageable level, it may be necessary to resort to "blanket insurance", which would cover a number of nano-satellites in one policy.[32] Governments may need to assist operators in arranging this kind of special policies. As a side-note, one may wonder what the rationale is for requiring insurance in a country like The Netherlands; "Dutch" nano-satellites are launched from other countries and The Netherlands will not consider itself a launching state under the 'procurement' definition, and therefore will not accept liability in case of damage caused by a collision for instance. Hence, requiring the owner ("operator"?) to purchase insurance may seem contradictory.

- *A financial guarantee*, whereby the private operator takes all or most of the financial risk; however this option is not suitable for the emerging nano-satellite market. It might become an option in the future for commercial missions, except in countries where insurance is a condition for obtaining a licence, such as The Netherlands.

32 See for a definition of 'blanket insurance': <www.investopedia.com/terms/b/blanket_insurance.asp#axzz2A7ylgr4Q>.

IV Conclusion

The case of nano-satellites illustrates the need to define the provisions of the space treaties and transpose them into relevant national space laws in a manner that corresponds with the needs of innovative space technology for a stable, predictable and affordable legal framework.
It is clear that nano-satellites are becoming increasingly popular and, in view of their technical capabilities and low cost, play a useful role in the further exploration and use of outer space by all states.
Therefore, the legal regulation of space activities employing these satellites should be sufficiently flexible in order to allow for free exploration and use of outer space on the one hand, and to ensure that states' international obligations are met on the other hand.
A comprehensive legal regime should address state responsibility, liability and registration issues, possibly solving the various issues in a step-wise approach as outlined in this paper, in order to clarify the distribution of rights and obligations between private entities in the space industry and the states concerned, irrespective of whether satellites are manoeuvrable or not.

** The authors are grateful to Mr. Jean-François Mayence for his explanations on the Belgian space legislation and its planned reforms.*