

Product Liability Ramifications for Erroneous GNSS Signals: Is an Alternative Approach Possible?*

*Andreas Loukakis***

Abstract

The liability regime for erroneous signals provided from Global Navigation Satellite Systems (GNSS) is a topical issue. There is already certain legal analysis relating to this matter which suggests the adoption of an international convention which would subject GNSS operators to a strict liability regime with a limitation on the amount and furthermore supplemented by a compensation fund. This paper will try to address the issues of liability for erroneous GNSS signals from a different perspective, namely that of product liability. Interestingly, someone could argue that in case of an erroneous GNSS signal, the GNSS provider could be considered liable for defective product, if the GNSS signal were qualified as a product. In some legal systems, this would lead to strict liability of the provider. In order to reach such a conclusion, it would be necessary to qualify the GNSS signal as a product. Thus, a number of particular questions need to be further explored: First, would the concept of product liability be relevant for GNSS activities? Furthermore, can a satellite signal be qualified as a product or as a service? What would be the legal consequences for GNSS signal providers if satellite signals were qualified as products? The basic aim of this paper is to give answers to the aforementioned questions. In doing so, the paper will base its analysis on two GNSS systems; the current system of GPS and the forthcoming system of Galileo. After briefly describing the basic elements of these systems and some hypothetical scenarios of damage, the paper will address the issue of whether satellite signals could be considered as products or services. In doing so, analogies from other fields as for instance electricity or defective information stemming from aeronautical charts, will be drawn. Electricity has been recognized as a product in a number of legal systems, within the EU for example. Defective information stemming from aeronautical charts has been qualified as a product by some American Courts. Given the fact that satellite signals share a number of common characteristics with electricity as well as with information derived from aeronautical charts, by analogy, one could reach the conclusion that satellite signals might be qualified as products. In addition, the legal consequences of recognizing satellite signals as a product will be

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** PhD Candidate, Faculty of Law, Economics & Finance, University of Luxembourg.

examined by reviewing product liability provisions in selected legal systems, namely the USA and the EU. Finally, some conclusions will be drawn from the aforementioned analysis.

I. Introduction

I.I Introductory Remarks with Respect to the Development of Satellite Based Services

Over the course of time, space technology has developed into a significant industry that produces satellites and launches vehicles to deliver a number of important services on earth to governments, individuals as well as businesses. Interestingly, these services cover various fields of daily life.

One example is the field of Global Navigation Satellite Systems (hereinafter GNSS). In brief, GNSS give instant answers to questions such as “where am I on earth?” and “where are my assets at all times?”¹, by using satellite based information –mainly signals- as well as specific kinds of technology. Hence, given these capabilities, GNSS are being used in a number of areas such as navigation, dispatching, fleet routing, fixed and mobile asset tracking. Along with the field of navigation, one could also observe other areas which are constantly being developed and are making use of satellite based information and of satellite signals. Telecommunications, meteorology as well as earth observation are all examples, just to mention a few².

It is beyond any doubt that there are a certain number of advantages of utilizing satellites signals in various areas for the provision of different kinds of services on earth. Better and more efficient transportation, better telecommunications, higher quality of television and internet services are some examples. Nonetheless, where there are advantages, there are also certain risks and legal challenges. Satellite based services make use of advanced technology³. Furthermore, these services, which are being rendered on earth, are based upon satellite signals. Many actors are contributing to the provision of the satellite signals and the satellite services more generally⁴: The satellite manufacturer, the satel-

1 “GPS: Charting New Terrain – Legal Issues Related to GPS-Based Navigation and Location Systems”, in ConstructionWeblinks. Com, April 1999.

2 Frans G. von der Dunk, “Earth observation and Data Policy: The legal issues – The Eopole Concerted Action Project”, Space and Telecommunications Law Program, Faculty of Law Publications, Nebraska-Linkoln, 1999, p. 373. See also Smith Delbert, “The legal ordering of satellite telecommunications: problems and alternatives”, in Indiana Law Journal, Vol. 44: Iss. 3, 1, 1969, p. 337.

3 European Commission, Roadmap, Regulation on EU GNSS third party liability risks, DG ENTR. GP2, 2011.

4 Francis P. Schubert, “An International Convention On GNSS Liability: When Does Desirable Become Necessary?”, Annals of Air and Space Law, Vol. XXIV, 1999, p. 245, esp. p. 248-251, see also Frans G. von der Dunk, “The European equation: GNSS=multimodality+liability”, Luf- und Weltraumrecht im 2, Jahrhundert, 2001.

lite services provider, government regulators, launch contractors and insurers are just to name a few. Thereby, these facts entail a significant number of risks and uncertainties. Technological risks, governance risks, and more importantly liability related risks could be mentioned⁵.

For instance, with regard to liability risks, situations including damage might be imagined. If the satellite system and the satellite-based technology do not function as anticipated, they might cause considerable damage. Consider the worst scenario, the malfunction of satellite systems – such as satellite signal loss or defect in the transmission of a satellite signal- might even lead to catastrophic losses. Some hypothetical examples of such losses would be the crashing down of an aircraft, the wreckage of a ship or damage where a major financial transaction being executed is disrupted by satellite signal loss. Therefore, questions concerning liability risks within the course of the provision of satellite based services become significant.

I.II Basic Purpose of This Contribution: Product Liability and Its Impact on GNSS

The aforementioned risks and challenges from a liability law perspective as well as how the concept of liability can be applied in the field of satellite based services and GNSS more specifically will be the core elements of this paper. In particular, the basic focus of this paper will be on damage scenarios resulting from a satellite system's malfunction, namely that of satellite signal loss or erroneous satellite signals within the field of GNSS. Primarily, the basic concern of this paper will revolve around liability ramifications for GNSS signal providers. Secondly, liability ramifications for other actors participating in the provision of GNSS (i.e. satellite's manufacturer or GNSS receiver's provider) will be also examined but to a lesser extent.

Notably, the liability regime for erroneous GNSS signals has been a topical issue. There is already certain literature⁶ relating to this matter which suggests the adoption of an international convention which would subject GNSS providers to a strict liability regime with a limitation on the amount and furthermore supplemented by a compensation fund. The proposal for an international law instrument is based on the fact that current space law and general tort liability law do not address GNSS liability risks in an appropriate manner. Thus, according to the existing literature, a public international instrument would be an appropriate step for addressing GNSS liability risks.

5 Report from the Commission to the European Parliament and the Council, "Mid term review of the European satellite radio navigation programs", COM (2011) 5 final, Brussels, 2011, pages 8-11.

6 Sergio Carbone & Maria Elena De Maestri, "The Rationale for an International Convention on Third Party Liability for Satellite Navigation Signals", *Uniform Law Review*, 2009, p. 38. See also in this regard: UNIDROIT, "An instrument on third party liability for Global Navigation Satellite Systems: A preliminary study", S79, 2010, page 1. In this respect as well: Ulrich Magnus, "Civil Liability for Satellite-based Services", in *Uniform Law Review*, 2008, p. 935.

This paper will attempt to address the issues of liability for erroneous GNSS signals from an alternative perspective, namely that of current product liability law. Interestingly, someone could argue that in case of an erroneous GNSS signal, the GNSS provider could be considered liable for defective product, if the GNSS signal were qualified as a product. In some legal systems, this would lead to strict liability of the provider. In order to reach such a conclusion, it would be necessary to qualify the GNSS signal as a product. Thus, a number of particular questions need to be further explored: First, how might product liability be relevant in the course of the provision of GNSS? Furthermore, can a satellite signal be qualified as a product or as a service? In addition, what would be the legal consequences for GNSS signal providers if satellite signals were qualified as products? Lastly, would current product liability law be the most appropriate way in addressing GNSS liability risks before the proposal for an international law instrument?

The paper will attempt to give answers to the foregoing questions methodically through the study of relevant literature and analysis of selected case law. In examining the aforementioned questions, it will base its analysis on two GNSS structures, the current system of GPS and the forthcoming system of Galileo. The legal systems that will be examined from a product liability perspective will be essentially that of the European Union as well as of the United States. It should be highlighted that the legal analysis of the paper will be general, based, principally, upon the study of certain -selected- legislative and policy documents from a product liability perspective, coming from both the EU and US. The European Directive for Damage Caused by Defective Products, the American Uniform Commercial Code as well as the American Restatement of Torts (especially the 3rd edition addressing product liability issues) are some examples of these documents which will be discussed in more detail.

II. Global Navigation Satellite Systems: Definitions, Functional Model, Applications

II.1 Architecture of GNSS Technology

Generally speaking, satellite based services are very broad in nature⁷. Many applications using satellite based information can be found. These, essentially, vary between telecommunications, television and radio applications via weather forecasts, navigation, search and rescue services, right up to police, military and secret service uses. Many more variations of uses can be imagined.

One of the first fields of satellite based services which developed very quickly has been that of navigation (more specifically, the field of Global Navigational Satellite Systems). In brief, GNSS can be understood as a specific kind of space based technique. In principle, this technique has been designed in such a way

⁷ H.G. Bollweg, "Initial considerations regarding the feasibility of an international UNIDROIT instrument to cover liability for damage caused by malfunctions in global navigation satellite systems", *Uniform Law Review*, 2008, p. 917.

as to provide all weather conditions, three dimensional position, velocity and timing data⁸. For the operation of GNSS, there is a need to employ advanced technology which essentially works as follows⁹: A number of satellites are placed into fixed orbits in outer space. The satellites are constantly emitting navigational signals by indicating their position at any given time and in a very precise way. The navigational signals can be received by any person possessing the necessary technology such as a GNSS receiver. When receiving the signals from at least 4 satellites, the receiver can give information and pinpoint the position of persons and goods around the globe exactly to the meter. Hence, many individuals around the globe by using the GNSS capabilities can pinpoint their position exactly to the meter and they can easily determine where they would like to go.

Currently, there are two GNSS structures in operation¹⁰: On the one hand, the United States' Global Positioning System (GPS), the first GNSS structure which became operational, and on the other hand the Global Orbiting Navigation Satellite System (GLONASS) operated under the auspices of the Russian Federation. In the near future, an additional GNSS structure will become operational, that is to say Galileo which will operate under the auspices of the European Union. An important element of GNSS worth mentioning is that the provision of these services is being undertaken by State entities or supranational organizations. For instance, GPS is operated by the US Department of Defense, whereas Galileo will most likely be operated by a specific EU GNSS under the authority of the European Commission¹¹.

II.II GNSS: Some Examples of Applications

It is important to note that the first GNSS structure, namely that of GPS, was developed for military applications only. Nonetheless, since the year 2000, GPS has been made available for a great range of civil applications as well. With the advent of GPS and GLONASS, and soon enough with the addition of Galileo, the different civil applications associated with navigation, timing and location data have proliferated remarkably around the globe and have made the use of GNSS technology quite popular. One of the most well-known applications of GNSS is that of navigation. However, the GNSS technique has been developed far beyond its original goal which was the provision of navigational data. The

8 UNIDROIT, "An instrument on third party liability for Global Navigation Satellite Systems: A preliminary study", S79, 2010, p. 1 esp. p. 4. See also: Ulrich Magnus, "Civil Liability for Satellite-based Services", in *Uniform Law Review*, 2008, p. 935, esp. 935-937.

9 Ulrich Magnus, "Civil Liability for Satellite-based Services", in *Uniform Law Review*, 2008, p. 935, esp. p. 935-938.

10 Alessandra Andrade, "*The Global Navigation Satellite System*", in *Ashgate Studies in Aviation, Economics and Management*, 2009, esp. p. 36-65.

11 See Regulation (EC) No 683/2008 of the European Parliament and of the Council of 9th of July 2008 on the further implementation of the European satellite navigation programs (EGNOS and Galileo), esp. Article 16.

GNSS technology can also provide information for timing and positioning. Consequently, many applications connected with timing as well as positioning have emerged.

Briefly, for the purposes of this contribution, the following categories of applications can be presented¹²: First, one can observe a great range of applications developed in all kinds of transportation; the navigation of ships, airplanes, trains and cars are some typical examples. Given that GNSS can provide information for timing, this kind of technology can also be used in the banking and financial sectors. The synchronization of economic transactions and financial networks more generally are two examples of applications in this regard. Moreover, it should be noted that other areas can benefit from the use of GNSS capabilities; for example, GNSS technology can be employed in the fields of agriculture and fishing activities where in many instances there might be a need for easier and more efficient performance of these activities. Additionally, GNSS can also become a useful tool in situations of emergency. In many instances, there might be a strong need to determine the position of a victim and/or the position of a hospital. Thus, by exploiting the possibilities offered by GNSS technology, different emergency situations might be facilitated. Finally, it is important to add that GNSS technology might also serve internal security situations by enabling the monitoring of suspects as well as the tracing of stolen objects.

To sum up, the GNSS technique has been evolved into a constantly expanding field of satellite based services. Undoubtedly, the use of navigational signals serves a great range of uses in daily life such as transportation, telecommunications, various banking and financial operations. For the near future, it is quite likely that many applications in relation to GNSS will continue to be developed. Thereby, the future of GNSS technology will not be limited to one specific field.

III. The Concept of Liability from a GNSS Perspective: Some General Remarks

III.I GNSS Technology and Liability Risks

There is no doubt that the benefits associated with different GNSS applications are various. As demonstrated above, many areas can benefit from the use of GNSS technology. Nonetheless, where there are advantages, there are also risks and legal challenges. One of these challenges is liability¹³. The starting point is

12 UNIDROIT, "An instrument on third party liability for Global Navigation Satellite Systems: A preliminary study", S79, 2010, p. 1, esp. p. 14-18. See also Ulrich Magnus, "Civil Liability for Satellite-based Services", in *Uniform Law Review*, 2008, p. 935, esp. p. 935-940.

13 As early as 1992, the US government realized the potential problem of liability. In 1992 the US Air Force inaccurately updated the position of one of the satellites in the GPS constellation. The resulting error caused a horizontal error to GPS receivers which exceeded 300 meters. These potential liabilities of the US government have expanded due to the millions users of GPS worldwide who depend on the reliability

that the GNSS technique, by making use of advanced technology, encompasses inherent risks. Consequently, this fact might give rise to liability implications: For example, if the satellite system and the satellite-based technology do not function as anticipated, this might result in situations of -considerable- damage. Loss scenarios stemming from failure of the systems -as for instance from satellite signal loss or erroneous GNSS signals- are not difficult to envisage. As already mentioned above, hypothetical examples of such losses would be the crashing down of an aircraft, the wreckage of a ship or damage where a major financial transaction being executed is disrupted by satellite signal loss. Therefore, many questions from a liability perspective can be imposed: From whom can the victims of the aforementioned scenarios seek compensation? Moreover, under which legal regime can compensation be sought? Finally, which sort of liability is the most relevant in addressing GNSS liability risks?

III.II The Concept of Liability from a Satellite Based Services Perspective: Current Liability Law Is Applicable

When analyzing liability risks for GNSS, two major observations are crucially important: On the one hand, the fact that satellite based services do not and will not start operating in a legal and regulatory vacuum, but already existing legal provisions will be applicable. On the other hand, the fact that most of the existing legal provisions which can be used or might be relevant have not been drafted with satellite based services in mind. Remarkably, as Professor Von Der Dunk observes¹⁴, there is a legal environment within which satellite based services more generally and GNSS more particularly, will operate. But this, in principle, encompasses a large range of separate, already existing, specific legal environments, none of which were developed with satellite based services in mind. Mostly, these legal environments are nationally defined; they operate only within the territory of one particular state, whereas in many cases as for instance in the fields of air, sea or space law, international law or European law instruments are superimposed. Additionally, all of these regimes might be applicable in the field of satellite based services as well; thereby, they can affect their various applications.

Notably, the aforementioned observations are valid for GNSS liability scenarios (i.e. damage caused by erroneous GNSS signal or satellite signal loss). In principle, the development of satellite based services and potential failures of the satellite systems merely add another potential cause of damage to those already existing under national, European and international liability law provisions; that is to say human errors, engine failures or *force majeure* rather

and accuracy of GPS services/data on a daily basis. For the Galileo undertaking, see in more detail EC Regulation No 683/2008 where there is an explicit recognition of potential liabilities that might arise in the near future, esp. in par. 22 of the preamble of this Regulation.

14 See Frans G. von der Dunk, "Liability for global navigation satellite services: A comparative analysis of GPS and Galileo", in *Journal of Space Law*, 2004, p. 129, esp. p. 132-135.

than leading to a completely different or separate legal environment. Therefore, already existing national, European and international liability law provisions will be applicable when someone attempts to examine liability ramifications for GNSS liability risks.

III.III The Threefold Distinction between Contractual, Tort and Product Liability Law as Provided by Current Law and Its Impact on GNSS

Given the fact that GNSS will not operate in a legal and regulatory vacuum but current law will be applicable, one can come up with the conclusion that the concept of liability as provided by current law will be applicable for GNSS liability risks. In light of this observation, it would be helpful now to briefly consider the concept of liability as provided by current law more generally.

According to current law and broadly speaking liability can be defined as “the condition of being responsible for a possible or actual loss, expense or burden” and further as “the state of being bound and obliged by law to do, pay or make good something”¹⁵. Further on, liability is based upon a specific legal regime -either national, European or international- which subsequently determines the following elements: The limits of the particular liability regime, when it applies, which persons or legal entities are involved, what type of liability is stipulated for and ultimately how compensation issues are being handled.

From the perspective of investigating which liability law regimes can be or might be applicable within the context of the provision of GNSS, the fundamental threefold distinction between contractual liability, tort liability and product liability as provided by current law would be vitally important¹⁶. In short, the basic element which differentiates the aforementioned types of liability is the legal relationship between the plaintiff and the defendant.

In the specific field of GNSS all the aforementioned types of liability would be potentially relevant. Damage scenarios stemming from satellite signal loss or erroneous GNSS signals might give rise to claims which will be based on either contractual, tort or ultimately product liability. In the hypothetical case of damage stemming from satellite signal loss or erroneous GNSS signal, it is most likely that there will be no contract between the potential claimant and the defendant. Consequently, any liability claim will most likely be based upon current tort or product liability rules (i.e. liability outside of a contract in other words).

Irrespective of this observation, contractual liability might still have a minor role. Some categories of services offered by GNSS will be subject to the payment of an access fee; Galileo’s commercial services would be an example in this respect¹⁷. Hence, in the hypothetical case that these paid services might be

15 *Ibid.*

16 For definitions see Black’s Law Dictionary, supra note 13, p. 295, as well as West’s Law Commercial Dictionary supra note 13 at Vol. I, p. 389.

17 See: Communication from the Commission to the European Parliament and the Council: Progressing Galileo: Re-profiling the EU GNSS programs, 19th September 2007, COM (2007) 534 final.

proven defective, there might be a claim based upon contractual liability law. Moreover, a contractual claim might also be introduced by the buyer against the seller of a defective GNSS receiver. Notwithstanding these observations, liability in contract will be the less likely scenario for GNSS. Taking into consideration the already mentioned hypothetical scenarios of damage stemming from signal loss or erroneous GNSS signals, it is most likely that there will be no contractual relationship between the potential claimant and defendant. Thereby, liability irrespective of any contractual relationship, will be of greater importance for GNSS liability risks, that is to say tort or alternatively product liability.

III.IV Existing Status Quo: Basic Focus on Third Party Liability Issues (Tort) by the Existing Literature

Thus far, the liability regime for erroneous GNSS signals has raised various questions in the literature. According to the prevailing view in the existing literature the space law provisions (i.e. the liability convention for damage caused by space objects¹⁸) are not applicable for the case of damage caused by satellite signals¹⁹. In addition, it is interesting to note that the existing literature pertains mainly to the examination of tort liability issues²⁰. Moreover, it does not examine the potential impact of product liability law on GNSS.

Given the fact that non-contractual liability will be the most likely scenario for situations involving damage from GNSS activities, one can interestingly argue that along with tort liability, product liability law might also play an important role. In particular, one might suggest that in case of an erroneous GNSS signal or signal loss, the GNSS provider could be considered liable for a defective product, if the GNSS signal were qualified as a product. In addition, damage resulting from defective GNSS receivers or defective satellite components might also trigger product liability claims. Thus, a number of intriguing questions can be raised: How might product liability be relevant in the course of the provision of GNSS? Furthermore, can a satellite signal be qualified as a product or as a service? In addition, what would the legal consequences be for GNSS signal providers if satellite signals were qualified as products? Moreover, what kind of legal provisions from product liability perspective could be invoked? Finally, would product liability law be the most appropriate way of addressing GNSS liability risks before submitting a proposal for a public international law instrument dealing with GNSS liability?

18 See Convention on International Liability for Damage Caused by Space Objects, New York, 29 March 1972.

19 Signals cannot qualify as space objects according to the prevailing view in the existing literature; thereby, article II of the Convention on International Liability for Damage Caused by Space Objects will not be applicable.

20 See footnote 6.

IV. Product Liability as a Distinct Type of Liability and Its Impact on GNSS

IV.I Product Liability as a Distinct Type of Liability

Product liability can be seen as a separate sort of liability from that of tort and contractual liability. In brief, product liability²¹ can be defined as the area of law in which manufacturers, distributors, suppliers, and/or sellers of products are held liable for the injuries their defective products may cause.

In general, this sort of liability is considered beneficial for victims having suffered damage due to defective products circulated in the market. Given that product liability law provides for strict liability of the manufacturers and/or sellers of the product, victims do not have to prove fault on the part of the manufacturer. Proving negligence can be an important obstacle for recovery in those instances where evidence has been destroyed because of the product defect itself or misfeasance on the part of the manufacturer/defendant. This, thus, can result in situations with a complete denial of recovery. Basically, the victim who attempts to benefit from product liability law provisions must establish only the following elements²²: i) that the manufacturer sold the product, or otherwise placed it in the market in a defective condition, ii) the defective product proximately caused the damage and iii) finally, there is no need for victims to prove negligence on behalf of the manufacturer.

One can find various arguments for and against this specific sort of liability. In short, the following can be mentioned²³: First, product liability law –by imposing strict liability- causes manufacturers to internalize costs they would normally externalize. Strict liability requires manufacturers to evaluate the full costs of their products. In this way, strict liability provides a mechanism for ensuring that a product's absolute good outweighs its absolute harm. Between two parties who are not negligent (manufacturer and consumer), one of the parties must necessarily bear the burden of the costs of defective products. Proponents of strict liability argue that it is preferable to place the economic costs on the manufacturers and/or sellers of products because they can better absorb them and pass them on to other consumers. Second, strict liability also attempts to diminish the impact of information asymmetry between manufacturers of products and consumers. In principle, manufacturers have better knowledge of their own products' dangers than the consumers do. Hence, manufacturers are better able to bear the burden of finding, correcting, and warning consumers of those dangers stemming from defective products. Yet, another argument for imposing strict liability for defective product is that of the reduction of litigation

21 Panagiotis Kornilakis, "*Law of Obligations, edited in Greek*", in Sakkoulas Publications, Athens-Thessaloniki, 2012, esp. p. 687-811.

22 Joseph Reutiman, "Defective Information: Should information be a product subject to products liability claims?", in *Cornel Journal of Law and Public Policy*, Vol. 22, 2013, p. 181, esp. p. 186-188.

23 David Lanneti, "Toward a Revised Definition of Product Under the Restatement (Third) Torts: Product Liability", 35 *Torts and Insurance Law Journal*, 1999-2000, p. 845, esp. p. 870-873.

costs. Under product liability a claimant should only prove defect in a product and causation without having to establish fault/negligence. Where causation is easy to establish, parties to a strict liability suit will most likely settle, because only damages are in dispute.

Despite the positive aspects, one may also find various arguments against the concept of strict liability. According to an economic analysis of law²⁴, product liability law, by imposing strict liability, might have various shortcomings. More specifically, it might induce the risk of moral hazard. The consumers -in being aware that manufacturers or sellers might be held strictly liable- are more likely to under-invest in care even when they are the least-cost avoiders. This, thereby, might result in a lower standard of care from that provided under negligence rules. Furthermore, under a strict liability regime, the final price of products might be affected. Manufacturers -in being aware that they are always held strictly liable- may not produce the socially optimal level of goods/products. Consequently, this will affect the final prices of the products and will ultimately result in more expensive products being placed on the market.

In summary, product liability law is a contested area of law. There are various arguments for and various arguments against according to the foregoing analysis. Nonetheless, in light of the technological evolution, the application of strict liability/product liability has undergone a remarkable expansion by the Courts during the last decades. In general, many plaintiffs have benefited from the application of this specific sort of liability. Therefore, the following question can now be addressed: What are the most vital elements for the application of the concept of product liability and strict liability more generally?

IV.II Product Liability: Understanding the Definition of a Product

One of the most significant threshold issues in the area of product liability is the question of what can be qualified as a product for the purposes of applying product liability law. Therefore, a good understanding of the definition of product becomes of vital significance. In general, the issue of defining a product is incredibly important for potential litigants trying to benefit from product liability law as they may prove dispositive of a particular claim. For instance, a plaintiff whose claim falls outside the boundaries of product liability will generally be denied the benefit of strict liability. If that is the case, he should then prove fault under a negligence theory. As already demonstrated above, proving negligence might be a difficult, even insurmountable task in a number of cases. Hence, the question which needs first to be addressed is: What constitutes a product for the purposes of applying product liability law?

Thus far, there are various jurisdictions which have chosen to define the term product via legislation. It would be beyond the scope of this paper to discuss all of these jurisdictions in more detail. On the contrary, the paper will attempt to give a general idea of product liability law and of the definition of a product. Thereby, it will discuss two more specific legal systems, namely the European

24 Robert Cooter and Thomas Ulen, "*Law and Economics*", fifth edition, in Pearson International Edition, 2007, esp. p. 322-365.

Union and the United States. Both in the EU and the US there is a definition of the term product via legislation and via certain policy documents. The European Union Directive dealing with damage caused by defective products²⁵, the American Restatements of Torts (especially the 3rd edition) and the Uniform Commercial Code are some examples worth mentioning from a product liability perspective.

1. The European Union Directive for Damage Caused by Defective Products:

One of the most significant events in the history of product liability law in Europe occurred on 25 July 1985 with the introduction of the “Council Directive on the Approximation of the Laws, Regulations, and Administrative Provisions of the Member States concerning Liability for Defective Products”²⁶ (the so called, Product Liability Directive). In essence, the Directive requires all European Union Member States to impose strict liability on producers of defective products that cause personal injury or property damage. Notably, the Directive itself contains important provisions with respect to the definition of the term “product”, “producer” as well as “damage”. According to the text of this Directive (i.e. article 2) the term product is defined as follows: “*Product means all movables with the exception of primary agricultural products and game even though incorporated into another movable or into an immovable. Primary agricultural products means products of the soil, of stock-farming and of fisheries, excluding products which have undergone initial processing. Product also includes electricity*”.

2. The 3rd Restatement of Torts & the Uniform Commercial Code:

The EU belongs among these legal systems which have chosen to give a definition of the term product via legislation. Likewise, the same approach is followed by the US legal system. There are certain US legislative and policy documents which define the term “product” for the purposes of applying product liability and strict liability²⁷. Two of them are of importance for this contribution, namely the 3rd Restatement of Torts dealing with product liability issues as well as the Uniform Commercial Code.

i.) The 3rd Restatement of Torts:

In the US legal system, the Restatements of the law²⁸ have obtained an important legal value. Although, they are not legal instruments as such, they are considered as a set of treatises addressing various –general- legal subjects. In

25 Council Directive of 25th of July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (85/374/EEC).

26 *Ibid.*

27 Uniform Commercial Code par. 2-105 (1), 1995. See also Restatement (Second) of Torts, par. 402 A, 1965 as well as Restatement (Third) of Torts: Product Liability, par. 19, 1998.

28 David Lanneti, footnote 23, esp. p. 853-855.

principle, the Restatements of the law intend to inform judges and lawyers about general principles of law. To date, there have been three different editions of Restatements, all published by the American Law Institute, an organization of legal academics and practitioners. It is gratifying to note that the 2nd and especially the 3rd Restatement address various issues from a product liability perspective. More in particular, the 3rd Restatement of Torts deals extensively with the concept of product liability law in the US. Amongst the issues being dealt with by the 3rd Restatement, there is also an explicit definition of product. In particular, the following definition of product is provided: *a) a product is tangible personal property distributed commercially for use or consumption. Other items such as real property and electricity are products when the context of their distribution and use is sufficiently analogous to the distribution and use of tangible personal property b) services even when provided commercially are not products c) human blood and human tissue are not subject to the rules of the 3rd Restatement.*

ii.) **The Uniform Commercial Code:**

In addition to the 2nd and 3rd Restatement of Torts, one can also find other US policy and legislative instruments addressing issues of product liability. One of these instruments is the Uniform Commercial Code. The Uniform Commercial Code is a uniform act (a statute) that has been promulgated in conjunction with efforts to harmonize the law of sales and other commercial transactions in all 50 states in the US²⁹. This act essentially deals with the law of sales and not as such with product liability law. But still, it contains a number of provisions which might have product liability implications. An explicit definition of goods for the purposes of sales is one example of those provisions with potential product liability implications. In defining the term goods, the Uniform Commercial Code follows a quite similar approach to that followed by the 3rd Restatement of Torts. However, the definition of the Uniform Commercial Code is less detailed than the one provided by the 3rd Restatement. What is more, the Uniform Commercial Code refers to goods instead of products. More particularly, the Uniform Commercial Code adopts the following definition “*goods are all things including specially manufactured goods which are movable at the time of identification of the contract sales other than the money in which the price is to be paid, investment securities and things in action.*”

IV.III **Some Observations for the Current Definitions of Product**

Considering the foregoing definitions of product as provided by different legislative and policy documents both in the EU and the US, one can easily realize that the current definitions of product are relatively restrictive. The current EU and US legislative and policy documents follow a literal rule in defining the term of a product for the purposes of product liability. In other words, the definition of a product is provided explicitly by certain policy and legislative documents. Moreover, its basic characteristic is that it centers upon the element of

29 See in more detail: <<http://law.duke.edu/lib/researchguides/pdf/ucc.pdf>>.

tangibleness of products. Therefore, an item can be qualified as a product only and as long as it is tangible. In other words, if something can be manufactured, distributed and sold, then it qualifies as a product. Therefore, if that is the case, product liability and strict liability would be applicable.

Of course exceptions to the tangibility requirement exist. But these have been drafted in a narrow way. One example worth mentioning in this respect is electricity. Electricity, despite its intangible nature, has been recognized explicitly as a product for the purposes of applying product liability law both in the US and the EU. However, one should bear in mind the following element: the explicit inclusion of electricity both in the EU Directive and the 3rd Restatement of Torts indicates a deviation from the basic rule and in particular from the requirement of tangibility. According to the prevailing legal analysis³⁰, this explicit deviation from the rule cannot be extended by analogy (*expression unius est exclusio alterius*). Thus, intangible elements that are not explicitly recognized as products by the EU Directive and by the American policy documents cannot be qualified as products by analogy.

Overall, the current definitions of product as provided by both the EU and US would be characterized as restrictive and not at all flexible. By concentrating on the requirement of tangibility, they cannot accommodate other items –mainly intangible items- which have emerged as a result of technological evolution. Damage scenarios stemming from defective intangible items and new technologies is quite a likely scenario for the near future. Nonetheless, in light of the tangibility requirement, the victims of these scenarios will not be able to benefit from the application of strict liability. Instead, potential victims in those kinds of cases would only be able to obtain recovery under negligence theory, based on fault.

IV.IV A Further Element to Be Taken into Account: The Service versus Product Dilemma

Besides the good understanding of the definition of a product, a further element which affects the boundaries of product liability and should be taken into account is the distinction between products and services³¹. In general, product liability law supports the view that service providers unlike product manufacturers are not held strictly liable for the provision of defective services. Instead, victims of defective services can seek compensation under negligence theory

30 One should note that the express inclusion of electricity in the EU Directive for liability caused by defective products indicates a deviation from the rule that cannot become a source of analogy. Moreover, it should be noted that the inclusion of electricity by the EU Directive dealing with damage from defective products is connected with the qualification of electricity as a good by the European Court of Justice for the purposes of including it in the regime of the free movement of goods. In this regard, see more specifically: Case C-158/94, Commission versus Italy, 23rd of October 1997.

31 David Lanneti, footnote 23 esp. p. 865-870.

based on fault³². The basic rationale for applying negligence to service providers is based on the approach that a service provider practices an inexact science and thereby should be held only liable to a reasonably prudent person standard. Notably, this rule is valid both in the EU and the US. In this respect, it is worth stating that the EU Directive for damage caused by defective products explicitly recognizes that its provisions apply only to products whereas they do not apply for services³³. Similarly, the 3rd Restatement of Torts follows the same approach by distinguishing between products and services and by explicitly providing that services cannot be recognized as products. However, the question of where the boundaries are between services and products logically arises. In general, the distinction between the sale of a product and the provision of a service in many cases is not always very clear: As one legal scholar observes a product is delivered to the buyer in the course of the seller's rendering the service³⁴. But still, this distinction remains significant since in the end it determines the type of liability.

In exploring the limits between services and products, policy makers and Courts have applied different approaches. The commercial/professional test and the essence test are two specific examples³⁵. Under the professional test, if the defendant is professional and the transaction arose as a result of his professional activities then someone can speak about the provision of services and thus, strict liability will not be applicable. Under the essence test, the most important aspect is to investigate the basic essence of the transaction. In other words, there is an inquiry on whether the essence -the most prevailing aspect- of the transaction was the service rendered or the product supplied. If the service aspect prevails then there is not any possibility of applying product liability law. A third and final approach for the determination of the provision of services or goods is that of a case by case analysis; in other words, each case is examined differently in order to determine whether a transaction entails a product or a service.

Over the course of time service transactions have played an important role as technology evolves. Service transactions today outnumber product transactions. In addition, new technologies – due to their expanding developments and intangible nature- will continue to blur the distinction between goods and services. Nonetheless, the distinction has been maintained both in the EU and the US and will continue to play an important role for the application of the concept of strict liability and product liability more generally.

32 Charles Cantu, "The Illusive meaning of the term product under section 402A of the Restatement (Second) of Torts", 44, *Oklahoma Law Review*, 1991, p. 635, esp. p. 637.

33 Helen Delaney and Rene van de Zande, "A Guide to the EU Directive Concerning Liability for Defective Products (Product Liability Directive)", in NIST GCR 01-824, 2001, p. 1, esp. p. 1-5.

34 Annita Bernestein, "How can a product be liable", 45 *Duke Law Journal*, 1995, p. 1, esp, p. 65.

35 David Lanneti, footnote 23, esp. p. 865-866.

IV.V Preliminary Conclusions for GNSS Technology: Current Product Liability Law and Its Impact on GNSS

Having considered the most important elements of the concept of product liability both in the US and the EU, one can now raise the question of whether there is any impact of the concept of current product liability law on GNSS. The starting point is that GNSS will not operate in a legal and regulatory vacuum. Conversely, current law, including liability law, will be relevant. Therefore, one can raise the following question: What are –if any– the legal ramifications of current product liability law for GNSS liability risks?

In order to answer this question, it is important to bear in mind the architecture of GNSS and in particular the distinction between the space segment (i.e. satellites), the ground station, the specific technology being exploited by the user (i.e. navigational receiver) and finally the use of navigational satellite signals. As was demonstrated above, the current points of reference from a product liability perspective impose a tangibility requirement for the definition of product. Therefore, one can reach the conclusion that tangible GNSS elements might be qualified as products. Hence, damage scenarios coming from defective satellite components or defective GNSS receivers' hardware will most likely be addressed by current product liability law; strict liability will, thus, be applicable in these cases. On the contrary, intangible elements in the chain of the provision of GNSS will not be qualified as products. Given the fact, that the current points of reference for the definition of product both in the EU and the US adopt a strict and not flexible definition of products by imposing the requirement of tangibility, one can come up with the conclusion that damage scenarios stemming from defective GNSS receivers' software and from erroneous navigational signals will not be covered by product liability and strict liability. It is the most likely scenario that in those cases of damage stemming from defects in the intangible GNSS elements, recovery will be obtained under the theory of service provision. In other words, the provision of GNSS software and GNSS signals will most likely be qualified as service. Therefore, if the provision of these services is proven defective, then recovery will be possible under negligence theory based on fault.

V. Reconsidering the Definition of a Product: Would an Alternative Approach Be Possible?

V.I An Evolutionary Interpretation of the Term Product by the US Courts beyond Tangible Goods

During the last decades, one might notice an expansion of the application of product liability -especially by the US Courts- beyond traditional tangible goods. In addition, it is important to add that the American Courts have ceased to distinguish in many instances between services and goods. One can find a certain number of decisions of the US jurisprudence dealing with the issue of liability resulting from defectively marketed information where the US Courts

embraced the notion that information found in printed materials³⁶ (i.e. aeronautical charts) would be considered as a defective product for the purposes of applying product liability and strict liability. What is more, one American Court has taken the view in *obiter dictum*³⁷ that computer software, despite its intangible nature, might be qualified as a product and thereby strict liability might be applicable. In addition to defectively marketed information and computer software, electric and gas utilities have also been recognized as a product in a number of cases³⁸ by the American Courts.

By taking into account the aforementioned analysis for product liability as well as the strict definition of product as provided for by the different US legislative and policy documents, one would not have expected the American Courts to extend the concept of product liability to intangible goods. However, the American Courts decided to follow a different line of thinking in the aforementioned cases. Generally speaking, over the last decades the American Courts seem to have adopted a more dynamic definition of product for the purposes of applying product liability law. Although the current points of reference from a legislative perspective center upon the tangibility requirement for delimitating the boundaries of product liability law and retain the distinction between services and products, American Courts have taken a different, yet more expansive view, by applying strict liability to many intangible goods. What is more, the American Courts in a certain number of cases have started abandoning the distinction between products and services and applied product liability also to areas which in the past were traditionally characterized as services³⁹. In light of this evolutionary approach, a number of intriguing ques-

36 See e.g., *Sallomey v. Jeppesen & Co.*, 707 F.2d 671, 676-77 (2d Cir. 1983); *Aetna Cas & Sur. Co. v. Jeppesen & Co.*, 642 F.2d 339, 342 (9th Cir. 1981). However in the case *Winter v. G.P. Putnam's Sons*, 938 F.2d 1033, 1035 (9th Cir. 1991), the American Court came up to the conclusion that information contained in books ("encyclopedia for mushrooms") does not constitute a product for the purposes of applying strict liability.

37 See *Winter v. G.P. Putnam's Sons*, 938 F.2d 1033, 1035 (9th Cir. 1991); briefly in this case the 9th Circuit postulated in its analysis potential products that might be analogous to aeronautical charts which had been held by some Courts as to be products. Moreover, it should be stressed that many scholars have advocated the view that computer software should be treated as a product for the purposes of applying product liability law; see e.g. L. Nancy Birnbaum, "Strict Product Liability and Computer Software", 8 *Computer L.J.*, 1988, p. 135, esp. p. 138.

38 *Schriner v. Pennsylvania Power & Light Co.*, 501 A.2d 1128, 1133 (Pa. Super. Ct. 1985). Yet, *Elgin Airport Inn, Inc. v. Commonwealth Edison Co.*, 410 N.E.2d 620, 624 (3rd App. Ct. 1980).

39 See William Russel, discussing some of these cases in his note on "Products and the Professional: Strict Liability in the Sales-Service Hybrid Transactions", 24 in *Hastings Law Journal*, 1972, p. 111, esp. p. 114.

tions can now be imposed: First, why did the US Courts decide to deviate from the tangibility requirement? And more importantly, is there -if any- potential impact of this evolutionary approach on intangible GNSS elements such as in cases of damage caused by defective GNSS software or by the use of erroneous GNSS signals?

V.II Public Policy Considerations of Product Liability Law and Technological Evolution

In order to assess the reasons why the US Courts have adopted a more evolutionary approach in the definition of product, it is first necessary to understand the public policy goals behind product liability law in the US more generally. In this regard, of vital importance is the concurring opinion of Justice Traynor as expressed in the case *“Escola v Coca Cola Bottling”*⁴⁰. In short, four broad categories of policy goals for the application of product liability law were recognized by Justice Traynor. These essentially can be summarized as follows: First, the party best able to detect and eliminate product defects should be held liable. Second, the party best able to absorb and spread the losses should be held liable. Further on, the injured party should not be prevented from recovery due to problems of proof concerning the defect. Finally, consumers should be able to rely on the marketing of manufacturers.

In light of these policy considerations and of technological evolution, a more dynamic and evolutionary approach with respect to the definition of products emerged in the US. The American Courts in various areas recognized that technological progress demands a more flexible approach in the application of product liability and tort recovery more generally. New products -and new risks- as a result of technological evolution have appeared in the market. Interestingly, these products do not fulfill the tangibility requirement as provided for by current US legislative and policy documents. Electric light and power, the telephone, radio, radar, television, the automobile, the airplane, nuclear power, numerous consumer goods with an important informational element and all kinds of complex industrial machinery are some examples. All of these new products contain a number of risks. Thus, the possibility of having damage as a result of defects in these products is quite a likely scenario. Nonetheless, due to their intangible nature, recovery under negligence in many cases would be an insurmountable aspect preventing potential plaintiffs from recovery. Hence, the US Courts based upon the public policy considerations as expressed by Justice Traynor as well as the technological evolution decided to follow a more dynamic yet more flexible approach in the application of product liability. Consequently, many new areas, despite their intangible nature, were recognized as products for the purposes of applying strict liability. Notably, as one legal scholar observes⁴¹, once Justice Traynor introduced the policy objectives of

40 150 P.2d 436, 440, (Cal. 1944), *Escola Case*, Traynor J., concurring opinion.

41 John Wade, “Product Design Defects and Their Actionability”, 33 *Vand. L. Review*, 1980, p. 551, esp. p. 555.

strict liability, the expansion of the doctrine beyond traditional tangible goods proceeded at a remarkably rapid rate by the US Courts.

V.III Impact of the Evolutionary Definition of Product Liability on the Intangible GNSS Elements: GNSS Software and GNSS Signals

Considering the evolutionary approach as developed by the American Courts for the definition of product, one might argue that this approach can have potential implications for GNSS product liability issues as well. As already discussed, according to current law, only tangible GNSS elements might be qualified as a product due to the tangibility requirement and the strict definition of product. Nonetheless, if someone adopts the evolutionary interpretation of the term product, he might suggest the view that also intangible GNSS elements, such as GNSS receivers' software or GNSS signals, might be qualified as products for the purposes of applying strict liability.

The starting point is that GNSS make use of advanced technology which contains inherent risks. Under the negligence rule, potential victims having suffered damage from defects in the intangible GNSS elements might not be able to prove fault. This, thus, might result in situations with complete denial of recovery. Therefore, based upon the public policy considerations of product liability, one might take the view that product liability will be the most appropriate cause of action in the aforementioned situations of damage. A further element that might result in the application of this evolutionary approach for intangible GNSS elements is the fact that navigational satellite signals share a number of common characteristics with information derived from aeronautical charts. Both aeronautical charts and navigational signals have an important informational-intangible element. Moreover, both charts and navigational signals can be used for the same purposes such as navigation. Given the fact that information derived from aeronautical charts has been recognized as a product, a same approach might be followed if a potential case of damage caused by GNSS signals would appear before an American Court.

V.IV Difficulties in Applying the Evolutionary Approach in the Definition of Product to Intangible GNSS Elements

It is beyond any doubt that the evolutionary approach in the application of strict liability for damage caused by intangible GNSS elements would be a beneficial solution for potential victims. By imposing strict liability potential victims do not need to prove fault. Nonetheless, certain difficulties might arise when someone attempts to expand the doctrine of product liability to intangible GNSS elements.

In general, GNSS contain a number of specific characteristics. For the time being two GNSS systems are operational, namely the GPS and the GLONASS. In the near future, an additional structure will become operational, that is to say Galileo. Notably, all these structures are owned and operated by State entities and/or supranational organizations. For the near future, it is a likely scenario that some categories of these services will be offered by private undertakings. Nonetheless, for the time being, public entities predominate the

scene. In general, state entities in many instances can benefit from the doctrine of state immunity⁴². Thereby, the application of the concept of strict liability might be hindered by the invocation of the state immunity defense. An additional element which further complicates the situation is that the victims when they try to benefit from product liability should prove a defect in the product which ultimately caused the damage. In principle, there are two types of defects, that is to say manufacturing defects and design defects. Whereas for tangible GNSS elements it might be an easy task to prove manufacturing or design defects, for intangible elements of GNSS (i.e. navigational signals), this task might be difficult, even insurmountable. For instance, how would someone define a defective satellite signal? Furthermore, how can the concept of manufacturing/design defects be adapted in order to accommodate defective satellite signals? In response to these questions, one can draw comparisons from the field of electric utilities. Electric utilities have been recognized as a product for the purposes of applying product liability law. Yet, electric utilities can raise the same problems as regards the definition of defective electric utilities. Nonetheless, the Courts in a certain number of cases have taken the view that there is a possibility to apply the concept of manufacturing/design defects to electric utilities and thus strict liability can be applied⁴³. Would a similar view be followed in the field of satellite signals? A possible scenario for speaking about design / manufacturing defects regarding the provision of signals can be described as follows: A satellite system has to provide a signal which should conform to its declared specification. The declared specification is determined according to four criteria, namely accuracy, integrity, continuity and availability⁴⁴: First, accuracy refers to the difference between the measured and the real position, speed or time of the receiver. Second, integrity refers to a system's capacity to provide confidence thresholds as well as alarms in the event that anomalies occur in the positioning data. Third, continuity refers to a navigation system's ability to function without interruption. Finally, availability refers to the percentage of time during which the signal fulfills the accuracy, integrity and continuity criteria. One, subsequently, might argue that problems as regards the declared specification of GNSS signals (such as the case of wrong integrity information or wrong continuity) might be compared with design defects. Thus, the possibility of recognizing a signal as defective under the concept of design/manufacturing defects would be a difficult but still feasible scenario.

42 See: European Convention on State Immunity of 16th May 1972 & United Nations Convention on Jurisdictional Immunities of States and Their Property of 2nd December 2004.

43 *Pierce v Pacific Gas & Elec. Co.*, 166 Cal. App. 3d 68, 76-77 n.1, 212 Cal. Rptr. 283, 287 n.l., 1985. See also: *Beacon Bowl, Inc. v Wisconsin Elec. Power Co.*, 176 Wis. 2d 740, 792, 501 N.W. 2d 788, 809, 1993.

44 See also: Mariagrazia Spada, "Criteria Minimizing Legal and Financial Risks in Air-space Business", Aerospace Conference, 2008 IEEE, 10.1109/AERO.2008.4526682 (2008), esp. p. 2.

VI. Conclusion

There is no doubt that we are in the midst of a technological revolution. There is also no doubt that the remarkable progression in technological advancement will be accompanied by injuries resulting from defects associated with those new kinds of technologies. One of these areas which is based on advanced technology is that of GNSS. Generally speaking, GNSS technology is associated with positive and negative aspects. Many areas can benefit from the use of GNSS. But still, as GNSS technology evolves, it is a likely scenario that sooner or later the legal community might have to confront liability risks and challenges. In particular, who should be held liable for those cases of damage resulting from defective GNSS elements? And further on, under which liability regime? In light of the evolutionary approach -as emerged in the US- for the application of product liability law, one might suggest that product liability law will be the most appropriate legal regime for addressing liability risks arising in the course of the provision of GNSS. By imposing strict liability, it would be easier for potential victims of defective GNSS technology to obtain recovery. Conversely, one might argue that product liability law is not the appropriate legal basis for addressing liability risks arising in the course of the provision of GNSS. According to the law and economics analysis, the imposition of strict liability might hinder innovation for GNSS applications. Consequently it might also result in more expensive, -less accessible-, GNSS services. Additionally, there are also problems of immunities, of causation as well as of defining the notion of a defective signal for the purposes of applying product liability law. All in all, product liability law is a contested, yet dynamic area of law. Fortunately, thus far, there is no liability incident which has been reported as a result of using GNSS. Nonetheless, in light of the advent of the civilian structures for GNSS, it is a likely scenario that damage might be sustained in the near future. Thus, it remains to be seen by future legal analysis and case law whether the evolutionary definition of product will accommodate situations of damage stemming from defective GNSS software and more importantly from erroneous GNSS signals.