Dealing with the Regulatory Vacuum in LEO

New Insurance Solutions for Small Satellites Constellations

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Abstract

With the rapid increase of small satellites already orbiting in LEO, regulators and policy makers raise the need to mitigate potential risks which are associated with these satellites, now more than ever. The latest industry trend includes start-ups and commercial companies that are engaged in developing small satellites constellations to be operated in LEO.

Some of the constellations offer the opportunity to bring the internet to all parts of our world; others aim to monitor air and ocean traffic, benefiting mankind globally, and individuals. The commercial interest as well as benefits go hand in hand in this case, however, this is a new technological development, which space law is not adapted for. Consequently, there are some difficulties with respect to: The notion of 'fault' (Art. III LIAB) regarding the case of collisions in space involving non-manoeuvrable small satellites; Lack of STM rules; and debris mitigation guidelines which are 'soft law', cannot effectively deal with thousands of new satellites in LEO.

The author is currently contemplating these difficulties in her Ph.D. study at Leiden University. In the current paper, new solutions for the mentioned risks shall be in the spotlight.

Until recently no adequate insurance products were available for small satellites operators. Hence, the ability to deal with collision risks, and comply with international obligations was very limited.

During 2015 the author, working for a leading small satellites launch broker, developed together with partners from the space insurance industry, an innovative declaration based Third Party Legal Liability insurance policy for small satellites. This opens the option to have a number of satellites insured, additionally to satellites being added or removed easily, facilitating risk mitigation for constellations. While insurance does not solve all the concerns relating to said constellations, it brings the industry one step ahead towards a responsible use of LEO.

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Another consequence is catalysing further regulation of these constellations, and making operators aware of the financial and environmental aspects relating to their use of LEO.
The paper aims to elaborate on the mentioned recent developments and suggest further practices that will hopefully fill LEO's regulatory vacuum.

1. Introduction

Low Earth Orbit (LEO) is already considered to be one of the most congested orbits. The small satellites revolution will surely cause LEO to be even more congested, since these satellites which are small in size and mass – less than 1000 kilo grams, and at their smaller classes less than 10 kilo grams, are typically launched to LEO where they stay until they re-enter Earth's atmosphere.
Currently, number of NewSpace companies are planning satellite constellations and 'mega-constellations', meaning hundreds or thousands of small satellites per each constellation. When these plans will be realized, thousands more satellites will occupy LEO, increasing the risk of collisions between space objects in outer space.
The Liability Convention,[1] in its Article III, refers to the liability regime in case of such collisions and prescribes fault liability. The notion of 'fault' however is not defined in the Convention or elsewhere in the UN Space Treaties. It never was a subject of a case before any international tribunal and thus, scholars agree that this notion remains rather vague, and can be understood in more than one way. This creates legal uncertainty in case damage due to a collision between space objects occurs, making it hard to predict whether compensations are due to the victim. Additionally, the lack of clear Space Traffic Management (STM) rules makes it difficult to understand who the victim is, in some cases. And the fact that space debris mitigation norms are codified in the form of soft law, rather than binding treaty law, adds to the complexity of the legal situation.
One solution which can add some certainty, at least by making potential compensations more accessible, is third party legal liability (TPLL) satellite insurance. In the past years, the author was involved in developing a new insurance product which is suitable for mitigating the financial risk originating in possible collisions between small satellite constellations and other space objects.
This paper will first present some of the planned small satellites constellations and 'mega-constellations' in its second section, following by presenting the risk attached to those. In the third section the above mentioned legal situation will be analysed, and will be referred to as the regulatory vacuum in

1 Convention on International Liability for Damage Caused by Space Objects, 1972 961 *U.N.T.S.* 187.

LEO. The forth section will present the possible solution in the form of satellite TPLL insurance. The last section will include final remarks.

2. Examples for Planned Small Satellites Constellations and 'Mega-Constellations' in LEO

Hereunder are some examples for commercial entities which seek to operate constellations or 'mega constellations' of small satellites in LEO. It is noteworthy that the satellites' dimensions, mass and manoeuvring capabilities differ from one example to another.

The largest planned mega-constellation to date is SpaceX's 4,425 small satellites constellation, which aims to "rebuilding the internet in space".[2] The number of satellites which will be launched to LEO is bigger than the number of all other satellites orbiting in outer space to date, certainly a change in the magnitude of satellite activities. SpaceX already filed for a license with the United States Federal Communications Commission (FCC) in order to obtain governmental approval to operate the anticipated mega-constellation.[3]

OneWeb is another company which aims to provide internet connection all over the globe, including places which are yet to be connected: "OneWeb's constellation of satellites will logically interlock with each other to create a coverage footprint over the entire planet."

"Small, low-cost user terminals will talk to the satellites in the sky, and emit LTE, 3G and WiFi to the surrounding areas, providing high-speed access for everyone."[4]

In order to achieve such global connectivity, the mega-constellation will be comprised of 648 satellites, at a micro-satellite mass class. The company seems to be very much aware of the potential debris creation of its planned activities, and provides the following statement on its website:

> "OneWeb understands space is a shared, natural resource that must be protected like any other. We are passionate about preventing debris creation, respecting existing space assets, and ensuring a safe and sustainable space (and Earth!) environment for the future.

2 See for media reports about this project: http://fortune.com/2016/11/17/spacex-satellite-network-fcc-global-internet/; http://www.parabolicarc.com/2016/11/16/spacex-files-fcc-approval-4425-satellite-global-broadband-constellation/; https://www.businessinsider.nl/spacex-internet-satellite-constellation-2016-11/?international=true&r=US. All the links provided in this publication's footnotes were last accessed on 15th December 2016.

3 *Ibid*, see also FCC's website: http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SATLOA2016111500118&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number.

4 OneWeb website: http://oneweb.world/#technology.

> On Board Propulsion and State of the Art Positioning with state-of-the-art onboard GPS sensors and ground-tracking measurements, OneWeb satellites will know their position within meters.
> We've chosen clean orbits with minimal debris and our satellites, using their on-board propulsion systems are capable of performing maneuvers to steer clear of anything that may come our way.
> End of Life Disposal when a OneWeb satellite nears the end of its intended service life, it will de-orbit automatically, ensuring that the space around our planet remains free and clear for future generations."[5]

It is not stated what would be the length of operational life per each satellite, meaning how often the company would have to replace the satellites which ended their mission with new satellites in order to keep effective global coverage at all times.
Terra Bella was founded in 2009, and became a Google owned company in 2014. It provides imaging services using small satellite at a class of 100 kilo grams: "We are building an entirely new class of imaging satellites. We've developed a high-resolution, small satellite platform capable of rapid response, high-resolution imagery at a fraction of the cost of traditional imaging satellites."[6]
The company is already active in space:

> "We've launched the first three satellites of our constellation in November 2013, July 2014, and June 2016, which are continuing to capture beautiful imagery and video across the globe. Our third satellite, SkySat-3, includes a propulsion module to support orbit-stationing and enable improvements in resolution. As we continue to grow our constellation, we will be able to construct a living, breathing snapshot of any location in the world within hours, and tackle more problems around the globe."[7]

The company's website does not disclose the number of satellites it aims to launch to reach a full constellation.
Sky and Space Global is a recently founded company which aims to launch a small satellite constellation comprised of about 200 small class nano-satellites:

> "A constellation of Nano-Satellites (approximately 200), placed in carefully selected orbits giving equatorial coverage of the Earth, creating a global communication network for voice, data and instant messaging. Nano-Satellites are fully operational satellites with a mass of less than 10kg. Due to miniatuarization of technology Nano-Satellites are capable to provide accurate attitude and orbit control and communication services. Since the first Nano-Satellite launch in 2003 they became the most popular type of satellites in space

5 *Ibid.*
6 Terra Bella website: https://terrabella.google.com/?s=about-us&c=about-satellites.
7 *Ibid.*

> for diverse commercial uses. The low mass and high capabilities of Nano-Satellites make them an affordable building blocks for constellations."[8]

Planet Inc. is another good example of a large nano-satellites constellation, already operational and providing image-data. The company states: "Operating one satellite is a challenge. Operating a hundred is unprecedented".[9] Each satellite is named 'Dove' and the company launches more multiple Doves in a 'Flock' about every 3-4 months.[10]
It is noteworthy that there are additional commercial small satellites constellations planned, adding to other scientific and educational constellations. One example to a scientific constellation is the QB50 project, sponsored by the EU, which will launch about 50 nano-satellites to a very low orbit in order to perform scientific measurements and learn about the satellites' re-entry process. Currently, at the end of 2016, the satellites were built and are waiting to be launched.[11]
While these constellations will surely benefit mankind, they will contribute to the congestion in LEO, and collisions risks between space object in these orbits will predictably grow. The next section will present the legal challenges with respect to such potential collisions.

3. The Regulatory Vacuum

Article III of the Liability Convention provides that the launching state(s) are liable in case their space object causes damage to another state's space object, the prescribed liability standard is fault liability in this case.
Significant scholarly work was already written regarding the notion of 'fault' in the meaning of Article III. While each scholar chose to shed light on a different aspect of the elusive meaning of 'fault', it is clear that there is great legal uncertainty around this term:

> "Article III is ambiguous. On the one hand, it can mean that a launching State is liable only to the extent of its fault. On the other hand, it can also mean that a State becomes liable for the totality of the damage as soon as it has been established that there is fault on its part, and there is a causal connection between this fault and the damage."[12]

> "Article III gives no indication as to who carries the burden of proving fault or of disproving it: in this context, the facts of each case will probably be determining,

8 SSG website: http://skyandspace.global/index.php/technology.
9 Planet website: https://www.planet.com/company/approach/.
10 *Ibid.*
11 QB50 website: https://www.qb50.eu/.
12 B. Cheng, Studies in International Space Law 328 (2004).

> since compensation under the Convention is determined, *inter alia*, according to principles of justice and equity (*ex aequo et bono*)."[13]

Additionally, there are different interpretations to what exactly would constitute 'fault'. *Jakuh* expressed the opinion that 'fault' should be understood similarly as it is under general international law.[14] On the contrary, *Smith* and *Kerrest* are of the opinion that international law commonly refers to violations of legal obligations, which are different than 'fault' in this case.[15]

Illustrating how this uncertainty translates to a case study, the author had previously analyzed the legal difficulty using the case of the only collision known to date involving a small satellite. In the collision which was reported to happen in 2013, the first Ecuadorian satellite belonging to 'EXA' the Ecuadorian Space Agency '*NEE-01 Pegaso*' (meaning 'Pegasus'), which was a 1U CubeSat, weighting 1.2 kilo grams collided with what seemed to be a particle cloud of space debris generated by a Soviet space object which was in space since 1985. The CubeSat (a standardized nano-satellite), had no manoeuvring capabilities by design, while the debris of the other space object were non-operational.[16]

Since both parties lacked the ability to take actions in order to avoid the collision it is hard to determine which of them is at fault:

> "Is Russia at fault for not safely de-orbiting its dead space object, creating space debris? Firstly, the following has to be considered: during the launch of the space object in 1985 there were no international guidelines aiming to mitigate space debris that would potentially generate fault due to a breach of an internationally recognized practice or duty. Secondly, even if the dead object would have been launched after the issuance of the IADC Guidelines, it would not be clear whether the failure to de-orbit the dead object would amount to fault due to a breach of an internationally recognized practice or duty, or due to a breach of international customary law.
>
> Would a claim by Ecuador be accepted? The answer is dubious, considering that compensations will be claimed due to a collision with a dead satellite, while the Ecuadorian satellite itself has no mechanism for controlled de-orbiting (since it is non-manoeuvrable), and hence is expected to remain dead in LEO after the end

13 P.P.C. Haanappel, *Enforcing the Liability Convention: Ensuring the Binding Force of the Award of the Claims Commission, in* Space Law: Current Problems and Perspectives for Future Regulation 116, M. Benko and K. Schrogl (Eds., 2005).

14 R.S. Jakhu, *Iridium-Cosmos Collision and its Implications for Space Operations*, *in* K. Schrogl (Ed.) Yearbook on Space Policy: 2008/2009, 256 (2010).

15 L.J. Smith, A. Kerrest and F. Tronchetti, *The Convention on International Liability for Damage Caused by Space Objects*, *in* S. Hobe, B. Schmit-Tedd and K. Schrogl (Eds.), Cologne Commentary on Space Law vol. II 133 (2013).

16 N. Palkovitz, 'Small Satellites: Innovative Activities, Traditional Laws and the Industry Perspective' in *Small Satellites: Regulatory Challenges and Chances* I. Marboe (Ed.) 58-60 (2016).

> of its operational life. How does this situation correspond with principles of justice and equity?"[17]

As the author concluded before:

> "[I]n the case of a collision between an operational small satellite and a 'dead' space object, establishing fault on the basis of breach of international standards relating to debris mitigation and de-orbiting, may not be successful under the Convention, since it does not correspond well with principles of justice and equity. It would not seem just and equitable to grant compensations on the grounds of one party's failure when the other party suffers from the same failure, with no possibility for either of the parties to act in order to avoid the damage.
> Thus, in case that de-orbiting would be a mandatory practice, both of the parties would be at fault, since one party did not de-orbit its dead satellite, while the other party will not de-orbit its small satellite in the future, creating space debris. Similarly, in the case that de-orbiting is not a mandatory practice, like in the present, both parties would not be able to avoid the collision, even if they become aware of it, and hence, in that respect, they are both not at fault.
> These conclusions illustrate the failure of the Convention to successfully deal with such situations, as Article III is applicable in theory, yet its application does not seem to provide even a slight indication of the legal result in such a case."[18]

The legal uncertainty at the international treaty level is unfortunately not the only legally-ambiguous element which is worth to consider when analysing potential collisions between space objects in general, and small satellites in particular.
STM rules are currently under debate at the international level. Having a clear set of 'rules of the road' which apply to satellite traffic in LEO would help to establish fault in cases of collisions. It is yet to be clear how STM will work institutionally, despite some current coordination efforts.[19] This means that the future legal analysis relating to such collisions will be comprised of new elements; however, it seems likely that the industry will move faster with launching the mentioned constellations, before regulators find internationally acceptable STM norms.
In the most elaborate STM study completed to date, there is only little consideration of constellations in LEO:

> "[…] many new LEO constellations have not fulfilled all their promises nor materialized yet, but if their proponents are to be believed, and based on the fact

17 *Ibid* at 59-60.
18 *Ibid* at 60-61.
19 *See* for example: S. Di Pippo and N. Hedman 'ICAO/UNOOSA AeroSpace Symposium – an Inter-Agency Effort on Space Traffic Management' IISL/ECSL Symposium, UNOOSA, COPUOS, Legal Subcommittee (13 April 2015). Available: http://www.unoosa.org/pdf/pres/lsc2015/symp-06.pdf.

> that they are expected to alleviate the alleged future saturation of terrestrial Internet (IP) networks, they will be heavy users of LEOs".[20]

The small satellites industry was still in its infancy when the study was carried out, which meant it was difficult to predict the current trend of hundreds and thousands of them intended to be launched in the near future. It was concluded that:

> "Even if the number of very small satellites launched annually were to increase, the relatively short lifetimes of these satellites would mitigate the overall effect on the number of operational vehicles."[21]

The anticipated updated STM study is yet to be published; it remains to be seen if the experts involved in the study would update their conclusions relating to LEO and small satellites constellations.

Moreover, on the international level, the lack of binding regulations relating to space debris mitigation practices contributes further to the legal uncertainty. When *von der Dunk* and *Jakhu* analysed the *Iridium-Cosmos* collision case they both saw significance in linking 'fault' under Article III of the Liability Convention and space debris mitigation norms.[22]

Although both scholars reach different conclusions in relation to 'fault', and see the strength of the current existing debris mitigation norms in a different light, it is clear that the discussion is relevant to the case of small satellites constellations. As mentioned in the previous section of this paper, the planned constellations differ with respect to the satellites' manoeuvring capabilities which imply that some would be able to avoid collisions, at least potentially, while others will not have such capability. All these factors illustrate that there will probably be room for interpretation when determining the legal and financial outcomes of a collision.

When considering debris mitigation standards, distribution of liability and insurance obligations which the operators will be subject to, the state-level becomes relevant to the discussion as well.

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20 Cosmic Study on Space Traffic Management, C. Jorgenson, P. Lála, K. Schrogl (Eds.) IAA, 75 (2006). An updated study is expected to be published during 2016, 10 years after the original study was published, *see*: C. Jorgenson 'From the 2006 to the 2016 Space Traffic Management Studies of the International Academy of Astronautics' IISL/ECSL Symposium, UNOOSA, COPUOS, Legal Subcommittee (13 April 2015). Available: http://www.unoosa.org/pdf/pres/lsc2015/symp-01.pdf.

21 Cosmic Study on Space Traffic Management, C. Jorgenson, P. Lála and K. Schrogl (Eds.) IAA, 26 (2006).

22 F.G. von der Dunk, *Too-Close Encounters of the Third Party Kind: Will the Liability Convention Stand the Test of the Cosmos 2251-Iridium 33 Collision?*, IISL Proceedings of the 52nd Colloquium on the Law of Outer Space, 199 (2009); R.S. Jakhu, *Iridium-Cosmos Collision and its Implications for Space Operations*, *in* K. Schrogl (Ed.) Yearbook on Space Policy: 2008/2009, 263 (2010).

Currently, not all states members to the Outer Space Treaty[23] have enacted national space laws. States that have such legislation in place were free to choose to what extent they wish their nationals (the operators), follow debris mitigation norms. The same is true with respect to the liability distribution mechanism between the state and the operator, and to whether the operator must take TPLL insurance or not.[24]

This simply means that operators from different jurisdictions have different obligations towards their state and third parties, which may influence the way each state would deal with a claim in case of a collision. Of course that in principle all the launching states would have to compensate a collision victim in the same manner according to international law, however, common sense dictates that it may be easier to activate an insurance policy when such is in place, rather than having to go via a governmental procedure which would allow the allocation of state-funds to cover the damage caused by a private entity.

Another implication is the difficulty of extracting state practice and *opinio juris* in connection to collision outcomes. The fact that only some states include space debris mitigation obligations on operators while others do not,[25] hinders the argument that space debris guidelines are already elevated from being 'soft law' to binding customary law. This brings us back to the legal uncertainty on the international level again.

The combination of the legal uncertainty which Article III of the Liability Convention encompass, the lack of applicable STM rules which may indicate which party is at fault in a collision case, and the above mentioned legal difficulty which derives from the fact that debris mitigation norms are currently 'soft law', all create what may be described as a certain 'legal vacuum' in LEO's environment. National laws may aid the certainty on the

23 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967 610 *U.N.T.S.* 205.

24 *See* for comparison between national space laws: 'Schematic Overview of National Regulatory Frameworks for Space Activities' UNOOSA, COPOUS, Legal Subcommittee A/AC.105/C.2/2014/CRP.5 (2014). Available: http://www.unoosa.org/pdf/limited/c2/AC105_C2_2014_CRP05E.pdf; In the context of insurance *see*: C. Gaubert 'Do Small Satellites Need Insurance?' in *Small Satellites: Regulatory Challenges and Chances* I. Marboe (Ed.) 370 (2016): "According to the international rules, the launching state may be liable in case of damage caused to third parties due to the small satellite activity at the origin of the damage, even though the activity is carried out by a private entity. However, these international rules do not tie the liability regime they set forth to any insurance obligation.
Therefore, the obligation to insure, if any, is set up by relevant national legislation. Only a few dedicated national space legislations contain insurance obligations in respect of satellites. In most cases (if not all of them), such insurance or financial guarantee concerns third-party liability and not property damage insurance."

25 *See supra* note 24.

state-operator level, however, will not provide a solution which is applicable internationally to different operators involved in a certain collision case.
To clarify, the norms are there, however, applying them would not result in clear legal determination of which party is at fault for the collision, and hence, should provide compensations to the other party.
The author argues that TPLL insurance makes compensation funds accessible to the parties involved, and thus, solves at least part of the financial problem the legal uncertainty may generate.

4. TPLL Insurance for Multiple Small Satellites

As a starting point, experts from the insurance industry define space insurance as follows:

> "'Space insurance' is defined as a specialized niche market in which fall all insurance contracts designed for protecting against the financial consequences of events occurring between the lift-off of the satellite and its end of life. This definition excludes insurance against the risk of damage on the launch pad or the risk of damage occurring while the satellite is being transported from its factory to the launch site. The liability incurred by a party while its satellite is launched or already orbiting is part of the space insurance domain."[26]

While TPLL policies were available in the space insurance market for many years insuring 'traditional' satellites, up until recently, they were inaccessible to small satellites operators:

> "With respect to small satellites' exposure, due to their technical nature, the limited scope of activity involved, and the volatility of the risk, not all insurers are willing to underwrite such space risks."[27]

As part of her work as the Legal Adviser of the ISIS Group of companies, specializing in the production and launch of small satellites, the author was involved in the process of creating TPLL insurance policies which are adjusted to cover small satellites operators.
The first 'blanket' TPLL policy was created to meet certain requirements of the Dutch Ministry of Economic Affairs, as part of the preparations to launch three Dutch CubeSats in 2013. Subsequently, during 2013 ISIS – Innovative Solutions In Space B.V. (ISIS) and ISL – Innovative Space Logistics B.V. (ISL) together with Willis InSpace (Willis) a large space insurance broker, placed a TPLL insurance policy for these CubeSats, being pioneers in the small satellite insurance market.

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26 P. Montpert 'Space insurance' in *Contracting for Space: Contract Practice in the European Space Sector* L. J. Smith and I. Baumann (Eds.) 283 (2011).

27 C. Gaubert 'Do Small Satellites Need Insurance?' in *Small Satellites: Regulatory Challenges and Chances* I. Marboe (Ed.) 369-370 (2016).

The three satellites which were insured were Triton-1 belonging to ISIS, Delfi n3Xt of The Technical University of Delft and FUNcube-1 of AMSAT-NL, a non-profit radio-armatures' organization. Each satellite was covered for up to 20M Euro.[28]

More information relating to the mentioned case and the evolution of the regulatory insurance requirements for small satellite in The Netherlands can be found in previous publications by the author together with *Masson-Zwaan*.[29]

In time, the space insurance market was ready for another development, which led to the creation of 'declaration-based' TPLL insurance policies to cover a larger number of small satellites under one policy terms.

With the realization that more and more operators would have to procure TPLL coverage for their satellites, during 2015, ISIS, ISL and Willis developed a new optimized insurance product for small satellites. They have done so by placing a declaration-based TPLL insurance policy for a cluster of different small satellites, for the first time in history, creating an innovative and affordable insurance solution for small satellites operators.

This type of policy means that a number of satellites are insured under the same policy terms, with the ability to add or omit satellites under it without the need to renegotiate the policy terms for each satellite. This is a very practical and effective insurance solution for small satellite swarms and constellations since the declaration mechanism is dynamic.

Insuring multiple small satellites under one policy helped in terms of accessing the space insurance market, making these satellites more attractive for underwriters to insure. Having one policy and distributing certain costs among operators also meant that the premium payable for each satellite is lower than in the case of insuring each satellite with a separate policy. This is a crucial factor when considering the fact that small satellites projects are regarded as 'low cost' space activities when comparing them to 'traditional' satellites. In this sense the emergence of constellations may have a positive effect on the ability to procure insurance for small satellites in general.

To clarify, each satellite is insured and enjoys individual coverage in case of a collision in orbit. The policy terms are of industry standards; hence, there is no derogation of rights or coverage connected to the fact that the satellites

28 N. Palkovitz 'New Insurance Products for the Launch of Small Satellites' *Proceedings of the 4S Symposium*, ESA, Malta, 2016 (Forthcoming).

29 N. Palkovitz and T. Masson-Zwaan, 'Orbiting under the Radar: Nano-Satellites, International Obligations and National Space Laws' in *IISL Proceedings of the 55th Colloquium on the Law of Outer Space* (2013) 566; N. Palkovitz and T. Masson-Zwaan, 'Small but on the Radar: The Regulatory Evolution of Small Satellites in The Netherlands' in *IISL Proceedings of the 58th Colloquium on the Law of Outer Space* (Forthcoming, 2016).

insured are small satellites. This makes sense since according to the Liability Convention there is no differentiation between big or small 'space objects'.
This new insurance solution may help operators to mitigate the financial risks which are attached to operating a small satellite constellation, and surely will promote the case of national licensing of these operators under their respective national space law or licensing regime.
Moreover, in case more states will choose to include mandatory TPLL insurance for operators of such constellations, as well as other operators, the probability of receiving compensations in case of a collision in orbit will increase as more and more space objects will be insured against such damage. Much like in case of having to insure private vehicles against third party liability damage when driving on the road, regulations which include mandatory insurance may change the way we perceive financial-collision risks in space. The author is in the opinion that such a change will aid the promotion of the private-commercial space industry in general, and small satellites constellations and mega-constellations in particular.

5. Final Remarks

While creating financial solutions which facilitate the need to deal with unknown and unlimited exposure of the launching states and operators to potential liability, clearly, there is much work yet to be done in order to achieve legal certainty.
It is submitted that in addition to making TPLL insurance mandatory to satellite operators under national space laws, the notion of 'fault' under Article III of the Liability Convention requires further examination and clarification. Establishing STM norms would be a step in this direction, making it easier to point at the party at fault in case of a collision between space objects. Finally, creating certainty with respect to space debris mitigation guidelines would aid the determination of the precise standard for mitigation which states must implement, possibly indicating the parties which may have breached such international obligations.
LEO's future seems to be filled by innovative small satellite constellations which will add to the other space objects already orbiting, let us, space lawyers and scholars, fill it with helpful norms which will ensure its sustainable use.