

The Future of Uniform International Rules on GNSS Liability

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Abstract:

Incidents in recent years indicate the risk of GNSS signals malfunction. Whether or not we need a set of uniform international rules specific to GNSS issues, especially liability issues, has been discussed in the international society over years. This paper is to discuss the rationale to have the uniform international rules on GNSS liability to third parties and the idea to make GNSS service provider the liable party in the future international rules.

The paper will first of all examine whether current international law, especially space treaties and conventions concerning international transport, covers GNSS liability to third parties in case of the accidents caused by GNSS signal malfunction. Obviously current international rules are inadequate to cover such issues and a set of uniform rules is in need. Then it will turn to international efforts of establishing uniform rules on GNSS liability. The studies of the ICAO and the UNIDROIT will be discussed here. In its last part, the paper will focus on some specific liability issues.

I. INTRODUCTION

Global Navigation Satellite System (GNSS) is considered as one of the most critical technologies in the twenty-first century. The application of such systems was listed as one of the key actions of “using space applications for human security, development and welfare”, mentioned in the resolution adopted by UNISPACE III,¹ “to improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of, universal access to and compatibility of space-based navigation and positioning systems”.²

For the time being, the space parts of GNSS consist of two core constellations: the NAVSTAR Global Positioning System (GPS) of the United States and the Global Navigation Satellite System (GLONASS) of the Russian Federation. In the near future, other similar systems will be operational: the Galileo of European Union, the COMPASS-Beidou 2 Navigation System of China, the Indian Regional Navigation Satellite System (IRNSS)

of India and the Quasi-Zenith Satellite System (QZSS) of Japan. The first two systems will provide global service and the latter two will be regional.³ GNSS has been widely applied for both military and civil purpose. In civil field, its application includes transportation, banking and financial, telecommunications, encryption, fishing industry, agriculture, geodesy and building industry, disaster relief, public order and public safety.⁴

While GNSS brings great convenience and benefit to the whole world, it may also cause significant damage due to malfunction, which includes the absence of the GNSS signal, errors in the GNSS signal, the degradation of performance below the threshold defined by the Key Performance Indicator and inadequate quality of the service.⁵ Such malfunction may lead to incorrect information or data to end users, which may be source of accidents causing loss and damage in the different areas of activities relying on those signals.

In this case, the service provider would face two types of liability to parties suffering damage: contractual liability to contract users and

non-contractual liability to third parties. This article will focus on third party liability.

II. LIABILITY OF GNSS SERVICE PROVIDER UNDER CURRENT INTERNATIONAL LAW

1. GNSS Liability under Space law

There is no doubt that satellite-based navigation is space activity and is therefore regulated by international space law. The 1967 Outer Space Treaty⁶ and the 1972 Liability Convention⁷ provide for state responsibility for their national space activities and liability for damage caused by space objects they launch.

1.1 The Outer Space Treaty

Article VI of the 1967 Outer Space Treaty provides for international responsibility of States for their national activities in outer space, whether they are carried on by governmental agencies or non-governmental entities. It further provides that States are responsible for “assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty” and the activities of non-governmental entities in outer space “shall require authorization and continuing supervision by the appropriate State Party to the Treaty”. Moreover, when activities are carried on in outer space by an international organization, such responsibility “shall be borne by the international organization and by the State Parties to the Treaty participating in such organization”.

Two concepts need to be clarified here. The first one is “national activities”. In general international law, states are only responsible for their own activities; in case of private activities, a state is only responsible for its failure to control such activities.⁸ Under this article, on the other hand, states are internationally responsible not only for their own activities, but also for activities carried on by private entities.

That is to say, the states are responsible not only for lack of “authorization and continuing supervision”, but also for the consequence of the activities. Current and planned Global Navigation Satellite Systems are all owned and operated by States or international organisations. However, if in the future such a system is owned and operated by private entities, their national states shall still bear international responsibility under Article VI of the Outer Space Treaty.

The second concept is “activities in outer space”. Such activity in relation to contracting States’ responsibility “is not necessarily restricted geographically, or cosmographically to only what occurs in outer space”.⁹ That is to say, the international responsibility of States under Article VI would include “all the concomitant activities associated with what actually occurs in outer space, both before and after”.¹⁰ Therefore, although not every step of the navigation activities occurs in outer space, space segment operator states are still responsible for the entire process of navigation.

1.2 The Liability Convention

The liability of a launching state for damage is generally provided in Article VII of the Outer Space Treaty. This is further specified in the 1972 Liability Convention. The possible applicable provision is Article II of the Liability Convention, which imposes absolute liability on launching State “for damage caused by its space object on the surface of the Earth or to aircraft in flight”. There are four elements in this article: (1) The liable party is a “launching State” in Article I; (2) the “damage” falls within the scope of “damage” in Article I; (3) the damage is “caused by” a “space object”; (4) the damage occurred on the surface of the Earth of aircraft in flight.

In order to apply this article, it is necessary to examine the following two questions: (1) Can damage caused by GNSS signal malfunction be considered as damage “caused by a space object” under the Liability Convention? (2) Is there any

causal link between damage and GNSS signal malfunction?

As for question (1), the Liability Convention defines space object as “include component parts of a space object as well as its launch vehicle and parts thereof”.¹¹ It is difficult to identify the GNSS signal as a “space object”; it is even difficult to identify it as an “object” because the signals are intangible, but objects are most often tangible. In short, it is not very realistic to consider the GNSS signal “a space object”. However, since the signals can be traced to the navigation satellites, the damage could still be considered to be “caused by a space object”.

As for question (2), it is controversial whether “caused by” means that “direct contact” must be made or whether it is enough that the damage was a consequence of a space object.¹² In other words, will the Liability Convention cover proof of causation only in case where the said damage is suffered on “direct impact or hit”?¹³ Will indirect, consequential damage fall within its scope?

Most of the discussions on the Liability Convention have tended to settle on the issue of direct and indirect damage. No agreement was reached at the sixth session of UNCOPUOS as for whether or not to include in the definition a reference to indirect damage and delayed damage. At its seventh session in 1967, the majority of delegates regarded the matter as one of adequate causality which need not be expressed in the convention.¹⁴ Some are of the view that the language of directness concentrates on physical contact.¹⁵ According to this view the Liability Convention would not apply to damage caused indirectly through an orbiting GNSS space object transmitting faulty navigation and positioning information.¹⁶ On the other hand, some are of the view that the Liability Convention applies to both direct and indirect damage caused by space objects.¹⁷ They identify the GNSS satellite as an “indirect” cause

of the damage, based on the fact that “the signals can be traced to a particular satellite and the satellite can be identified”¹⁸ and a causal link between the damage and GNSS satellite could be expected.¹⁹ They also believe that “governments would be liable for their navigation satellites under the Outer Space Treaty, Art VII, and under the Liability Convention”²⁰.

2. GNSS Liability under Other International Conventions

In addition to space treaties, GNSS liability to third parties could also possibly be covered by respective conventions concerning international transport or environment. These conventions *per se* do not deal with liability of GNSS service providers who may have caused the accidents, but they are somehow applicable to issues of such.

Take international air law as an example. There are two sets of rules concerning damage in international air transport. One is the Warsaw system²¹ regulating inter-party liability of the air carrier. Passengers on board suffering death, injury or damage to their baggage can seek compensation from the carrier - no matter the carrier is at fault or not - based on the Warsaw system.²² The Conventions also provide carriers for the right of recourse against party liable for the damage,²³ in this case GNSS service provider, if the air crash is caused by GNSS malfunction. The other set of rules, dealing with third party liability, is the 1952 Rome Convention and its protocol,²⁴ and the 2009 Montreal Convention.²⁵ Under these conventions, the operator of the aircraft is strictly liable for damage caused to third parties. Nevertheless he can seek recourse against another liable party.²⁶

Other accidents caused by GNSS malfunction make different cases. In case of ship wreckage, the international maritime conventions, for example the 1969 International Convention on Civil Liability for Oil Pollution

Damage (the 1969 Brussels Convention), will come into play, which excludes the ship owners liability in case he proves the damage was wholly caused by the wrongful act or negligence of “other authority responsible for the maintenance of lights or other navigational aids in the exercise of that function”.²⁷

In case that an aircraft crashes into a nuclear plant and triggers nuclear incident, nuclear conventions, for example the 1963 Vienna Convention on Civil Liability for Nuclear Damage, will apply. The nuclear conventions channel liability exclusively onto the operator who is the only person that may be sued by victims,²⁸ which means even the liability totally lies in the GNSS service provider rather than the nuclear equipment operator, the operator is still the only liable party. Where these instruments are applicable and where they cover liability for damage even through GNSS failures there is no need for further protection of the victims.²⁹

As for the abovementioned international conventions, in part they cover the damage caused by the malfunction of GNSS, in part they do not.³⁰ Even where GNSS liability issues are likely to be covered, the provisions vary in different conventions.

3. The Rationale of Having the Uniform GNSS Liability Rules

Currently, there is no specific international convention dealing with GNSS liability. Although GNSS liability seems likely to fall within the scope of application of space treaties, it is reluctant to apply the Liability Convention to GNSS liability. Besides the abovementioned argument whether damage occurred in accidents caused by GNSS malfunction can be considered as “damage caused by a space object”, the Liability Convention cannot apply to GNSS service provider if it neither launches nor procures the launching of the GNSS satellite, or the GNSS satellite is not launched from its

territory or facility, because the Convention only provides for liability of the “launching State”. Moreover, States are the only competent subject to claim compensation, and the claim must be presented through diplomatic channels.³¹ Such procedural rules make it difficult for victims to claim compensation.

As for international conventions other than space treaties, although under some of them the liability can possibly be attributed to GNSS service provider, there is no uniform rule dealing with the recourse. As there is no contract between the GNSS service provider and the end users, for example, air carriers and ship owners, such claim is to be only based on tort. When the potential plaintiffs present such claims to domestic courts, they are likely to confront the following problems, both procedural and substantial. First of all is state immunity. States and international organisations enjoy immunity from the jurisdiction of local courts and the local agencies of law enforcement.³² GNSS service provider may invoke immunity in case of a lawsuit, since all service providers are states or international organisations, as can be seen from current situation. The second issue concerns jurisdiction. The general rule is that the court located in the domicile of the defendant is competent. In tort claims, as in the present case, the court located in the place where the occurrence or result of the tortious act is also the competent court. The basic rule of jurisdiction is further refined by additional jurisdiction rules, such as jurisdiction of claims against the EU (as in case the EU is sued as the operator of Galileo).³³ Moreover, determination of applicable law is also taken into consideration. According to theories of conflict laws and state practice, in tort claims, the law of the country in which damage occurs is applicable, nevertheless there are more specific rules on product liability, environmental liability and customer service. In addition to conflict rules, the substantial rules such as the basis of liability, scope of coverable

damage, the limit of amount of compensation, burden of proof also diverse in different countries. The abovementioned issues may lead to different judgments, even in claims resulted in the same GNSS malfunction.

The damage caused by GNSS malfunction is not likely to be confined within the national boundaries of one State only. Such malfunction can cause accidents in different parts of the world at the same time. The need for a comprehensive international framework is strictly linked to the specific risk that characterises a particular activity and to the international scope of the effects of such risk.³⁴ Therefore, in the event of damage in more than one country, it is desirable that the recoverable amount to be awarded to victims be distributed equitably among all affected persons on the basis of mandatory uniform rules, irrespective of the country to which they belong.³⁵ To this end, an international framework is the only way to ensure adequate, equitable and uniform compensation for persons who have suffered damage.³⁶

III. INTERNATIONAL EFFORTS ON THE UNIFICATION OF GNSS LIABILITY RULES

Whether or not we need an international convention specific to GNSS issues, especially liability issues, has been discussed in the international society over years. International organisations, such as the ICAO and UNIDROIT, put this issue on their agendas. States expressed different views during the discussions and no consensus was reached.

1. ICAO

As aviation is one of the sectors benefiting most from the GNSS service,³⁷ the ICAO has been concerned with GNSS application in air navigation. It established the ICAO Communications Navigation Surveillance / Air

Traffic Management System (ICAO CNS/ATM), in which GNSS is the backbone. In 1998, the 32nd Session of the ICAO Assembly adopted the draft Charter on the Rights and Obligations of States Relating to GNSS Services, which listed fundamental principles of such service including continuity, availability, integrity, accuracy and reliability.³⁸ Although the language used in the Charter seems somehow mandatory, the Charter is only a non-binding Assembly Resolution; thus there is no legal guarantee that there will be universal adherence to these principles.³⁹

In the Eleventh ICAO Air Navigation Conference in 2003, the need for an international GNSS liability regime was again one of the vital subjects addressed. Member states expressed different views on the future international legal framework on GNSS service. African states, representing the opinions of most user states, make a strong case for an international convention which should be binding and enforceable and clearly spell out the rights and responsibilities of all parties involved in the GNSS, CNS/ATM service.⁴⁰

The provider states, on the other hand, took a totally different view, as can be seen from the statement of the United States. The US delegation expressed that current legal regime-referring to the Chicago Convention, its Annexes and ICAO guidance materials-is enough to cover liability issues in CNS/ATM service and the conference should do no such thing for both procedural and substantive reason.⁴¹ The other provider state, the Russian Federation, did not make any statement on this issue.

European states took a moderate position, proposing a contractual framework for the short to medium-term based on a two-tier approach. On one level, it offers a regulatory agreement dealing with public law matters including certification, liability and jurisdictional matters. Another level consists of private contractual agreements between the various stakeholders in

which they would have a very large degree of autonomy subject to certain mandatory elements determined by the regulatory agreement.⁴²

In 2004, the ICAO Study Group on Legal Aspects of CNS/ATM Systems submitted its final report, which contained the issue of liability. This report was presented to the 35th ICAO General Assembly in 2004 for the adoption of a resolution.⁴³ Opinions within the Study Group were divided about the need for an international convention on the liability from GNSS services and the report presented to the ICAO General Assembly contained both opinions without a compromise. In Subsection 3.3.3 of the report, the Group identified three possible approaches to the problem of liability relating to GNSS, including: (1) to ensure that the doctrine of sovereign immunity and related principles will not be an obstacle to bringing all potential defendants; (2) to establish an adequate recourse action mechanism for the state having jurisdiction and the aircraft operator to take recourse against other party at fault; (3) to ensure adequate compensation coverage.⁴⁴

The European Civil Aviation Conference (ECAC) acting on behalf of its 41 members also submitted a working paper to the 35th ICAO General Assembly with the draft on a “contractual framework” as Appendix B and a draft convention as Appendix C to the working paper.⁴⁵ The 35th ICAO General Assembly in 2004 resolved to finalise a contractual framework in line with the ECAC proposal.⁴⁶ However, the 36th ICAO General Assembly in 2007 no longer regarded the finalisation of the contractual framework as a task for the ICAO. Finally the 36th ICAO General Assembly in 2007 downgraded the priority of this project.⁴⁷ It seems less likely that the ICAO will put the GNSS liability issue on its agenda in the next few years.

2. UNIDROIT

At the suggestion of the Italian Government, the UNIDROIT Governing Council held initial consultations at its 85th session in 2006 on the inclusion of a new project in the UNIDROIT Work Programme: the elaboration of an international instrument to cover liability for damage caused by malfunctions in global (navigation) satellite service. At its 86th session in 2007, the UNIDROIT Council received a feasibility study entitled “The civil liability and compensation for damage resulting from the performing of European GNSS Services”, which came to a positive assessment.⁴⁸

Following that, the Governing Council at its 88th session held in 2009 discussed, also on the light of some considerations presented by an ad hoc Committee, the possible inclusion in the Work Programme of the Institute might envisage of a project on the civil liability for services provided by satellite navigation systems (GNSS). The debate which took place during that session underlined the interest of the subject but also its complexities. In 2010, a preliminary study paper was compiled by the secretariat, which a detailed feasibility study focusing in particular on gaps in liability resulting from malfunction of satellite-based navigation systems under existing conventions on carriage of goods and passengers by air, rail, road and sea, as well as conventions governing liability for environmental damage and third party liability by those modes of transport, including related insurance and reinsurance arrangements.⁴⁹ The preliminary study paper was submitted to the *ad hoc* committee for review prior to finalising the study for consideration by the Council at its 89th session in 2010.⁵⁰ The topic “Third Party Liability for Global Navigation Satellite System (GNSS) Services” is listed in the 2011-2013 programme.⁵¹

IV. THE LIABILITY OF GNSS SIGNAL PROVIDER IN THE FUTURE CONVENTION

A number of legal issues, both substantive and procedural, were addressed in the proposed international framework on GNSS liability. As a liability regime is always victim-oriented, such a legal regime should ensure the prompt payment of a full and equitable measure of compensation to victims⁵² and provide recourse to remedy to the greatest extent possible. The future convention is supposed to cover procedural issues such as jurisdiction and conflict rules, as well as substantial issues such as the identification of liable party, basis of liability, scope of damage. The principal thought is that GNSS signal provider be held liable, the rationale and feasibility of which will be discussed here.

1. The Channelling of liability

Channelling the liability on one person entails attributing responsibility to a party that can be easily identified, is economically reliable and engaged in presumably extremely hazardous activities while simultaneously making it possible to exclude from responsibility any other party involved in performing such services, at least towards third parties.⁵³ The rationale behind this is that such a liability convention is victim-oriented. More importantly, due to the complicated navigation technology, it is quite difficult to identify which party/parties is/are liable, because there will be a number of parties involved in the service chain going from the signal provider to the end-user.

The liable party must be easy to identify and economically reliable. The reference model is the 1963 Vienna Nuclear Convention, which establishes that liability is channeled exclusively to the operators of the nuclear installations and that liability of the operator is absolute. In GNSS liability, the proper responsible party should be responsible both vis-à-vis the victims (owing to the plain relationship between itself as service provider and the end-users, rendering it easily identifiable and, as a consequence, capable of

being sued before the competent court) and vis-à-vis the party from which compensation was claimed.⁵⁴ The service provider would be the most appropriate party to internalise the costs of a performed hazardous activity since it would be in a position to take out adequate insurance coverage before commencing operations.

2. Basis of Liability

Basis of liability includes fault liability and absolute liability. If we want to establish fault liability to a party, fault or negligence of that party must be proven. On the other hand, if the liability is absolute (or strict), there is no need to prove fault or negligence. The victims only need to demonstrate the loss, the wrongful act, and the causal link between them.

Liability was usually based on fault, that is to say, liability is attached to the person causing harm intentionally or negligently.⁵⁵ However, when the nature of the activity is “ultra-hazardous”, the liability shall be absolute, and the liability therefore is incurred irrespective of the perpetrator’s compliance with the required standards of care.⁵⁶ Under normal circumstances, international law does not impose liability on States for lawful activities.⁵⁷ Space activities are an exception to this principle, as States may be held liable even if their activities are not prohibited under international law.

There already existed a generally accepted rule that “ultra-hazardous activity in an act of conduct necessarily involves a risk of serious harm to a person, land or chattels of others which cannot be eliminated by the utmost care and which is not a matter of common usage”.⁵⁸ Although space activities have rapidly developed in the past decades, it is still regarded “ultra-hazardous”. In the case of air navigation, if the accident occurred due to the GNSS signal malfunction, the lives of hundreds of people on board the plane are threatened and there is little possibility for them to survive. That is why States pay much more attention to safety

regulation of air navigation as compared to, for example, personal vehicle positioning. In addition, it is unreasonable to impose the burden of proof of fault/negligence on victims, because the proof is almost impossible for ordinary people and they can never foresee such danger.

Moreover, the absolute liability regime is supported by international conventions dealing with “ultra-hazardous” activities or catastrophes. An example is the 1963 Vienna Nuclear Convention, which imposes strict liability on nuclear installation operators. Support for an absolute liability may also be found in international judicial decisions.⁵⁹ The most famous case is the *Trail Smelter Case* in which the arbitral tribunal held Canada liable to pay damages despite the fact that there was no negligence in the pollution of the US territory.⁶⁰ Article II of the Liability Convention may be an even better example.

Based on these reasons, therefore, it is reasonable to establish absolute liability in a GNSS convention.

3. Immunity

As current and planned GNSS primary signal providers are States and international organisations, it would be necessary to examine the issue of immunity. The state immunity rules were codified by the ILC.⁶¹ Under this convention, which tends to reflect *communis opinio* of different countries, only actions that can be defined as commercial transactions may be excluded from judicial immunity.⁶² This rule also applies to international organisations. Therefore, it implies that damage deriving from commercial services may be subject to claims for compensation whereas damage caused by sovereign acts would benefit from procedural immunity.⁶³

If the provision of signals is based on contract, like the case of Galileo, the service falls within the scope of “commercial transactions”, and the provider states (or

international organisations) are therefore not subject to immunity. If it is a non-contractual service, like the case of GPS or Open Service of Galileo, it is possible to be considered as sovereign acts and benefit from procedural immunity. However, whether or not the provider states enjoy state immunity depends on the domestic legislation of policy of that state. For instance, under the Federal Torts Claims Act of the United States, the government has waived immunity for claims caused by its wrongful acts.

4. Limit of Liability and Insurance

Although the GNSS signal provider is supposed to be held absolutely liable, the future convention needs to have some provisions to make sure of its sound operation and development. Limit of liability and compulsory insurance are two approaches of such.

The two-tier liability system, as in the 1999 Montreal Convention,⁶⁴ may be taken into consideration here. Such system sets, as in the Montreal Convention, an amount of 100,000 SDRs per passenger in case of death or injury in air accident. The air carrier is strictly liable for damage below this amount, but for damage above this amount, only liable when it is at fault. This amount will be reviewed and modified every certain period of time.⁶⁵ Although it is reasonable to hold GNSS service provider absolutely liable, it is not reasonable to make it burden all the economic loss, especially when it is not at fault. The two-tier liability system can, on the one hand, make the service provider to perform due care, and on the other hand, encourage and protect the operation of such service.

Another approach is compulsory insurance. It requires the GNSS service provider to provide appropriate insurance to prove its economic reliability. The idea of compulsory insurance has been incorporated in national space legislation of a number of countries, such as Belgium, France, and the Netherlands. Similarly, it can be

incorporated in the GNSS liability convention to make sure the reliability of the service provider as well as to maintain its sound operation and development.

V. Conclusion

After examining the existing international conventions, we find that there is no specific provision concerning GNSS liability. Although this issue is possible to be covered under space treaties and some other relevant conventions, the ambiguity of the language of the convention and the lack of specific rules make it difficult to apply to accidents caused by GNSS malfunction, and may lead to different judgment in lawsuits for the same accident, which is inequitable and unfair to victims. Based on the wide-spread effect of potential GNSS malfunction and the shortcomings of current legal regime, it is proposed to have uniform international rules dealing with GNSS liability. Such rules should cover both procedural issues such as jurisdiction and conflict rules, and substantial issues such as the identification of liable party, basis of liability, scope of damage. The principal thought is that it is reasonable to channel the liability on GNSS service provider and the liability should be absolute, with supplementary provisions, such as limit of liability and compulsory insurance, to guarantee its sound development at the same time.

¹ Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999, Chapter I Resolution 1: The Space Millennium: Vienna Declaration on Space and Human Development, A/CONF.184/6, at 7.

² Report of the Action Team on Global Navigation Satellite Systems (GNSS): Follow-up to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (ST/SPACE/24, 2004), at 1.

³ An instrument on Third party liability for Global Navigation Satellite System (GNSS) service: a preliminary study, UNIDROIT

Informal Consultation Meeting "Third Party Liability for Global Navigation Satellite System (GNSS) service", Rome 22 October 2010.

⁴ *Ibid.*

⁵ Anna Masutti, CSN/ATM Systems: framework and regulation on GNSS, experiences in Europe, presented at Conference on Contemporary Issues in Air Transport, Air Law and Regulation, April 21-25 2008 in New Dehli, India.

⁶ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 610 UNTS 205 (1967) [hereinafter Outer Space Treaty].

⁷ Convention on International Liability for Damage Caused by Space Objects, 961 UNTS 187 (1972) [hereinafter Liability Convention].

⁸ Arnel Kerrest, 'Remarks on the Responsibility and Liability for Damages Caused by Private Activity in Outer Space', (1997) *Proceedings of the Fortieth Colloquium on the Law of Outer Space* 134, at 138. He further provides an example that in the well-known US-Canada *Trail Smelter Case*, the Arbitral Tribunal decided that Canada was responsible for a lack of efficient control of the smelter's activity, but Canada was not held responsible for the pollution as such.

⁹ Bin Cheng, 'Article VI of the 1967 Space Treaty Revisited: "International Responsibility", "National Activities", and "The Appropriate State"', (1998) *Journal of Space Law* 7, at 27.

¹⁰ *Ibid.*

¹¹ Liability Convention Article I (c).

¹² See e.g., Bruce A. Hurwitz, *Space Liability for Outer Space Activities in Accordance with the 1972 Convention on International Liability for Damages Caused by Space Objects* (1992), at 17.

¹³ See e.g., Stephen Gorove, *Developments in Space Law: Issues and Policies* (1991), at 149; Carl Q. Christol, *Space Law: Past, Present and Future* (1991), at 223.

¹⁴ Nandasiri Jasentuliyana and Roy S. K. Lee, *Manual on Space Law*, vol.1 (1979), at 115.

¹⁵ See e.g., Frans G. von der Dunk, *Private Enterprise and Public Interest in the European "Spacescape" - Towards Harmonized National Space Legislation for Private Space Activities in Europe* (1998); Gorove, *supra* note 13, at 149.

¹⁶ Francis. Lyall and Paul. B. Larsen, *Space Law: A Treatise* (2009), at 405.

¹⁷ Bin Cheng, *Studies in International Space Law* (1997) at 506.

¹⁸ B.D.K. Henaku, *The Law on Global Air Navigation by Satellite* (1998) at 225.

¹⁹ See *ibid.*, at 227.

²⁰ Paul B. Larsen, 'Legal Liability for Global

Navigation Satellite Systems', (1993) *Proceedings of the Thirty-Sixth Colloquium on the Law of Outer Space* at 89.

²¹ Warsaw system refers to the 1929 Warsaw Convention (Convention for the Unification of Certain Rules Relating to International Carriage by Air, Signed at Warsaw on 12 October 1929) and its protocols including the 1955 Hague Protocol, the 1961 Guadalajara Convention, the 1971 Guadalajara Convention and the four Montreal Additional Protocols signed in 1975. These set of instruments has been actually replaced by the 1999 Montreal Convention (Convention for the Unification of Certain Rules Relating to International Carriage by Air, Signed at Montreal on 28 May 1999), which now has 100 State Parties.

²² 1999 Montreal Convention Article 17.

²³ 1999 Montreal Convention Article 37.

²⁴ Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Rome, 7 October 1952 (hereinafter 1952 Rome Convention) and Protocol to Amend the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface signed at Rome on 7 October 1952, Montreal, 23 September 1978.

²⁵ Convention on Compensation for Damage Caused by Aircraft to Third Parties, Montreal, 2 May 2009 (hereinafter 2009 Montreal Convention).

²⁶ 1952 Rome Convention Article 10, 2009 Montreal Convention Article 13.

²⁷ 1969 Brussels Convention Article III (2)(c).

²⁸ 1963 Vienna Convention Article IV.

²⁹ Ulrich Magnus, Civil Liability for Satellite-Based Service, (2008) *Uniform Law Review* 935, at 944.

³⁰ *Ibid* at 943.

³¹ 1972 Liability Convention Article VIII and IX.

³² Ian Brownlie, *Principles of Public International Law* (6th sixth edition, 2003), at 319.

³³ *Supra* note 29, at 949.

³⁴ Segio M. Carbone and Maria Elena De Maestri, The Rationale for An International Convention on Third Party Liability for Satellite Navigation Signals, (2009) *Uniform Law Review* 35, at 40.

³⁵ *Ibid*.

³⁶ *Ibid* at 41.

³⁷ I.H.Ph.Diederiks-Verschoor, An Introduction to Space Law (3rd edition 2008), at 67.

³⁸ Charter on the Rights and Obligations of States Relating to GNSS Services, ICAO Assembly Resolution A32-19.

³⁹ Ram Jahku, Galileo Governance and Liability:

Legal and Liability Aspects, presented at International Galileo Governance and Liability Workshop, 26-27 May 2011 in Galaxia, Transinne, Belgium.

⁴⁰ LEGAL ASPECTS OF GNSS presented by African States in the Eleventh Air Navigation Conference, Montreal, 22 September to 3 October 2003, AN-Conf/11-WP/143.

⁴¹ LEGAL AND INSTITUTIONAL ISSUES AND THE STATUS OF CNS/ATM, presented by the United States in the Eleventh Air Navigation Conference, Montreal, 22 September to 3 October 2003, AN-Conf/11-WP/160.

⁴² ICAO Doc A36-WP/140.

⁴³ Hans-Goerg Bollweg, Initial Considerations regarding the Feasibility of an International UNIDROIT Instrument to Cover Liability for Damage Caused by Malfunctions in Global (Navigation) Satellite System, (2008) Vol.XIII *Uniform Law Review* 917, at 926-927.

⁴⁴ REPORT ON THE ESTABLISHMENT OF A LEGAL FRAMEWORK WITH REGARD TO CNS/ATM SYSTEMS INCLUDING GNSS, ICAO Doc A35-WP/75, Appendix para.3.3.3.

⁴⁵ DEVELOPMENT OF A CONTRACTUAL FRAMEWORK LEADING TOWARDS A LONG-TERM LEGAL FRAMEWORK TO GOVERN THE IMPLEMENTATION OF GNSS, ICAO Doc A35-WP/125.

⁴⁶ Bollweg, *supra* note 43.

⁴⁷ *Ibid*.

⁴⁸ Bollweg, *supra* note 43.

⁴⁹ *Supra* note 3.

⁵⁰ *Supra* note 3.

⁵¹ <http://www.unidroit.org/english/workprogram/me/main.htm> (last visited 08 September 2011)

⁵² Liability Convention Preamble.

⁵³ *Supra* note 34 at 52.

⁵⁴ *Ibid*.

⁵⁵ Hurwitz, *supra* note 12, at 27.

⁵⁶ See *ibid*.

⁵⁷ Manfred Lachs, *The International Law of Outer Space* (1964), at 78.

⁵⁸ Diederiks-Verschoor, *supra* note 37, at 31.

⁵⁹ Hurwitz, *supra* note 12, at 29.

⁶⁰ Kerrest, *supra* note 8.

⁶¹ United Nations Convention on Jurisdiction Immunities of States and Their Property (2004).

⁶² United Nations Convention on Jurisdiction Immunities of States and Their Property Article 10.

⁶³ Pietro Manzini and Anna Masutti, 'An International Civil Liability Regime for Galileo Service: A Proposal', (2008) Vol.XXXII Issue 2 *Air and Space Law* 114, at 117-118.

⁶⁴ 1999 Montreal Convention Article 21.

⁶⁵ 1999 Montreal Convention Article 24.