Global Navigation Satellite Systems (GNSS) and the GPS-Galileo Agreement

by

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Abstract

The law of global navigation satellite systems is a nascent, yet growing academic field. The subject matter it studies, GNSS, has been and is becoming ever-more important in the modern world, both for transportation, as well as for commerce. Indeed, globalization has seen billions of euros in trade associated with both nautical and aviation shipping, and this trend is likely to grow larger with the passage of time. Additionally, the nations of the world are fast realizing the potential of GNSS to make their aviation industries more robust and efficient, with integration of GNSS into air traffic management certain to increase the number of aircraft in flight at any given time, decrease the separation between such craft, and allow for safer takeoffs and landings, as well as improve flight in areas whose terrain has traditionally been quite challenging for contemporary navigational aids. In 2004, the United States and the European Community signed an Agreement intended to ensure radiocompatibility and interoperability between the U.S. Global Positioning System and the upcoming Galileo GNSS. This collaboration should enable continued and rapid growth of commerce and navigation improvements to aviation, but several of its provisions are poorly, if at all, defined. As a result, this thesis attempts to elaborate the nature and meaning behind the 2004 Agreement, while also serving to illuminate current legal theories concerning the liability regimes that accompany GNSS.

Résumé

Le droit des systèmes de positionnement par satellites (GNSS) est une nouvelle matière académique qui est en train de se développer. Le GNSS devient de plus en plus important dans le monde d'aujourd'hui tant pour le transport que pour le commerce. La mondialisation a contribué à la croissance du transport des biens par voies maritime et aérienne, et cette tendance ne pourrait qu'augmenter. Les pays du monde se rendent de plus en plus compte des possibilités d'usage du GNSS pour renforcer leurs industries aériennes en employant le GNSS dans la gestion du trafic aérien afin d'augmenter la capacité du ciel en réduisant la distance séparant les aéronefs, de rendre plus sécuritaires les décollages et les atterrissages, et de faciliter l'aviation dans des zones où la technologie contemporaine a prouvé insuffisante. En 2004, les États-Unis et l'Union Européenne ont signé un accord qui assure la radio-compatibilité et l'interopérabilité du système GNSS américain et son équivalent européen, Galileo. Cette collaboration devrait contribuer à une croissance continue du commerce et de l'aviation. Par contre, plusieurs dispositions dans l'accord sont mal ou pas du tout définies. Cette mémoire cherche donc à élaborer la nature ainsi que le sens à donner à l'accord de 2004, tout en exposant les théories juridiques contemporaines concernant la responsabilité juridique pour GNSS.

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Introduction

Global Navigation Satellite Systems[1] are a prominent technology in the rapidly advancing global economy. More and more, governments and private enterprises are relying on these satellite-based navigation aids to ensure the efficacy of their commercial and military enterprises, and signs point to the continued evolution and reliance on such technology on an ever increasing scale.

It is difficult to reliably discern the number of extant users for global navigation satellite systems, but that great engine of modern communications—the cellular phone industry—pays close attention to the use of such systems in their phones. Indeed, one company estimated that there were 163 million[2] smart phones in 2009 that possessed integrated GPS[3]. One may only imagine the number of total users of GNSS, since fields like shipping and (increasingly) aviation also heavily rely on the service; however, one study by the EU Commission predicted there would be more than 800 million users of GNSS worldwide by 2020.[4]

This thesis is an exercise in policy and legal analysis, along with certain jurisprudential elements. Specifically, the first chapter that follows will delineate what GNSS is, why it is important, and what its future uses will be. Though somewhat technical, this information is necessary for a basic understanding of the legal, regulatory, and political factors that affect the development and use of GNSS, as well as how the end users of the service will be impacted by the changing international climate.

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[1] Global Navigation Satellite Systems [hereinafter GNSS].
[2] Nokia, Press Release, "Nokia makes walk and drive navigation free on its smartphones, doubling size of mobile navigation market" (21 Jan. 2010) online: Events Nokia <http://events.nokia.com/ovimaps/press/210110_Nokia_makes_walk_and_drive_navigation_free.pdf>.
[3] The Global Positioning System, operated by the government of the United States of America [hereinafter GPS].
[4] Technical Documents of the EU Commission, Directorate-General of Energy and Transport: "The European Dependence on US-GPS and the Galileo Initiative" (Brussels 2002).

The second chapter focuses on recent international agreements between the United States and the European Union concerning the integration of signals and systems for GNSS, specifically the creation of a new European GNSS system known as Galileo and its future companionship with the US GPS. The first, and most germane, agreement is known as the Agreement on the Promotion, Provision and use of Galileo and GPS Satellite-based Navigation Systems and related Applications.[5] The second agreement was a joint-statement, created in 2008 and intending to reaffirm the commitments each Party had made towards GPS-Galileo compatibility.[6] A second joint-statement was released in 2010, again reaffirming each Party's commitments, as well as recognizing the exceptional benefits that would accrue to aviation navigation from the use of a compatible GPS-Galileo network.[7]

After a discussion of the GPS-Galileo Agreement, chapter two delves into the nature of international agreements, and attempts to discern whether the 2004 Agreement in particular constitutes an international treaty or something weaker. The analysis proceeds to ask what constitutes a treaty from an international law perspective, and how this differs from the conception of treaty making in the United States. The chapter also asks what other types of international agreements exist, and how these apply to the U.S. and E.U. Finally, this discussion is made all the more relevant by the problems associated with vague and ill- or non-defined language in the Agreement, as well as how

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[5] *Agreement on the Promotion, Provision and use of Galileo and GPS Satellite-based Navigation Systems and related Applications*, United States of America and the European Community, 26 June 2004 [hereinafter the Agreement].
[6] *Joint-Statement Joint Statement by Representatives of the United States, the European Community and its Member States on GPS and Galileo Cooperation*, 24 Oct. 2008, online: United States Mission to the European Union <http://useu.usmission.gov/dossiers/galileo_gps/oct2408_joint_statement.html>.
[7] U.S. Department of State Media Note, "United States and European Union Announce Collaboration on the Use of Global Navigation Satellite Systems", online: U.S. Department of State <http://www.state.gov/r/pa/prs/ps/2010/07/145465.htm>.

such language might properly be interpreted and resolved under an international law matrix.

Ultimately, then, chapter two serves as a case study in current GNSS law, for the resolution of problems generated by potential disagreements between the two primary parties of the Agreement is a testament to current understanding of international law, as well as navigation through the serpiginous waters of geo-political realities. The chapter attempts to wade through this material in a succinct manner, and to prepare the reader for the final section of the thesis.

The third and final chapter focuses on the liability regime surrounding the use of GPS and, eventually, joint use of GPS and Galileo. Certain of the Agreement's language addresses liability, but some case law and policy has already been developed, especially in the United States, as to how GNSS liability may be apportioned. The chapter summarizes the current liability law, and attempts to integrate any changes brought about by the Agreement. While the primary focus of the thesis is not an analysis of liability for GNSS systems[8], no thesis concerning this technology would be complete without at least a cursory review.

The research methodology employed in this thesis is comprised of several styles, relying primarily on informational and historical analysis, as well as reliance on customary international law and interpretive mechanisms. The sources used comprise several genres, including primary sources (such as case law, treaties, and judicial decisions), secondary sources (including monographs, journal articles, newspaper stories, and legal interpretations), and miscellaneous sourcing (such as unpublished works,

[8] For such a thesis, *see* Pablo Rodriguez-Contreras Pérez, *GNSS Liability Issues: Possible Solutions to a Global System* (LL.M. Thesis, McGill University Institute of Air and Space Law, 2002) [unpublished].

university theses, etc.). Multiple legal databases were utilized, as were a host of traditional library sources and internet-based research. Finally, the Canadian Guide to Uniform Legal Citation, 6th Edition, provided guidance in proper citation methodology.[9]

Chapter One: GNSS Law, Policy, and Problems

A. *General Aspects of GNSS*

1. *Positioning, Navigation, Timing, and Orbits*

Global Navigation satellite systems are navigation tools utilized by various State, military, civil, and individual users in order to determine position, velocity, and highly accurate timing.[10] Indeed, a GNSS is an example of positioning, navigation, and timing technology.[11] These systems are comprised of three primary segments: first, a space segment, consisting of the satellite constellations on which PNT systems so critically rely; secondly, the ground segment, constituted by several ground stations that collect and correct[12] GNSS data; and thirdly, the user segment, which is represented by either States, corporations, other organizational entities, or individual users.[13] The space and ground segments are sometimes augmented by corrective systems meant to increase the accuracy and reliability received from primary GNSS systems.[14]

GNSS satellites are typically placed into a medium Earth orbit, or MEO.[15] This orbit ranges from 8,000 to 20,000 km above the surface of the Earth, and satellites placed

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[9] *Canadian Guide to Uniform Legal Citation* 6th ed. (Thomson Carswell, 2006).
[10] *See, e.g.,* United States Department of Defense, Air Force Programs, "NAVSTAR Global Positioning System (GPS)", online: Office of the Director, Operational, Test & Evaluation <http://www.dote.osd.mil/pub/reports/FY2005/pdf/af/2005navstar.pdf>.
[11] For a basic description of positioning, navigation, and timing [hereinafter PNT] technology, *see* "What is PNT?", online: Space-Based Positioning Navigation & Timing <http://www.pnt.gov/101/>.
[12] *See* IGS Electronic Mail, <http://igs.bkg.bund.de/root_ftp/IGS/mail/igsmail/year2005/5209>.
[13] "What is GPS?", online: GPS.gov < http://www.gps.gov/systems/gps/>.
[14] "Augmentation Systems", online: GPS.gov <http://www.gps.gov/systems/augmentations/>.
[15] *See, e.g.*, James J. Miller, "GPS Modernization Update & NASA's GNSS Activities", online: <http://www.eiseisokui.or.jp/ja/pdf/forum_07/forum_07-

in this orbit typically exhibit an elliptical pattern of movement.[16] MEO provides the most amenable option for GNSS, as it avoids some of the problems associated with placing such satellites in Clarke Orbits (Geo-Stationary, or GEO; such problems including distortion of timing accuracy, and the need for larger and more interference-resistant GNSS satellites in GEO).[17]

The use of such satellite systems is fully consistent with extant international space law, as the Outer Space Treaty, the Magana Charta of Space, promotes the use and exploration of space, which, as it notes, "is the province of all mankind".[18] The Outer Space Treaty also notes that there shall be no appropriation in space by way of the extension of national sovereignty, by utilizing space, or by any other conceivable method of claim.[19] Stated succinctly by Judge Lachs, "Non-appropriation, then, is the rule."[20] Thus, space is a *res communis*, and therefor States are free to place satellites into orbit over the Earth, irrespective of which States may be overflown via the satellites' orbits.[21] There are several GNSS systems of varying usability, including the U.S. Global

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01.pdf?PHPSESSID=5e0b09132a0a4d62552bdb7519877c97>; *see also* Alan Chen et al., "GNSS Over China: The Compass MEO Satellite Codes" InsideGNSS (July/August 2007), online: InsideGNSS <http://www.insidegnss.com/node/155>.

[16] Intelsat, "Satellite Basics", online: Intelsat <http://www.intelsat.com/resources/satellite-basics/how-it-works.asp>.

[17] Rodriguez-Contreras Perez, *supra* note 8 at 3.

[18] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* [hereinafter the Outer Space Treaty, or OST], 27 Jan. 1967, 18 UST 2410, TIAS 6347, 610 UNTS 205, at art. I.

[19] *Ibid.* at art. II.

[20] Manfred Lachs, *The Law of Outer Space*, rev. ed. by Tanja Masson-Zwaan & Stephan Hobe (Leiden: Martinus Nijhoff Publishers, 2010) at 42.

[21] *Cf. The Bogotá Declaration*, 3 Dec. 1976, online: JAXA Space Law Library <http://www.jaxa.jp/library/space_law/chapter_2/2-2-1-2_e.html>, in which several equatorial States claimed their sovereignty extended into what most consider Outer Space, specifically geostationary orbit, or GEO. Their claim in international law was suspect, at best, as of the States that had signed the Declaration, only Zaire had not been a party to the OST. Indeed, Brazil, Indonesia, Ecuador, Kenya, and Uganda had all ratified the OST. Colombia and the Congo had signed, but not ratified, the OST. *See* "Space Law Documents" (2005) XXX:II Ann. Air & Sp. L. 11-13.

Positioning System (GPS), the Russian Federation Global Navigation Sputnik Systems (GLONASS), the European Galileo, and the Chinese BeiDou.[22]

The positioning benefit of GNSS allows users to determine their location in either two or three dimensions, and by reference with a geodetic system.[23] The navigation benefit allows users to steer themselves according to their needs, traveling in the appropriate direction to reach their goals.[24] Finally, the timing aspect of GNSS allows users to know *when* they are, and to the degree of accuracy necessary to perform the tasks they require of the system.[25]

2. *GNSS Applications*

Many of the applications which utilize GNSS avail themselves of each aspect of positioning, navigation, and timing. An example involves automobile navigation—a common use for GNSS derivative technology, such as the TomTom or Garmin systems. These systems benefit from the positioning aspects of GNSS by receiving information about where the traveler currently is in space, and, combining this information with the geographic destination preferred, as well as the velocity of the vehicle (timing), the user is given directions to the final destination, complete with accurate estimation of the time needed to arrive. Such technology is popular among drivers, and its users number in the millions.[26]

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[22] Francis Lyall & Paul B. Larsen, *Space Law: A Treatise* (Farnham: Ashgate Publishing Limited, 2009) at 391, 394-95, 399.
[23] "What is PNT?", *supra* note 11.
[24] *Ibid.*
[25] *Ibid.*
[26] *See, e.g.*, "Navigation Statistics", online: IT Facts <http://www.itfacts.biz/portable-gps-navigation-market-statistics/7163>.

Automobile navigation is but one of the many uses for GNSS.[27] To fully appreciate the need to consistently and ably interpret laws and regulations governing the use of the technology, one ought first be exposed to its varied applications. Only then does one begin to see how integrated GNSS has become in modern civilization, and how critical its continued, uninterrupted, and peaceful use remains. Some examples include the following:

- Forestry and Agriculture: Government agencies can utilize GNSS data to discern accurate boundaries for forests, helping to eliminate land disputes with private owners who border such forests. Farmers can also use data to ascertain estimates for their fertilizer needs, helping in the process to remove excess runoff and improving crop yields.[28]
- Archaeology[29]: Ancient dig sites and places of interest can garner assistance from the appropriate use of GNSS data. As an example, one such group, from Heildelberg College in Ohio, used GNSS data to help analyze the Battle of Fallen Timbers—a conflict between the U.S. Government and a confederation of Native American tribes.
- Aviation Navigation: The future of air navigation will depend heavily on GNSS. Indeed, the U.S. Federal Aviation Administration intends to use GPS data in the developing Next Gen air system to assist in reducing

[27] Indeed, for specific information on the various applications of GNSS technology, *see generally* "Galileo Applications", online: European GNSS Agency <http://www.gsa.europa.eu/go/home/galileo/applications/>; "GPS Applications", online: GPS.gov <http://www.gps.gov/applications/>; and "GPS Applications Exchange", online: NASA.gov <http://gpshome.ssc.nasa.gov/> [Applications Exchange].
[28] "Forestry & Agriculture", online: NASA.gov <http://gpshome.ssc.nasa.gov/country_form.aspx?cfips=US>, Applications Exchange, *supra* note 27.
[29] "Archaeology", online: NASA.gov <http://gpshome.ssc.nasa.gov/country_form.aspx?cfips=US>, Applications Exchange, *supra* note 27.

traffic congestion and improve the safety of separating aircraft.[3031] This use of GNSS has received considerable attention[32], and is discussed further, *infra*.

- Aviation Security: Knowing where an aircraft is located at all times is essential for security purposes. Even "civil" aircraft can be readily converted for military use[33], or for espionage. States have a right to control the airspace above their land territory, and indeed possess sovereignty in that space that must remain inviolable unless otherwise agreed by the rightful State.[34] The Chicago Convention permits a State to ground all air traffic[35]—a right given as a function of sovereignty over the air. The claim that a State has needed to defend its airspace against intrusion has been utilized before, most notably by the U.S.S.R. in 1983, when it shot down the civilian aircraft Korean Air Lines 007, killing hundreds of civilians. The aircraft had strayed into Soviet airspace, apparently without the knowledge of the pilots, and the U.S.S.R. claimed (after initially denying it had anything to do with the shootdown) that the

[30] "Fact Sheet—Next Gen", 2007, online: Federal Aviation Administration <http://www.faa.gov/news/fact_sheets/news_story.cfm?newsid=8145>.
[31] "Navigation Services—Global Navigation Satellite System", online: Federal Aviation Administration <http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/>.
[32] *See generally*, Stephanie Andries, *The Global Navigation Satellite System (GNSS) and the European Galileo Programme: Legal Issues* (LL.M. Thesis, McGill University Institute of Air and Space Law, 1999) [unpublished].
[33] John Cobb Cooper, "Air Power and the Coming Peace Treaties" (1946) 24:3 Foreign Affairs 441-452.
[34] John Cobb Cooper, "Air Transport and World Organization" (1946) 55 Yale L.J. 1191 at 1195-96.
[35] *Convention on International Civil Aviation*, 7 Dec. 1944, 15 U.N.T.S. 295, ICAO Doc. 7300/8 [hereinafter Chicago Convention], at Art. 9(b). Specifically, 9(b) states that "Each contracting State reserves also the right, in exceptional circumstances or during a period of emergency, or in the interest of public safety, and with immediate effect, temporarily to restrict or prohibit flying over the whole or any part of its territory, on condition that such restriction or prohibition shall be applicable without distinction of nationality to aircraft of all other States."

civil aircraft was on a spy mission for the United States.[36] A United Nations Security Council Resolution condemning the attack was blocked by the Soviets, who used their veto power.[37] Recognizing that such a tragic loss could be avoided through the use of better air navigation, President Reagan announced that GPS, once completed, would be made freely available.[38]

- Recreation[39]: hunters, fishers, hikers, bikers et. al. could benefit from portable receivers guiding them to the best rivers, paths, trails, and campsites. Nature lovers and individuals on vacation could find locations traditionally difficult to locate. Even golfers can benefit, using handheld devices to assist them in their game, rather than having to look for their course markers.[40]
- Location Based Services: Handheld receivers will enable users to find the location of the nearest desired locale, e.g., the nearest restaurant or bank. This same technology can be used to enhance security, allowing individuals to track lost pets or stolen property.[41]

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[36] "Turning on the Heat: KAL Flight 007", *Time*, (19 Sept. 1983), online: Time.com <http://www.time.com/time/magazine/article/0,9171,954035-1,00.html>.
[37] Walter Isaacson, Johanna McGeary & Erik Amfitheatrof, "Diplomacy: Salvaging the Remains", *Time*, 26 Sept. 1983), online: Time.com <http://www.time.com/time/magazine/article/0,9171,949814-1,00.html>.
[38] Asaf Degani, "The Crash of Korean Air Lines Flight 007", online: NASA.gov <http://ti.arc.nasa.gov/m/profile/adegani/Crash%20of%20Korean%20Air%20Lines%20Flight%20007.pdf>.
[39] Rodriguez-Contreras Perez, *supra* note 8 at 4.
[40] Applications Exchange, *supra* note 27, online: NASA.gov <http://gpshome.ssc.nasa.gov/country_form.aspx?cfips=US>.
[41] "Galileo Applications", *supra* note 27.

- Transport: The safety and efficiency of transportation services, maritime and otherwise, can be enhanced by GNSS.[42] In rail travel, various States utilize positive train control (PTC) systems made possible by GNSS data, and these systems help prevent train collisions, increase traffic efficiency, and generally improve the safety and reliability of rail transport.[43]
- Surveying and Mapping: GNSS data allow improved surveying techniques, removing the obstacles of poor weather and lighting that plague traditional surveying methods, and allowing precise positional data to be acquired quickly and by the efforts of far fewer individuals than were needed prior to the use of this technology.[44] Mapping benefits as well—Natural Resources Canada notes that topographic mapping can be used in conjunction with GNSS.[45]
- Disaster Management and Rescue Services: In a disaster, time is always of the essence. GNSS data can provide rapid and accurate information to rescue personnel about the locations of individuals needing immediate medical assistance, and can provide mapping information for areas where little mapping data is readily available.[46]
- Energy: Synchronized instruments monitoring power consumption and the means that carry power are essential. If a power line goes down, or

[42] *Ibid.*
[43] "GPS Applications", *supra* note 27.
[44] *Ibid.*
[45] "Mapping Information", online: Natural Resources Canada <http://maps.nrcan.gc.ca/topo101/faq_e.php#8>.
[46] "GPS Applications", *supra* note 27.

power goes out to a particular region, the highest accuracy is desired for addressing the problem.[47]

- Civil Engineering: Be it in the construction of new bridges and roads, or the maintenance of civil projects, GNSS data can help with digital mapping, decreasing costs, and improving construction efficiency.[48]
- Fisheries: Monitoring fisheries, their health and numbers, is made more accurate with GNSS. An additional benefit to fishermen is the mapping technology that can lead them to the areas of highest productivity.[49]
- Time Reference: Telecommunication networks will find GNSS timing information of the utmost value. In the world of internet based everything, ecommerce benefits from electronic stamping of the time in which a transaction is made, which is useful for verification of contracts and sales. Scientific endeavors which require highly accurate time synchronization for experiments can benefit from the atomic clock accuracy of GNSS satellites.[50] Power grid management, as well as financially based industries can benefit from accurate timing provided by this technology.[51]
- Military: Of course, GNSS technology was originally developed as a military tool and, at least in the case of the U.S.' GPS, remains under the direction of the military. While civilian users of GPS use the Standard

[47] "Galileo Applications", *supra* note 27.
[48] *Ibid.*
[49] *Ibid.*
[50] *Ibid.*
[51] "GPS Applications", *supra* note 27.

Positioning Service (SPS), the U.S. and her allies are enabled with the Precise Positioning Service (PPS) for security systems.[52]

3. *Key Definitions*

A final technical point necessary to understand GNSS consists in defining six prominent terms, all of which impact on the efficacy of the various national systems. These terms, and their meanings, reflect both the strengths and weaknesses of the systems. Variously, they are:

- Accuracy—"the degree of conformance between the estimated or measured position and/or velocity of a platform at a given time and its true position or velocity", and this is expressed, statistically, as a function of predictability, repeatability, and relativity.[53]
- Availability—essentially, this is the time, expressed in percentage, that the GNSS systems are available for use, and is a function of both the capabilities of the technology, as well as the physical characteristics of the environment.[54]
- Continuity—the ability of the GNSS to maintain its service over a period of time without interruption, and is often expressed as a likelihood of the system performing over a given period of time.[55]
- Coordinated Universal Time (UTC)—a scale of time based on atomic clocks, and serves as the basis of civil time[56]; this feature is one of the most recognizable abilities of GNSS to provide accurate timing.

[52] Paul Larsen, "Regulation of Global Navigation and Positioning Services in the United States", in Ram Jakhu ed., *National Regulation of Space Activities*, (New York: Springer, 2010) at 460.
[53] U.S. Federal Radionavigation Plan [hereinafter FRNP], 2010, p. E-1.
[54] *Ibid.* at E-2.
[55] *Ibid.*

- Coverage—the space volume which possesses signals of high enough strength and quality for a user to determine his position with accuracy (this is affected by power levels, receiver sensitivity, atmospheric noise, etc.).[57]
- Integrity—comprises the measure that one may trust in a navigation system; i.e., it should provide warning to potential users if the system should not be used for navigation at any given point.[58]

4. *Air Traffic Management Systems*

In the aerospace industry, GNSS is exceptionally important for aviation navigation. As mentioned above, aviation is growing dependent on GNSS to provide better safety, decongestion of airways, more efficient aircraft separation, and better ability to avoid straying into dangerous airspace. In this regard, any discussion of GNSS would be remiss without relaying the history of the International Civil Aviation Organization's (ICAO) efforts to modernize aviation via their Special Committee on the Future Air Navigation Systems (FANS), as well as its descendant, the Special Committee for the Monitoring and Coordination of Development and Transition Planning for the Future Air Navigation Systems (FANS II).

For much of the twentieth century, aviation navigation relied on tried and true methods of assuring craft got to their destinations on time, and safely. Such technology, like radar, radio-telecommunication, and topographic charting of areas surrounding airline routes, seemed sufficient for a time. Because of a huge growth in air traffic, issues crop up surrounding the efficient use of landing slots, the proper separation of aircraft from one another whilst in flight, and the possibility that reliance on the old system of

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[56] *Ibid.*
[57] *Ibid.*
[58] *Ibid.* at E-3.

navigation would eventually result in unsafe flying conditions, possibly concluding in the loss of an aircraft. Typical problems associated with the old system included the following: 1) the difficulty of implementing and operating communications, navigation, and surveillance (CNS) systems, for various reasons, in different parts of the world; 2) limitations on the propagation of so called "line of sight" technology; and 3) voice communication limitations, as well as the absence of a digital air-ground data interchange systems that could support automation in both the ground and in air.[59]

Recognizing the growth of the aviation industry would eventually require new methodologies to address insufficiencies in the old system, ICAO decided to form its Future Air Navigation Systems Committee, foreseeing its work would modernize the aviation industry and its methods of navigation.[60] This Committee determined that the then-used system of air traffic management (ATM) had inherent limitations that could only be overcome by utilizing new concepts, and that "exploitation of satellite technology was the only viable solution to overcome the limitations of the present system and meet future needs on a cost-effective global basis."[61]

After the initial success of the first FANS Committee, ICAO created FANS II to help implement the efforts its predecessor. FANS II helped create the new conception of the future of CNS/ATM systems, and assisted efforts in the Tenth Air Navigation Conference held in Montreal, 1991. This conference set the pendulum of progress in motion, but noted that implementation of the CNS/ATM systems of the future would

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[59] G*lobal Air Navigation Plan for CNS/ATM Systems*, ICAO Doc. 9750 AN/963, 2002 at I-1-3, accessible online through the archives of the International Business Aviation Council, online: IABC.org <http://www.ibac.org/Files/CNSATM/9750_2ed.pdf> [hereinafter ICAO CNS/ATM Plan].
[60] *CAR/SAM Regional Plan for the Implementation of the CNS/ATM Systems*, (1999), at 1.3.1, online: ICAO.int <http://www.lima.icao.int/eDocuments/GEN/CNSATM/CHAP01.pdf> [hereinafter ICAO CAR/SAM Plan].
[61] *Ibid.* at 1.3.2.

require the help and assistance of independent States and regions.[62] In order to facilitate the goals of including GNSS technology into aviation navigation, regional plans are created to focus on the needs and capabilities unique to various geographic areas. As an example, the Caribbean/South American (CAR/SAM) Regional Plan for the Implementation of the Communications, Navigation, Surveillance, and Air Traffic Management (CNS/ATM) Systems sets forth characteristic guidelines and expected benefits of the switch to heavier reliance on the CNS/ATM plan. Among others, the CAR/SAM Plan notes the shortcomings of the current system (including limited communication over the oceans and having to depend on pilot position reports for purposes of surveillance); the benefits for airlines (including, and primarily, increasing the capacity[63] of the airspace by allowing aircraft to fly more closely to one another and to operate virtually anywhere); benefits for general aviation (including enhancing current levels of safety, making the use of airspace more efficient, increasing airport capacity, and homogeneous and efficient provision of CNS); planning considerations; and evolution and implementation.[64]

Legally, the CNS/ATM plan advocated by ICAO does not appear problematic.[65] A Panel of Legal and Technical Experts recommended that GNSS should be compatible with international law (including the aviation-centric Chicago Convention), a framework

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[62] ICAO CNS/ATM Plan, *supra* note 59, at 1.10-1.11.
[63] The issue of capacity is a constant concern to the aviation industry. While more capacity would seem, at first, to be always a good thing, excess capacity, combined with a 'perishable' good (such as an airline seat), can cause variable pricing. Thus, while more capacity brought about by virtue of integration of GNSS technology is listed in the CAR/SAM Plan as a benefit, and while airlines are indeed likely to see it, in general, as such, it does have its drawbacks—especially if an airline does not or cannot fill the increased quantity of seats brought about by more efficient scheduling and higher flight density in the air. *See generally*, Paul Dempsey & Laurence E. Gisell, *Airline Management: Strategies for the 21st Century*, 2d ed. (Chandler: Coast Aire Publications, L.L.C., 2006).
[64] ICAO CAR/SAM Plan, *supra* note 60.
[65] ICAO CNS/ATM Plan, *supra* note 59 at 1.44.

for implementing the use of GNSS should be enshrined in a legal charter, and that further issues in GNSS law should be analyzed as the technology itself continued to be developed.[66]

Furthering the work of integrating GNSS into future air navigation, the 32nd ICAO Assembly adopted a Charter on the Rights and Obligations of States Relating to GNSS Services.[67] The GNSS Charter's preamble mentions the compliance that GNSS will have with both the Chicago Convention and the rules applicable to outer space. Also, States are to be guided by the principles of mutual assistance and cooperation, and they may be entitled to jointly provide GNSS services.[68]

While the international community has planned for the future of GNSS systems, the United States has planned its own future air navigations systems, and has consolidated these into the Federal Aviation Administration's NextGen program. This program is intended to modernize U.S. aviation travel, making it, in the process, more efficient, saving fuel and reducing negative impacts on the environment, and advancing safety management.[69]

Administrator J. Randolph Babbitt of the FAA noted that the use of GPS in NextGen will enable airports to receive aircraft in all kinds of weather[70]—an improvement over conventional methods of approaches and landing. The GPS required navigation performance and area navigation, or RNAV-RNP, increase the efficiency of

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[66] *Ibid.*
[67] *Charter on the Rights and Obligations of States Relating to GNSS Services*, ICAO CAR/SAM Plan, Appendix A to Chapter 11 [hereinafter GNSS Charter].
[68] *Ibid.* at arts. 7, 9.
[69] "Why NextGen Matters", online: Federal Aviation Administration <http://www.faa.gov/nextgen/why_nextgen_matters/>.
[70] Babbitt, J. Randolph, "Better Access with NextGen", speech given to the American Association of Airport Executives on May 17, 2011, online: Federal Aviation Administration <http://www.faa.gov/news/speeches/news_story.cfm?newsId=12723>.

airports by allowing greater throughput.[71] Airlines can also expect greater fidelity to their schedules (thereby incidentally pleasing customers) by using the GNSS enhanced Next Gen—Alaska Airlines has heavily relied on required navigation performance, and has claimed that it would have cancelled 729 flights into Juneau in 2010 if it did not have the use of GPS based approaches.[72] Such efficiencies, along with savings in aviation fuel (estimated by the *FAA's NextGen Implementation Plan for 2011* to be worth $23 billion between 2010-2018[73]), will have profound and beneficial impacts on the aviation industry.

5. *The Need for Augmentation Systems*

Despite its promises, GNSS still requires the assistance of sister technology known as augmentation systems. These systems can be ground-based or satellite-based, and may even be both, but their essence is that they serve to enhance the accuracy and reliability of the higher order GNSS systems like GPS and GLONASS. Three such systems, WAAS, EGNOS, and LAAS, are topically discussed below in order to demonstrate both a current and future weakness of the CNS/ATM vision (in that it still needs other systems to be fully reliable), as well as to demonstrate sources, the utilization of which ameliorates qualms regarding reliance on the new systems, as well as providing potential sources of liability should the darker possibility of system failure occur.

The Wide Area Augmentation System (WAAS) is an example of a satellite based augmentation system (SBAS). Such SBAS systems "are networks of ground relay stations and geostationary satellites which receive satellite navigation signals and

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[71] *Ibid.*
[72] *Ibid.*
[73] "FAA's NextGen Implementation Plan: March 2011", online: Federal Aviation Administration <http://www.faa.gov/nextgen/media/ng2011_implementation_plan.pdf>.

transmit corrected time and distance measurement. The user's receiver applies the correction message to improve the accuracy of its position."[74] WAAS was commissioned by the FAA to interact with the World Meteorological Organisation (WMO) Global Observing System (GOS); it can, however, operate with any suitable GPS receiver.[75] WAAS enables accurate separation, both vertical and lateral, of aircraft in flight, and enables the use of GPS for landing.[76] The technology functions by a procedure in which GPS signals are received across the National Airspace System (NAS) by Wide Area Reference Stations (WRS). These signals are then forwarded to the WAAS Master Station (WMS) by a ground linkage (thus avoiding mistakes that can occur by transmission of signals into space). Finally, the WMS generates data that correct errors in GPS signals, allowing users' receivers to utilize more accurate information.[77] WAAS not only enables safer approaches and landing at airports, but can provide useful guidance during flight as well. In 2009, Northern Air Cargo in Alaska received permission to use their 737-200 with full WAAS capability—the first such aircraft to be granted that ability.[78]

The European Geostationary Navigation Overlay Service (EGNOS) that consists of three geostationary satellites and a series of ground stations, and serves to augment the

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[74] Delphine Jaugey, *The Use of Global Navigation Satellite Systems (GNSS) for Air Navigation Purposes: Benefits, Vulnerabilities of the Systems and Legal Issues* (LL.M. Thesis, McGill University Institute of Air and Space Law, 2006) [unpublished] at 25.
[75] Larsen, *supra* note 52, at 400. *See also* UN Report 2004 (n. 3) paras 176-81, *and* World Meteorological Organization <http://www.wmo.int/pages/prog/www/OSY/GOS.html>.
[76] Larsen, *supra* note 52 at 400.
[77] "Navigation Services—WAAS—How it Works", online: Federal Aviation Administration <http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/waas/howitworks/>.
[78] "Navigation Services—WAAS—News", online: Federal Aviation Administration <http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/waas/news/>.

U.S. GPS system[79] (though presumably will be eventually available to augment the Galileo System as well). EGNOS is a joint project of Eurocontrol, the European Space Agency, and the European Commission, and constitutes Europe's first foray into GNSS applications.[80] In addition to amplifying the GPS signals for aviation and maritime use, an EGNOS Safety of Life service became available for use in March of 2011.[81]

Other satellite based signal processors include the Indian GAGAN (GPS Aided Geo Augmentation Navigation), a project borne of the cooperation between ISRO and the Airports Authority of India (AAI).[82] GAGAN will be interoperable with GPS, and should aid in aviation navigation, as well as integration into the future GNSS CNS/ATM system.[83] Once implemented, GAGAN should assist aviation in much the same way as other SBAS augmentation systems, allowing less aircraft separation, more efficient flight patterns, and precision approaches to airports.[84]

Japan's Quasi-Zenith Satellite System is designed to improve GPS signal use, especially over Japan.[85] The system is designed to enable positioning up to the one centimeter level, and is designed to be compatible with GPS; moreover, it is intended to do more than simply assist in navigation, including aiding with "detecting earthquakes and volcanic activities, weather forecasting and many other applicable fields."[86]

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[79] "What is EGNOS?", online: European Space Agency <http://www.esa.int/esaNA/GGG63950NDC_egnos_0.html>.
[80] *Ibid.*
[81] *Ibid.*
[82] Ranjana Kaul & Ram. S. Jakhu, "Regulation of Space Activities in India", in Ram Jakhu ed., *National Regulation of Space Activities*, (New York: Springer, 2010), *supra* note 52 at 185.
[83] *Ibid.*
[84] "India to launch satellite-based navigation system GAGAN" *Hindustan Times* (9 August 2010), online: Hindustan Times < http://www.hindustantimes.com/India-to-launch-satellite-based-navigation-system-GAGAN/Article1-584371.aspx>.
[85] "Quasi-Zenith Satellite-1 "MICHIBIKI" *JAXA* (14 July 2011), online: JAXA < http://www.jaxa.jp/projects/sat/qzss/index_e.html>.
[86] *Ibid.*

The Local Area Augmentation System (LAAS) is a ground based augmentation system (GBAS). The U.S. Federal Aviation Administration designed LAAS to provide high levels of accuracy, availability, and integrity for Category I, II, and III approaches to airports.[87] Ground based stations receive information from the GPS satellites, and they then correct errors in the GPS system. These signals are then transmitted to the proper avionics (on an approaching aircraft) via very high frequency (VHF) signals.[88] Such a system is useful for the safest of approaches to airports, and it provides an alternative and a redundancy for SBAS systems like WAAS.

B. *GNSS Systems*

1. *U.S. GPS*

Of the handful of GNSS systems currently operating, in full or in part, the U.S. Global Positioning System is by far the most utilized on a global basis. While the following sections will present information on these systems, greater usage of GPS over the others justifies more detailed analysis and description of that particular system, and therefore the following paragraphs present its historical, technical, legal-regulatory, and policy background.

i. Historical Background

The historical background for the Global Positioning System could arguably be traced back to 1945 and the academician and popular writer Arthur C. Clarke's seminal paper, *Extra-terrestrial Relays*.[89] In that paper, Clarke suggested ways to deal with the

[87] "Navigation Services—LAAS—How it Works", online: Federal Aviation Administration <http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/laas/howitworks/>.
[88] *Ibid.*
[89] Arthur C. Clarke, "Extra-Terrestrial Relays", *Wireless World*, (Oct. 1945), 305-308, online: <http://lakdiva.org/clarke/1945ww/1945ww_oct_305-308.html>.

problem of getting signals from space to cover the entire planet, thereby making an "invaluable" broadcast service possible for use by the world. Little more than a decade later, Clarke, in correspondence with Andrew G. Haley (sometimes referenced as the world's first space-lawyer) commented once more on these relays and their possibilities, noting that, "For example…three stations in the 24-hour orbit…could also make possible a position-finding grid whereby anyone on earth could also locate himself by means of a cou[ple] of dials on an instrument about the size of a watch."[90] He continued, "no-one on the planet need ever get lost…unless he wanted to be."[91] He concludes the correspondence with a prescient and somewhat immodest boast: "But as to the details of frequencies and powers, I'll have to leave that to the experts to work out; I'll get on with my sciencefiction and wait to say 'I told you so!'"[92]

Insofar as the United States government was concerned, the possibility of GNSS was discussed as early as December 3, 1962, when statements were made at a meeting of the United Nations' First Committee by a representative for the United States. He noted, in the first volley of a diplomatic tête-à-tête that primarily concerned observation satellite technology, that "a navigation satellite in outer space can guide a submarine as well as a merchant ship. The instruments which guide a space vehicle on a scientific mission can also guide a space vehicle on a military mission."[93] Even before the Outer Space Treaty had been conceived, the U.S. had recognized the dual-use nature of space technology.

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[90] Arthur C. Clarke correspondence to Andrew G. Haley, August 1956, posted on *Res Communis* blog on 3/27/2008, online: ResComunis <http://rescommunis.files.wordpress.com/2008/03/clarkeletter2-1.jpg>.
[91] *Ibid.*
[92] *Ibid.* Incidentally, the "24-hour orbit" referenced by Clarke above have since been renamed Geosynchronous orbit; however, sometimes they are also, in his honor, referred to as "Clarke Orbits". *See also* the Andrew G. Haley Collection at the University of Mississippi School of Law's National Center for Remote Sensing, Air, and Space Law, which is accessible online at <http://www.spacelaw.olemiss.edu/archives/haley/>.
[93] John Cobb Cooper, "Doing Business Abroad" (1963) 41:3 N.C.L. Rev. 339 at 343-44.

The U.S. Representative's prediction eventually came true, as the discussion of civil and military use of navigation satellites in preceding sections attest.

ii. Statutory Basis

The Global Positioning Service has its statutory basis in the Title 10, section 2281 of the United States Code.[94] 10 USC 281 was in turn created by section 1074 of the National Defense Authorization Act for Fiscal Year 1998.[95] Section 2281 gives authority to the Secretary of Defense to provide and sustain GPS for the benefit of national security, including sub-sections 1 and 2, which, respectively, ask the Secretary to provide for methods of preventing the hostile use of GPS so as to avoid the necessity of continuous use of selective availability (discussed further *infra*), and to ensure the United States and her allies have the ability to use GPS for military purposes despite hostile attempts to prevent such use. Insofar as civilian use is concerned, section 2281(b) notes that that Secretary shall provide for GPS' Standard Positioning Service (SPS) "for peaceful civil, commercial, and scientific uses on a continuous worldwide basis free of

[94] 10 U.S.C. §2281 (2011), Global Positioning System; to give further scale to the quantity and importance of statutory law in the United States concerning GPS, in addition to the statutes mentioned thus far and *infra*, GPS is affected by several statutes not thoroughly covered in this thesis. The curious reader might find herself directed towards the following: Section 913 of the *Ike Skelton National Defense Authorization Act for fiscal year 2011* concerning military GPS equipment (Pub. L. No. 111-383 [2011], 124 Stat. 4137 (2011)); Section 1032 of the *National Defense Authorization Act for Fiscal Year 2010* on GPS reports (Pub. L. No. 111-84; 123 Stat. 2448 (2009)); Section 111 of the *John Warner National Defense Authorization Act for Fiscal Year 2007*, authorizing multi-agency funding for the national PNT and related organizations (Pub. L. 109-364, 123 Stat. 2354 (2006)); Section 218 of the *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999*, requiring the development of an enhanced GPS (Public Law 105-261, 112 Stat. 1951 (1998)); Section 279 of the *National Defense Authorization Act for Fiscal Year 1996*, requiring the development for a plan for navigation warfare (Public Law 104-106, 110 Stat. 243 (1996)); Section 152 of the *National Defense Authorization Act for Fiscal Year 1994* (Public Law 103-160) and Section 260 of the *National Defense Authorization Act for Fiscal Year 2006* (Public Law 109-163; 119 Stat. 3185; 2006) requiring military aircraft, armored vehicles, ships, and indirect firing systems purchased after 2007 to be GPS equipped; Section 50112 of Title 51 of the United States Code, which promotes GPS standards, the continuous use of GPS free of direct user fees, and the establishment of international agreements on the use of GPS as an international standard. This codification is part of the newest Title in the Code, and was created in 2010. This new Title, as well as supporting documents, can be found reprinted in "Enactment of Title 51—National and Commercial Space Programs" (2011) 37:1 J. Space L. 153; finally, Section 301 of Title 49, establishing Nationwide Differential Global Positioning Service.

[95] *National Defense Authorization Act for Fiscal Year 1998*, Pub. L. 105-85 [1997].

direct user fees."[96] The Secretary of Transportation is given joint responsibility with the Secretary of Defense for devising a Federal Radionavigation Plan that specifies performance requirements of GPS, and the Secretaries are also instructed to coordinate about the development of augmentation systems that enhance transportation.[97] This requirement is in conformance with the Secretary of Transportation's primary duty—to ensure safe and efficient travel.[98]

GPS is itself governed by the Federal Radionavigation Plan (FRNP). The purpose of the FRNP is to posit the United States' responsibilities, policies, and roles with regard to PNT technology.[99] It covers PNT systems provided by the federal government, including GPS, augmentation systems, Long Range Navigation, Internet Time Service, Microwave Landing System (MLS), and others.[100] The FRNP also provides policy objectives, including strengthening and maintaining national security, improving travel safety, promoting efficient travel systems, and contributing to the economic growth and productivity of the United States.[101]

iii. Technical Aspects

The space segment of GPS is comprised of 24 satellites arranged six orbital planes of 4 satellites each, although the Air Force has been handling 31 operational satellites for several years.[102] There are three to four additional decommissioned satellites that serve as spares, and combined with the primary satellites, they help ensure

[96] 10 USC § 2281(b).
[97] *Ibid.* at § 2281(b)(1-2).
[98] 49 USC § 101(a).
[99] FRNP, *supra* note 53, at 1-2.
[100] *Ibid.* at 1-3.
[101] *Ibid.* at 1-4.
[102] "Space Segment", online: GPS.gov <http://www.gps.gov/systems/gps/space/>.

the plan to keep GPS operating with at least 24 satellites 95% of the time.[103] The satellites are flown in an orbit of approximately 20, 200 km, in middle earth orbit (MEO). The current coverage should receive a significant boost by the end of 2011, at which time, according to the "Expanded 24" plan, a primary satellite should be added to three of the existing orbital planes, thereby increasing fidelity in geographically challenging areas.[104] Currently, the system is a constellation of different generation of satellites, including the Block IIA, Block IIR, Block IIR(M), and Block IIF.

The ground segment of GPS is comprised of several ground stations that receive GPS data from the satellites in orbit. The master station is located at Schriever Air Force Base in Colorado, with other stations distributed throughout the world.[105]

The user segment is comprised of both military and civil users. As stated, the U.S. Air Force maintains control of the system, and the United States provides specific data to her allies via the precise positioning system (PPS). This stands in contrast to the standard positioning system (SPS) which is used by most receivers of GPS data. The civil users include airliners navigating from one region to another, shippers moving goods across vast oceanic spaces, individuals serpiginously meandering through crowded city streets, and even bankers and brokers utilizing the high accuracy of the timing applications provided by the on-board atomic clocks of GPS.

With regard to aviation, the Federal Aviation Administration is responsible for positioning, navigation, and timing in aviation. Specifically, the Administrator is mandated to "develop, alter, test, and evaluate systems, procedures, facilities, and

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[103] *Ibid.*
[104] *Id.*; *see also* "STRATCOM/AFSPC to Improve Global GPS Coverage" (7 Jan. 2010), online: Air Force Space Command <http://www.afspc.af.mil/pressreleasearchive/story.asp?id=123184576>.
[105] *See, e.g.* IGS Mail, *supra* note 12; *see also* "What is GPS?", *supra* note 13.

devices…to meet the need for safe and efficient navigation and traffic control of civil and military aviation…."[106] For surface transportation support, the Secretary of Transportation has the authorization to provide Nationwide Differential GPS under the *Department of Transportation and Related Agencies Appropriations Act of 1998*.[107] NDGPS, like its cousins WAAS and EGNOS, augments GPS signals, but in this case it performs this service for surface (terrestrial) and maritime users (such as the Coast Guard).[108] Thus, the United States Coast Guard possesses a tool that enables it to more accurately perform its mission—a fact which can assist in the prevention of crime and terrorism, as well as in the assistance of individuals in distress who require immediate aid.

iv. Weaknesses of the System

For all its abilities, GPS, like all GNSS systems, suffers from certain limitations and weaknesses that may give pause to those companies and individuals on whose livelihood properly functioning PNT depends. Particularly with regards to liability that may result from reliance on the system that leads to death, damage, or injury, any State would do well to acknowledge and attempt to eliminate flaws in their GNSS. In chapter two, *infra*, a potential amelioration of some of these problems is discussed in the form of what essentially may constitute a constellation merger between GPS and the nascent Galileo system. However, even without relying on other systems to buttress its

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[106] 49 USC § 44505(a)(1)(A).
[107] 111 Stat. 1449.
[108] "Augmentation Systems", *supra* note 14; *see also* U.S. Coast Guard Navigation Center, online: Nav Center <http://www.navcen.uscg.gov/?pageName=ndgpsMain> and the Research and Innovative Technology Administration (RITA), "Nationwide Differential Global Positioning System (NDGPS) Program", online: RITA <http://pnt.rita.dot.gov/major_initiatives/nationwide_differential_gps_major_initiative.html>.

functionality, GPS is continuing to evolve in an effort to confront and extirpate challenges to its efficacy.

Indeed, one of the predominant threats to GNSS is intentional interference with the signal. Tactically, this would be advantageous to an enemy of a GPS-dependent combatant (e.g., the United States or one of her wartime allies) wishing to disrupt the speed, accuracy, and effectiveness of military applications. Various threats exist, and the Secretary of Defense has been directed by Congress to "ensure that United States armed forces have the capability to use GPS effectively despite hostile attempts to prevent the use of the system by such forces."[109]

Jamming, for one, is a constant challenge for the technology. The Air Force is aware of this vulnerability, and General Norton Schwartz, Chief of Staff for the Air Force, recently acknowledged the jamming threat.[110] To prepare for the eventuality of intentional signal jamming, the U.S. military has long performed tests meant to identify and prevent such problems, as well as to develop anti-jamming technology and the ability to switch to back-up navigational systems.[111] Even still, the threat of cheap, easily assembled jamming technology looms over the present GPS constellation.[112] To combat jamming, the military employs satellites in the GPS constellation with jam-resistant signal abilities, such as the GPS Block IIR(M) sats, seven of which are currently in

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[109] 10 USC § 2281(a)(2).
[110] Glen Gibbons, "Is GPS Vulnerability Leading the U.S. Towards a More Cooperative Space Posture?", 5/26/10, online: InsideGNSS <http://www.insidegnss.com/node/2081>; *see also* E.S. Waldrop, "Integration of Military and Civilian Space Assets: Legal and National Security Implications" (2004) 55 Air F.L. Rev. 157.
[111] Graham, Bradley, "Coast Guard Opposes GPS Jamming by Pentagon" *The Washington Post* (13 March 1999), online: The Washington Post <http://www.washingtonpost.com/wp-srv/national/daily/march99/gps13.htm>.
[112] *See, e.g.* Jaugey, *supra* note 74 at 32-33.

operation.[113] Civilian users have, at times, intentionally jammed GPS signals, and this behavior has been vehemently discouraged by the Federal Communications Commission.[114]

Indeed, aviation has been affected already by intentional jamming. In 2009, Newark Airport in New Jersey noticed that their satellite positioning receivers, intended for a new navigation aid, were suffering daily disruptions in reception.[115] The disruptions were caused by a driver who utilized a weak GPS-jamming device, typically designed for use by employees who are displeased with the notion of their employers tracking their movements via GPS.[116] In 2011, the Aircraft Owners and Pilots Association (AOPA) asked the Federal Communications Commission to address a threat provided by a potential mobile communications network operated by LightSquared, arguing their system interferes with GPS signals, with Pete Bunce of the General Aviation Manufacturers Association (GAMA) commenting that LightSquared's system threatens the multi-billion dollar investment in the NextGen transportation system.[117] The FCC has been asked to undergo a formal rulemaking procedure to protect GPS from such systems in the future.[118]

A related threat is signal spoofing, in which a false signal is transmitted to confuse the intended user. It has been reported that a simple one watt spoofer, for

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[113] "Space Segment", *supra* note 102.
[114] Federal Communications Commission, Daily Release, "FCC Enforcement Bureau Steps Up Education and Enforcement Efforts Against Cell Phone and GPS Jamming" (9 Feb. 2011), online: FCC.gov <http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DOC-304575A1.pdf>.
[115] "No Jam Tomorrow" *The Economist* (10 March 2011), online: The Economist: <http://www.economist.com/node/18304246>.
[116] *Ibid.*
[117] Dan Namowitz, "FCC Asked to Halt GPS-Jamming Network" (1 August 2011), online: AOPA Online <http://www.aopa.org/advocacy/articles/2011/110801fcc-asked-to-halt-gps-jamming-network.html?WT.mc_id=ebrief>, posted on *Res Communis* blog by Sara Langston on (2 August 2011), online: Res Communis <http://rescommunis.wordpress.com/2011/08/02/fcc-asked-to-halt-gps-jamming-network/>.
[118] *Ibid.*

example, could confuse GPS receivers at Logan Airport in Boston up to 350 miles away.[119] Such a tool could be used by terrorists intending to confuse and wreck an incoming aircraft at its landing strip, or cause aircraft near mountainous regions to collide with terrain that its avionics did not "see" due to false data. Airlines may take precautions against this sort of behavior by utilizing backup and alternate systems to ensure safe flights.

Another, more ballistic method of interference would be to engage in an anti-satellite attack. ASATs could potentially wreak havoc with GNSS, as utilizing a kinetic weapon would not only produce a gap in the constellation, thereby reducing coverage, but it would also create potentially dangerous orbital debris that might interfere with the replacement of the destroyed asset. Though GPS has spares in case of such exigencies, the debris threat is ever-present. Any State willing to initiate such an attack would not only be declaring war against its victim, but would also be subject to strong condemnation internationally for violation of Article IX of the Outer Space Treaty and its provision requiring consultation before engaging in activities that interfere with other States' activities in space.[120] Such an attack would also violate Article IV of the OST, which prohibits military manoeuvres in space.[121] No doubt aware of its international obligations, yet unwilling to cast aside its own interests, the United States communicated

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[119] Langhorne Bond, "Red on the Radar Screen: GPS Dependency Grows" (Paper delivered to the Air Traffic Control Association, Dublin, Ireland, 7/20/2001) [unpublished].

[120] OST, *supra* note 18 at art. IX. "If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment."

[121] *Ibid.* at art. IV. "The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden."

its intent to shoot down one of its satellites, *US 193*, perhaps in an effort to comply with Article IX.[122] Much furor accompanied the *U.S. 193* and especially the Chinese *Fengyuan* 1C shootdowns—with the latter causing great quantities of potentially harmful debris that have surpassed 3000 pieces in number, "of which 97% remained in Earth orbit more than three and a half years after the test, posing distinct hazards to hundreds of operational satellites".[123] Indeed, recently the crew of the *International Space Station* were forced to temporarily evacuate because of threat from orbital debris, evidencing the seriousness of the problem.[124]

Less malicious, but nevertheless equally malefic occurrences could interfere with GPS signals. Solar radiation is variable depending on the point in the solar cycle. Fortunately, this cycle is somewhat predictable; however, the emission of such radiation could, at times, albeit briefly, negatively affect the fidelity of GPS.[125] Additionally, satellites will occasionally malfunction of their own accord, as recently happened with *SVN-49*, a Block IIR(M) GPS satellite that was decommissioned on May 6, 2011 due to "technical issues".[126] Even the natural threats associated with the placement of new satellites must be watched. The International Telecommunications Union has established that when States set up their space-based stations, they "must be established and operated

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[122] Michael Dodge, "El Derecho del Espacio Exterior y el Futuro de la Humanidad", 58 THEMIS-Revista de Derecho 231 (2010).
[123] NASA's Orbital Debris Quarterly News, Volume 14, Issue 4, October 2010, online: NASA.gov <http://orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv14i4.pdf>; *see also* Michael W. Taylor, "Trashing the Solar System One Planet at a Time: Earth's Orbital Debris Problem" (2007) 20 Geo. Int'l Envtl L. Rev. 1.
[124] "Astronauts Evacuate Space Station to Avoid Space Junk Hurtling Towards Them" *Daily Mail* (28 June 2011), online: Mail Online <http://www.dailymail.co.uk/sciencetech/article-2009073/Astronauts-evacuate-space-station-avoid-space-junk-hurtling-them.html>.
[125] "GPS Interference by Solar Radio Bursts", online: IPS Radio and Space Services <http://www.ips.gov.au/Educational/1/3/10>.
[126] "Space Segment", *supra* note 102.

in such a manner as not to cause harmful interference to the radio services or communications of other Member States".[127]

Aware of the various threats to the GPS, the U.S. federal government has acted at the executive level to counter these and other problems. The President of the United States sets the U.S. National Space Policy, and in President Obama's release of his policy in 2010, the White House noted that the United States shall "invest in domestic capabilities and support international activities to detect, mitigate, and increase resiliency to harmful interference to GPS, and identify and implement, as necessary and appropriate, redundant and back-up systems or approaches for critical infrastructure, key sources, and mission-essential functions."[128]

v. Third Generation

The obvious significance of GPS for world-wide commerce and U.S. national defensive and offensive capabilities stands as a constant impetus for improving and deploying new generations of GPS satellites. Problems like jamming, solar interference, and the need to maintain the best and most consistent signals prompt the U.S. government to continue its research and development of GPS. Modernization of the system is already under way, and may take 15 years or more.[129] This process includes the launching of Block IIR(M) and IIF satellites, and the combined effort will add three additional coded civil signals for use (current receivers will still be able to utilize the GPS constellation, though new equipment may be necessary for full benefits), namely L1C (to improve the current C/A signal; also, this is being adopted as the international standard of GPS civil

[127] *Constitution of the International Telecommunications Union* at art. 45(1).
[128] *National Space Policy*, President Obama, online: White House <http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf>.
[129] FRNP, *supra* note 53 at 5.1.1.

use), L2C (supporting dual frequency PNT use), and L5 (at 1176.45 MHz, to support dual frequency PNT for safety-of-life uses, such as civil aviation, and eventually search and rescue operations).[130] GPS Block III satellites, designed to improve the integrity, accuracy, and availability of GPS, as well as improve anti-jamming performance, are currently under development, and the first such satellite is expected to be launched in 2014.[131] These satellites are being developed by Lockheed Martin, and are expected to have a 15 year lifespan.[132] Recognizing the international importance of PNT, GPS III will also lack the selective availability feature[133], precluding the United States from "turning off" the signal if it saw fit to do so, and fending off concerns that the U.S. would continue to possess this potentially economically-depressive ace in the hole.[134]

vi. GPS Policy

The GPS policy of the United States is a function of the national positioning, navigation, and timing policy. The policy has been mostly consistent over the years, morphing only slightly. Consequently, the policy has allowed the development of global industry and competition based on GNSS services.[135] This stability is compromised only by the above discussed weaknesses to GPS (and, realistically, to any other GNSS system as well), and, in the past, by the process, discussed below, of selective availability. The import of U.S. PNT policy cannot be stressed enough, since most of the GNSS users of the world use GPS as their data source, and, as a result, what the U.S. mandates for its navigational systems falls on the shoulders of both domestic and international users.

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[130] *Ibid.*; *see also* "Space Segment", *supra* note 102.
[131] FRNP, *supra* note 53 at 5.1.1.
[132] "Space Segment", *supra* note 102.
[133] FRNP, *supra* note 53 at 3.2.1.
[134] Jaugey, *supra* note 74 at 35-36.
[135] "U.S. Space-Based PNT Policy", online: PNT.gov <http://www.pnt.gov/policy/>.

α *General Policy*

The position of the U.S. government is that GPS has grown into a "global utility" that is critical to economic means, national security, transportation, and "worldwide economic infrastructure".[136] As such, the U.S. plans to continue its policy of providing GPS free of direct user fees to all who receive it for civil purposes.[137] Variously, the White House also assured the international community that the United States shall[138]:

- Engage with foreign GNSS providers to encourage compatibility and interoperability, promote transparency in civil service provision, and enable market access for U.S. industry.[139]
- Operate and maintain the GPS constellation to satisfy civil and national security needs, consistent with published performance standards and interface specifications.[140] Foreign positioning, navigation, and timing (PNT) services may be used to augment and strengthen the resiliency of GPS

The current U.S. PNT policy also includes related goals for strengthening and improving GPS services. In 2004, President Bush promulgated a policy, modified by President Obama only in "reaffirming U.S. commitments to GPS service provision,

[136] FRNP, *supra* note 53 at 3.2.1.
[137] *National Space Policy*, *supra* note 128.
[138] *Ibid.*
[139] Indeed, the issue of fairness in trade has already occurred regarding U.S. and E.U. relations with Galileo. The United States filed a trade report on the matter in 2009. *See* "USTR Report to Congress on U.S. Equipment Industry Access to the Galileo Program and Markets" [hereinafter USTR Report], online: Office of the United States Trade Representative <http://www.ustr.gov/sites/default/files/Galileo%20Report%20Final.pdf>; *see also* Gibbons, Glen, "U.S. Access to Europe's Galileo Program Markets Subject of Trade Rep Report" *Inside GNSS* (17 July 2009), online: Inside GNSS News <http://www.insidegnss.com/node/1598>.
[140] By this, the White House means the FRNP.

international cooperation, and interference mitigation."[141] In addition to the policies mentioned in the White House National Space Policy Statement, the 2004 statement noted that GPS goals and objectives included[142]:

- Improving the performance of space-based positioning, navigation, and timing services, including more robust resistance for, and consistent with, U.S. and allied national security purposes, homeland security, and civil, commercial, and scientific users worldwide.
- Maintain the Global Positioning System as a component of multiple sectors of the U.S. Critical Infrastructure, consistent with Homeland Security Presidential Directive-7, Critical Infrastructure Identification, Prioritization, and Protection, dated December 17, 2003.
- Improve capabilities to deny hostile use of any space-based PNT services, without unduly disrupting civil and commercial access to civil PNT services outside an area of military operations, or for homeland security purposes.[143]

This last policy warrants particular attention. As written, it clarifies any doubts one might have regarding GPS; indeed, it is, and always has been, a U.S. military asset. Though the United States does provide a civil version of GPS free of direct user fees to anyone or any State or entity that wishes to use it, the U.S. still views the technology as a critical piece of national security infrastructure. While the U.S. is apparently constantly struggling to maintain interference-free PNT services, it nonetheless wishes to be able to do the same, or at least achieve a similar result, to its enemies in times of militaristic

[141] "U.S. Space-Based PNT Policy", *supra* note 135.
[142] *Ibid.*
[143] FRNP, *supra* note 53 at 3.2.1.

conflict. Furthermore, what "unduly disrupting" technically or actually means is unclear. Does this mean that the U.S. may degrade the signal to a wartime region by ten times, or twenty? Either way, it could make aviation navigation that depends on GNSS impossible, save in instances in which another system such as GLONASS may be substituted. Maritime shippers may find they have to adjust to older methods of navigating in order to avoid foundering in treacherous waters. Such language, and therefore its accompanying problems, will appear again in chapter two during the discourse on the GPS-Galileo Agreement.

β *Selective Availability*

The final aspect of GPS policy that calls for discussion is the policy of selective availability, or SA. In recognizing the military applications for GPS, one need not be surprised that for a time, the United States actively degraded the signal available for civil use, thereby rendering it far less accurate. At times, this degradation could reduce accuracy by as much as ten times[144], rendering very precise needs and applications moot. The GPS satellites currently in orbit are still capable of SA, should it be required, and as such, this ability has been decried by some authors as a weakness of the system.[145]

Recognizing that GPS had become a global utility, and that economic prosperity often relied on the service, in 2000 the United States made it national policy to no longer use SA.[146] President Clinton proclaimed that the service was no longer necessary for national defense, noted that the United States already has the capability to deny the use of

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[144] President Clinton, "Statement by the President Regarding The United States' Decision to Stop Degrading Global Positioning System Accuracy", 5/1/2000, Office of Science and Technology Policy [hereinafter Clinton Statement], online:RITA <http://ntl.bts.gov/lib/31000/31300/31337/18_2000_Decision_to_End_Use_of_GPS_Selective_Availability.pdf>.
[145] Jaugey, *supra* note 74 at 35-36.
[146] FRNP, *supra* note 53 at 3.2.1.

the service to its enemies on a regional basis if need be, and recognized the lack of SA would allow more technology to develop and enhance the lives of people the world over.[147] In 2004 President Bush included, as part of his PNT policy, the directive that the Secretary of Defense will "maintain the commitment to discontinue the use of the feature known as Selective Availability designed to degrade globally the Standard Positioning Service of the Global Positioning System".[148] The Obama Administration has continued the policy of not using SA, marking the third presidential generation to insist that SA is a demon of the past.[149] Indeed, the third generation of GPS satellites will not even possess the technical capability to engage SA,[150] which should service to militate against fears that the United States will always hold the Sword of Damocles over large swaths of international commerce.

2. *GLONASS*

The Russian Federation operates a GNSS known as the Global Navigation Sputnik Systems, or GLONASS. Currently, 23 satellites are operational, with a planned total of 27 satellites to fill out the constellation.[151] Like GPS, GLONASS provides a civil signal freely available for use by all, and, similar to GPS, the system operates in middle Earth orbit, albeit at the somewhat lower altitude of 19,100 km.[152] GLONASS provides a standard and more precise signal, with the latter being restricted, and its central control

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[147] Clinton Statement, *supra* note 144.
[148] "U.S. Space-Based Positioning, Navigation, and Timing Policy", 12/15/2004, online: PNT.gov <http://www.pnt.gov/policy/2004-policy.shtml>.
[149] "U.S. Space-Based PNT Policy", *supra* note 135.
[150] FRNP, *supra* note 53 at 3.2.1; *see also* White House, "White House Statement Regarding Global Positioning Satellites" (18 Sept. 2007), online: Spaceref <http://www.spaceref.com/news/viewpr.html?pid=23551>.
[151] "GLONASS", online: Federal Space Agency Information-Analytical Centre <http://www.glonass-ianc.rsa.ru/en/GLONASS/>.
[152] Lyall, *supra* note 22 at 394.

station is in the Moscow region.[153] Though Russia does not now degrade the signal to their service, for a time in the 1990s they did so for national security purposes[154] (it may be remembered that the 1990s were a time of political turmoil and transition for the U.S.S.R. which, eventually, emerged as the current Russian Federation).

3. *Galileo*

The European Union's answer to U.S. and Russian dominance in GNSS is their Galileo system. Galileo is intended to be a potent and civilly used PNT system, free from the constraints and concerns of military interests.[155] Galileo is planned to have 30 operational satellites in middle Earth orbit, and, as of 2007, was planned to cost approximately 3 billion euros.[156] It is not completely obvious why the E.U. would desire to create their own GNSS system, especially when GPS and GLONASS would be available for its use already. One obvious possibility is that Europe does not want to be held hostage to systems run by the world's largest and most active militaries. Since the military runs these systems, it is always possible that they will be made unavailable for use when Europe or her citizens need them most. Other possibilities include: the unwillingness of the U.S. to share GPS control with Europe; degradation of signal being instituted again; costs could be charged to users, though this is not presently done; Galileo is supposed to be more accurate than GPS, which should enable better aviation navigation; Europe's manufacturing sector could be stimulated by the creation of the system; and, finally, the issue of liability from relying on the other GNSS systems

[153] *Ibid.*
[154] *Ibid.*
[155] *Ibid.* at 395.
[156] *Ibid.*

remains uncertain.[157] Europe was also sceptical of investment in GLONASS due to political and financial problems in Russia.[158] Another possibility is that having an independent GNSS strokes Europe's collective ego, and enables it to continue a programmatic campaign of defiance against the hegemony of U.S. technocracy, but this is merely supposition. However, the GSA website does note that "European independence is the chief reason for taking this major step."[159]

Currently, only two Galileo satellites, *GIOVE-A* and *GIOVE-B*, are in orbit.[160] Even still, these are but experimental satellites, though Europe has scheduled to launch the first two permanent Galileo satellites on October 20, 2011.[161] In addition to providing navigational services to users, the European Commission notes that Galileo is expected to offer a crucial search and rescue service—something touted as a benefit, in particular, for maritime navigation and sailors.[162] A critical element of Galileo concerns its compatibility with GPS. The European Space Agency notes that compatibility with GPS and GLONASS will make Galileo a "cornerstone of the Global Navigation Satellite System (GNSS)".[163] The second chapter of this thesis will analyze the further commitment of both the United States and the European Union to this future compatibility.

4. *BeiDou*

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[157] *Ibid.* at 395-96.
[158] "EU Galileo Task Report to Commissioner Neil Kinnock", (4 June 1999).
[159] "Why Galileo?", online: European GNSS Agency <http://www.gsa.europa.eu/go/home/galileo/why-galileo/>.
[160] "What is Galileo?", online: European GNSS Agency <http://www.esa.int/esaNA/GGGMX650NDC_galileo_0.html>.
[161] "Galileo: Europe Prepares for October Launch", online: European Space Agency <http://www.esa.int/esaNA/SEM9IVMSNNG_galileo_0.html>.
[162] European Commission, online: Europa.eu <http://ec.europa.eu/enterprise/policies/satnav/galileo/applications/index_en.htm>.
[163] "Why Europe Needs Galileo", online: European Space Agency <http://www.esa.int/esaNA/GGG0H750NDC_galileo_0.html>.

Like its sister programs in Russia and the United States, BeiDou is a military originated and controlled GNSS system, in this instance for China.[164] The current system does not consist of worldwide service, but the second generation, BeiDou-2, is planned to consist of 35 satellites (5 in geosynchronous orbit, 30 in MEO) that provide global coverage.[165] Like GPS and GLONASS, there will be separate civil and military signals, but unlike those systems, BeiDou is an active GNSS—meaning, a ground station has to initiate contact with the satellite constellation to begin the process for ascertaining location, rather than simply receiving a signal constantly transmitted from orbit.[166]

Chapter Two: The GPS-Galileo Agreement and Treaty Law

A. *The GPS-Galileo Agreement*

Where the first chapter demonstrated the usefulness and adaptability of GNSS to terrestrial matters, this chapter reveals the mutual interest two of the major powers share with regards to further development in the field. Both the United States and the European Union have a plethora of designs on the use of PNT, both now and in the coming years. To that end, these entities have come together to draft a solution to their oft-times shared vision of the future. Though each party has its own practical and ulterior motives for concluding an agreement with the other, their joint cooperation is certain to have a lasting effect on GNSS for the next several decades.

1. *Origins and Purposes*

Arising out of Europe's growing dependence on GNSS technology, the Galileo PNT program sets Europe on the path to navigational certitude. Indeed, Europe has stressed that the Galileo program was conceived and initiated primarily to ensure

[164] Lyall, *supra* note 22 at 399.
[165] *Ibid.*
[166] *Ibid.*

European independence from the existing GNSS systems available—primarily GPS and GLONASS. Europe claims that "Galileo will ensure Europe's independence in a sector that has become critical for its economy and the well-being of its citizens."[167] The fear of possibly losing access to the aforementioned systems currently available free of direct user fees is a potent motivator for creating a Europe-centric GNSS. The European Commission also notes the desirability of having a European navigational system that allows for business, scientific, and employment opportunities, and that should the systems on which Europe currently relies be switched off, those same fields would suffer as a consequence.[168] The economic boon predicted to come of the Galileo enterprise should not be forgotten: the European Commission boldly claims that all-told, Galileo should result in 90 billion euros within the first twenty years alone.[169] Finally, the fact that the system was supposed to be fully civil, and not military, based, likely curried favor with business and scientific interests desirous of the stability that accompanies the knowledge that one's system will not be compromised for ongoing military operations.

Having thus established the motivation for Galileo, the road to its creation certainly has not been easy. The European Commission presented the plan for development in 1999[170], and the European Community signalled its intention to participate that same year with the Council Resolution of 19 July 1999.[171] The program was intended to attract private investors, though this expectation has produced underwhelming results. A decision was made to continue Galileo with public funding,

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[167] "Why Galileo", *supra* note 159.
[168] *Ibid.*
[169] *Ibid.*
[170] EC Commission, *White Paper on European Transport Policy for 2010: Time to Decide*, COM(2001)370, [2001] at 101.
[171] EC, *Council Resolution of 19 July 1999 on the Involvement of Europe in a New Generation of Satellite Navigation Services-Galileo-Definition Phase*, [1999] OJ C 221 3.8.1999/1.

though this has not failed to garner the requisite political attention.[172] Ultimately, though, the program marches inexorably onward, eking out existence despite economic and political hurdles placed in its path.

Once it became clear that Europe wished to create its own system, however, international concern grew on the part of the United States, which opposed Galileo as a duplication and competitor for the GPS.[173] Notwithstanding this concern, Europe pressed forward with its GNSS plans, leaving the United States to modify its position. In the end, the two powers decided the best solution rested in joining the two systems together, and reaping the benefits of both simultaneously whilst mollifying U.S. concerns. This was the genesis of the Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications.

Before analyzing specific features of the Agreement, it is interesting to note that it was originally signed by the United States on the one hand, and the European Community on the other. Since the success of the Treaty of Lisbon, the European Community political entity has transmuted into the European Union. The question as to whether the Agreement still applies to the EU, then, while valid, is readily dismissed. The U.S. Department of State stated:

> In a Verbal Note dated November 27, 2009, that was transmitted to the Government of the United States of America, the Council of the European Union and the Commission of the European Communities stated in part: 'The Treaty of Lisbon amending the Treaty on European Union and the

[172] "Galileo's New PPP: Public-Public Partnership?" *Inside GNSS* (July/August 2007), online: Inside GNSS News <http://www.insidegnss.com/node/255>. "The abandonment of the public-private partnership (PPP) approach, first embraced nearly nine years ago, has opened the Galileo program to a new round of political maneuvering with even more players and perspectives to reconcile than when the program was approved."
[173] Jaugey, *supra* note 74 at 41.

> Treaty establishing the European Community will enter into force on 1 December 2009. …[A]s from that date all agreements between your country and the European Community/European Union, and all commitments made by the European Community/European Union to your country and made by your country to the European Community/European Union, will be assumed by the European Union.'[174]

Moreover, amendments to the Treaty of Lisbon noted that "the Union shall replace and succeed the European Community".[175] The change from Community to Union prescribes no quizzical legal problems; indeed, though "state succession is an area of great uncertainty and controversy…partly to the fact that much of the state practice is equivocal…"[176], little controversy should erupt upon proclaiming "that which we call a rose, by any other name would smell as sweet".[177] In essence, there was not so much a change in sovereign as a change in moniker.

2. Key Provisions

The Agreement contains a number of provisions which define its mandate and shape its use in the international arena. Concepts such as cooperation among States, search and rescue policy, interoperability of services, military applications, derivative services, and liability all receive due treatment under the Agreement's articles. Other facets of the Agreement include the preamble, common to international accords and replete with diplomatic language facilitating the forthcoming articles, a definitions

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[174] "EC to EU", U.S. Dept. of State, online: State Department <http://www.state.gov/documents/organization/143863.pdf>.
[175] *Amendments to the Treaty on European Union and to the Treaty Establishing the European Community*, 17 Dec. 2007, Official Journal of the European Union, C 306/10, 17/12/2007.
[176] Ian Brownlie, *Principles of Public International Law*, 7th ed. (Oxford: Oxford University Press, 2008) at 650.
[177] William Shakespeare, Romeo and Juliet act 2, sc. 2.

section listing the myriad technical and legal concerns addressed below, and an annex detailing GPS and Galileo signal structures.

Article 1 sets forth objectives, focusing on the peaceful use of civil GPS and Galileo signals, services, and applications. The Agreement is meant not only to compliment agreements in force between the United States and the European Community concerning civil GNSS, but also to facilitate the creation of future agreements. Such agreements could also concern the design of future GNSS, as well as the services and augmentations thereof.

The insistence on the peaceful use of GNSS signals between GPS and Galileo is in keeping with the principles of other extant space laws. Article III of the Outer Space Treaty implores States to "carry on activities in the exploration and use of outer space…in accordance with international law…in the interest of maintaining international peace…." Such cooperation is also promoted by the International Civil Aviation Organization's Charter on the Rights and Obligations of States Relating to GNSS Services, which notes, among other provisions, that "with a view to facilitating global planning and implementation of GNSS, States shall be guided by the principle of co-operation and mutual assistance whether on a bilateral or multilateral basis"[178]—a feature echoed by the "framework of cooperation" established by Article 1 of the Agreement.

Value-added services—those services that use civil GNSS signals in such a way as to "provide additional utility"[179] to the end-user, are of major concern in the Agreement. Such services might include anything from shipping or aviation mapping services to a bank or laboratory's timing software. The vast usages of such services were

[178] *Charter on the Rights and Obligations of States Relating to GNSS Services* [hereinafter GNSS Charter], ICAO Assembly Resolution A32-19, at art. 7.
[179] Agreement, *supra* note 5 at art. 2(q).

described above in chapter one, and the obvious utility of GNSS signals to such derivative applications no doubt drove the drafters of the Agreement to quickly conclude they ought to be protected by future intercourse between Parties. Article 5 of the Agreement goes so far as to mandate the Parties consult with one another before establishing new rules, regulations, or procedures regarding the use of value-added services (along with augmentations, navigation and timing equipment, et al. affected by the use of GNSS signals).

A particularly interesting feature of the Agreement is its prioritization of a search and rescue service signal. Article 12 notes that both Galileo and future generations of GPS satellites will have a search and rescue service, and that the signal used for such services should be radiofrequency compatible, as well as interoperable at the user level.[180] Cooperation on rescue services is established, albeit such deliberations are not pigeonholed into one or another particular international forum. This forward-thinking article also evidences that the Parties were concerned with more than commercial, scientific, and military usages during the drafting phase.

While intending to reinforce the exclusively civil nature of the upcoming Galileo system, the Agreement was nevertheless aware of the national security and military usages of GNSS. To that end, the Parties undertook to prevent the hostile use of GNSS signals while continuing to provide service outside of areas of hostility, endeavouring in the meantime to comply with the National Security Compatibility Compliance criteria found in the Annex.[181] The Parties also agreed to continue studying national security

[180] This may eventually prove useful as a tool to be utilized in conjunction with the International Charter on Space and Major Disasters, *see* online: Disasters Charter <http://www.disasterscharter.org/home>.
[181] Agreement, *supra* note 5 at art. 11(2).

issues in a working group setting.[182] This article demonstrated the commitment of each Party to cooperation in the provision of civil signals, while carefully skirting around the intrinsically militaristic origin (and continued military use) of GPS.

Responsibility and liability are handled via Article 19, the crux of which states that the Parties have responsibility for failure to comply with the Agreement's obligations. To provide for confusing situations in which it is unclear whether an obligation belongs to the European Community as a whole, or to one of its member States, the United States would be entitled to request clarifying information and, if this information is not forthcoming, then the European Community and their several member States would be jointly and severally liable for the resultant damage.

Finally, the key provisions in the Agreement, and those that most ably demonstrate its purpose in being, are those concerning radiofrequency compatibility and interoperability at the user level. This, of course, is the primary consolation to the United States for co-existing with a new civil system out of Europe. Instead of bracing against a new competitor, it could welcome a *de facto* expansion in its own current constellation, minus military applications. Article 4(2) notes that "GPS and Galileo shall be radiofrequency compatible". Article 4(3) continues that to the greatest extent possible, GPS and Galileo shall be "interoperable at the non-military user level". The Parties are to go so far as to "realize their coordinate reference frames as closely as possible to the International Reference Terrestrial System", and to transmit the time offsets between the systems. They also agreed to establish a working group to study these matters.[183] In efforts to maintain radiofrequency compatibility and service interoperability, the Parties

[182] *Ibid.* at art. 11(8).
[183] *Ibid.* at art. 4(4).

are further bound to comply with standards set by international bodies such as ICAO and the ITU.[184] Finally, Article 11(1) notes that the Parties shall work together to "ensure radio frequency compatibility in spectrum use between each other's signals". Furthermore, these provisions seem to comply with the GNSS Charter's Article 5, which notes that "States shall co-operate to secure the highest practicable degree of uniformity in the provision and operation of GNSS services".

This focus on interoperability and compatibility ensures end-users and government providers alike of greater GNSS fidelity and usability in the future. "GNSS is inherently fragile"[185], but together the systems will strengthen reliance on PNT in commerce, scientific pursuits, and general civil convenience. Indeed, though the systems will remain separate, and though GPS will continue to be a military asset that provides a civil benefit, the compatibility of the civil aspect of GPS and totality of Galileo will essentially double the power of either system, providing a much-warranted salve of redundancy to critical Earth-bound infrastructure, commercial, scientific, and individualistic interests. Should several satellites in GPS fail all at once—perhaps due to collisions with orbital debris—then Galileo could compensate, and vice versa. Concern over the possibility of selective availability or military degradation of GPS signals in conflict areas would be of far less concern to interests capable of relying on the civil Galileo, and yet in the vast majority of cases in which this concern would never even

[184] *Ibid.* at art. 4(5); *see also, e.g.,* ICAO Annex 10, 2.4.3.1 (establishing "Recommendation.— A State that approves GNSS-based operations should ensure that GNSS data relevant to those operations are recorded. Note 1.— These recorded data are primarily intended for use in accident and incident investigations. They may also support periodic confirmation that accuracy, integrity, continuity and availability are maintained within the limits required
for the operations approved.")
[185] Lyall, *supra* note 22 at 401.

arise, these same users would have a truly *global* navigation satellite system on which they could faithfully depend.

3. *Related Agreements and Statements*

Before delving too far down the proverbial rabbit's-hole in analyzing the Agreement, it behooves the inquisitive mind to know that many other agreements and statements have been made between the U.S. and other States.[186] Several of these have been between the U.S. and Europe, though none quite so critical as the Agreement itself. Of note:

- 2006 Joint Statement on Galileo and GPS Signal Optimization by the European Commission (EC) and the United States (US).[187] This Statement revealed the efforts of 21 months by the Parties to address concerns over signal structure optimization meant to ensure better performance. A jointly-optimized common signal was produced by the working committee on frequency compatibility and interoperability, and the Statement notes the Parties would then assess the implementation this signal, which is to be broadcast by up to 60 satellites (the eventual combined might of GPS and Galileo).
- 2007 Joint Statement of Working Group B on trade related matters.[188] The Statement relayed the purpose of the Group, which is to address concerns about trade issues in GNSS services, augmentations, and value-

[186] For a listing of such agreements and State partners, *see* "International Cooperation", online: GPS.gov <http://www.gps.gov/policy/cooperation/>.
[187] *Joint Statement on Galileo and GPS Signal Optimization by the European Commission (EC) and the United States (US)*, online: PNT.gov <http://www.pnt.gov/public/docs/2006/gpsgalileo.shtml>.
[188] United States-European Union GPS-Galileo Working Group "B" on Trade & Civil Applications U.S. Department of Commerce, Washington D.C., 1/17/2007, online: PNT.gov <http://www.pnt.gov/public/docs/2007/wgb.shtml>.

added services. The Parties exchanged information about U.S. and E.U. industry interests in GPS and Galileo, and discussed the U.S. National Table of Frequency Allocations, as well as the Galileo concessionaire. Finally, the Group adopted a policy of expanding the public's knowledge of the usefulness of the compatible GPS-Galileo GNSS.

- 2008 Joint Statement on GPS and Galileo Cooperation.[189] Arising from the first plenary meeting about GNSS cooperation, the U.S. and EC undertook the critical step of reaffirming their commitment to the 2004 Agreement. Each side showed the current status of their systems, and the U.S. once more affirmed its commitment to provide the standard positioning service (SPS) for free of direct user fees. Meanwhile, Europe had begun procurement of the Galileo system. Both Parties noted that they believed the interoperability and compatibility of the two systems with each other and eventually other GNSS systems would lead to continued improved commercial growth and international cooperation. The Statement also reported on the progress on the improved common civil signal, while the working group on trade noted success in "opening channels of communication" regarding fair trade, barriers to global markets in GNSS services, equipment and applications, etc. Finally, the Parties expressed a desire for continued cooperation in PNT matters.

[189] *Joint Statement on GPS and Galileo Cooperation by Representatives of the United States of America, the European Community and its Member States*, 23 Oct. 2008, online: PNT.gov <http://www.pnt.gov/public/docs/2008/gpsgalileo.shtml>.

- 2010 Joint Statement on Improved Performance from Receivers.[190] A working group "completed an assessment of the global, combined performance for GPS Space-Based Augmentation System (SBAS) receivers using the European Geostationary Navigation Overlay Service (EGNOS) and the GPS Wide Area Augmentation System (WAAS) supporting safety-of-life applications. The results confirmed improved availability for a wide range of aviation services in both hemispheres and significantly improved robustness to GPS satellite outages." The working group also investigated the interoperability of GPS III and Galileo open civil services, and noted that the combined system enhanced performance in difficult areas (such as tall buildings, trees, or other objects that obscure access to the sky). The consultations produced two additional papers: "Combined Performances for SBAS Receivers Using WAAS and EGNOS", and "Combined Performances for Open GPS/Galileo Receivers".[191] The Statement notes the new phase in cooperation between the Parties as focusing on safety of life services, especially through changing SBAS and using GPS-Galileo open signals. The Statement makes efforts to show these products of cooperation continue the commitment to compatibility and interoperability as prescribed by the 2004 Agreement. The Statement closes with the assurance that the U.S.

[190] *Joint Statement, U.S. and E.U. Announce Improved Performance from Receivers Using both GPS and Galileo Combined Performance* [hereinafter *Joint Statement Receivers*], 30 July 2010, online: PNT.gov <http://www.pnt.gov/public/docs/2010/wgc.shtml>.
[191] Links to both of these papers may be found, "Working Group Papers", online: PNT.gov <http://www.pnt.gov/public/docs/2010/wgc.shtml>.

> and E.U. will continue to work together to enhance the future interoperability and compatibility issues of PNT services.[192]

4. Ambiguous Language

A stated purpose of the 2004 Agreement was continuation of peaceful interaction in space. The above agreements and joint statements, as well as the productivity of the working groups on GNSS matters, have all shown this goal is being seriously implemented by the U.S. and the E.U. However, the future of U.S.-E.U. interaction in space based PNT activities is still uncertain, both because Galileo is still in its infancy, and, perhaps more importantly, the precise meaning behind several of the clauses and statements in the Agreement are murky, at best. To ensure that the peaceful design of the Agreement may be carried out effectively, its language must be analyzed for potentially ambiguous or questionable provisions.

The accountability of both Parties to the Agreement depends on interpretation of any such ambiguous language, and their working relationship is contingent upon a common understanding of the obligations entailed therein. Indeed, peace and security extend into space by virtue of the legal relationships established by the Agreement. It provides for cooperation and the promotion of peace (Article 1(1)), while also providing for national security concerns (Article 11(2)). Signals governed by the Agreement are produced from space based assets, the use of which holds major implications for peace both on Earth and in space itself. Cooperation on Earth regarding global navigation satellite systems and space based assets would pave the way for continued peaceful interaction in space itself, whereas dissention and willful neglect of the Agreement would

[192] *Accord* the "U.S. Statement from COPUOS Science and Technology Subcommittee", 10 Feb. 2011, online: PNT.gov <http://www.pnt.gov/public/2011/02/COPUOS/>.

produce international friction that could spoil peaceful cooperation in outer space. As each Party has repeatedly "expressed strong support for continued close cooperation" and have noted that they "will continue to work together on GPS-Galileo compatibility and interoperability issues"[193], clarification of questionable language could serve only to ameliorate potential international discord.

Ultimately, then, identification and analysis of the language of the Agreement is key to its interpretation, and, by extension, implementation in the international legal arena. This analysis is a two-step process. In the first, questionable language must be identified and parsed for meaning, whilst in the second, the very legal nature of the Agreement itself, writ large, must be discerned. The second step involves asking whether the Agreement qualifies, under international and local law, as a treaty between two Parties, or as something very different. Other possibilities lend themselves; Memoranda of Understanding (MOUs), Exchanges of Notes, or even (on a more domestic U.S.-level) Executive Agreements are all possible formats filled by the Agreement, and they all have their own associated international and domestic obligations and interpretations. Determining the kind of legal arrangement the Agreement posits will also provide a framework for better ascertaining the meaning of its more peculiar clauses. This second step is the primary task of the second part of this chapter.

First, however, questionable provisions in the Agreement must be determined. The language of Article 4(2) is particularly germane. Article 4(2) of the Agreement reads "The Parties agree that GPS and Galileo shall be radio frequency compatible. This paragraph shall not apply locally to areas of military operations. The parties shall not

[193] *Joint Statement Receivers*, *supra* note 190.

unduly disrupt or degrade signals available for civil use."[194] The latter provision describing 'undue disruption or degradation', as it were, is certainly unclear. From the perspective of a legal agreement, what does it mean to be 'undue'? Different interpretations of the language from Article 4(2) could lead to substantially divergent policy decisions from the parties to the Agreement, the result of which could be inconsistent application of policies, significant economic damage inconsistent with the goals of either Party or their eager industries, or generation of international ill will harmful to peaceful relations on Earth and in space.

However, peace and security are not served by the uncertain language of Article 4(2). What the European Union considers undue degradation or disruption of signals could vary diametrically from the views of the United States. The possibility arises that one Party may use the Agreement to function as a heavy hand to encourage the other Party to adopt policy or economic decisions more amenable to the first Party. For example, the EU may threaten to degrade signals from Galileo if the U.S. were to conduct ASAT testing. Should the U.S. decide to conduct the ASAT testing regardless of the EU position, their ability to rely on Galileo data could be compromised. As long as the EU reasonably argues their degradation was not undue, they will not have violated the provisions of the Agreement. The U.S. could react in a similar fashion to policy decisions of the EU deemed unfavorable to U.S. interests. While a spirit of international ill-will should never be assumed, the contexts of the Agreement demand a certain definitiveness to language that otherwise could open the door to international discord. Clarification of this clause would allow an understanding of what it means to be "undue", and this in turn would enable the Agreement to serve as an instrument of peace and

[194] Agreement, *supra* note 5 at art. 4(2).

economic growth. Mechanisms of linguistic interpretation are available, especially in the case of treaties, and these shall be explored *infra* in the section covering treaty law.

Article 6, governing non-discrimination in trade relations, seems clear enough at first glance. The Parties are not to engage in trade discrimination regarding GNSS timing signals, value-added services, or augmentations, nor should either party employ "measures with respect to goods and services"[195] related to such signals and services that would be disguised restrictions. But what constitutes such 'measures'? Could one Party's tariffs, deemed necessary and fair by its legislative authority, be another Party's 'disguised restrictions'? Perhaps this is why the drafters saw fit to establish, in Art. 6(3), a working group to suss out these matters. Whatever may be the case, some troubles have already arisen, as with the United States trade report that complained of lack of access to Galileo signal test equipment, as well as lack of information regarding "licenses to sell products…derived from Galileo Open Service Documentation".[196] On the other hand, some U.S. industry sources have been pleased with the progress in gaining access to Galileo equipment thus far[197], indicating that perhaps in some respects, at least for commercial operators, the language in Art. 6 is either clear enough for business, or that the ambiguity is irrelevant. Conversely, U.S. industry has complained about not receiving information on how to license the E6 signal, though these sources are hopeful for continued cooperation between the U.S. and EC, noting that "as emerging national GNSS systems become interoperable with GPS, we believe that open GNSS markets are essential in order to sustain the GNSS utility."[198] For its part, the EC riposte noted that

[195] Agreement, *supra* note 5 at art. 6(2).
[196] USTR Report, *supra* note 139.
[197] Comments, United States GPS Industry Council, Doc. USTR-2009-0010-0004.
[198] *Ibid.*

intellectual property rights and licensing issues were close to being solved, and that once this was done, the information would be promptly transmitted to the U.S.[199]

Article 7(1) notes that with an exception for "reasons of national security", the Parties shall not restrict their PNT information via their open systems to the end-users. The question, here, is what is it exactly that counts as 'national security'? Is this purely a military term, or might it include more esoteric or non-traditional governmental prerogatives? One might speculate that the U.S. 'War on Terror'[200] could serve as an excuse to restrict PNT to end users in cases where the military or Dept. of State feels such end-users could utilize the information for maleficent ends. Domestically, this is unlikely to occur within the U.S., as civil commercial interests could potentially be badly damaged by any disruption in PNT; nevertheless, it remains a possibility so long as the exact meaning of 'national security' remains elusive.

Art. 7(2) is also a bit obscure, noting that the Parties "shall endeavour to provide signals intended for safety of life services…." Obviously, this comports with both Parties' intentions to create search and rescue services built out of the 60-satellite mega-constellation of the future combined GPS-Galileo, but the language 'endeavour' is somewhat perplexing. Are the Parties merely supposed to attempt to provide such signals, perhaps giving it the 'old college-try'? Or are they seriously expected to provide the signals, fulfilling their part in the greater S&R scheme? If they wanted to close the book on the question, perhaps the drafters should have omitted the word 'endeavour' altogether, making the obligation for each side to provide such signals absolute.

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[199] Comments, European Community, Doc. USTR-2009-0010-0003.

[200] Or the "overseas contingency operations", as the Obama Administration's doublespeak now stands. *See* Oliver Burkeman, "Obama Administration Says Goodbye to 'War on Terror'" *The Guardian* (25 March 2008), online: The Guardian <http://www.guardian.co.uk/world/2009/mar/25/obama-war-terror-overseas-contingency-operations>.

Art. 16 notes that "Each Party shall bear the costs of fulfilling its respective responsibilities under this Agreement. Obligations of each Party pursuant to this Agreement are subject to the availability of appropriated funds." The obligations, then, of each Party depend on whether or not they are able to appropriate funding? Does this not put the implementation of the Agreement into doubt, based on the sea-changes often wrought by shifting of political tides? The current fiscal hawkishness of the U.S. House of Representatives may give the Parties pause, as any "excess" is seen as fodder for the chopping block[201]--one might argue this would apply to creating the new search and rescue service, opening better trade for GNSS equipment and services, or setting the standards and regulations that affect PNT service. The EU is not immune to political changes and the tectonic fiscal movements that so often accompany them—will they default on obligations if they cannot procure sufficient funding? If either party has funding difficulties, the entire Agreement could be reduced to little more than good intentions, unless Art. 16 is not meant to be read with such draconian rigor. Though less obscure than the previous examples, this too deserves analysis.

Without a solid attempt at clarifying these ambiguities, the Agreement, meant to propel the Parties forward into a gilded future of economic prosperity and international cooperation crafted from the new age of GNSS may instead, it seems, stand athwart such progress.

5. Treaty or No? The Need to Determine the Nature of the Agreement

[201] *See e.g.* "House Seeks to Cut Tens of Millions from Congress' Own Budget" *Politico* (6 June 2011), online: Politico <http://www.politico.com/blogs/glennthrush/0711/House_GOP_seeks_to_cut_tens_of_millions_from_Congress_own_budget.html> . This is in keeping with the House's recent efforts to drastically slash the size of the federal budget, as well as with attempts to pass a balanced budget amendment to the U.S. Constitution in return for increasing the federal deficit limits. *See* David Rogers, "Debt Deal Momentum Builds as House Resists" *Politico* (19 July 2011), online: Politico <http://www.politico.com/news/stories/0711/59421.html>.

As alluded above, the particular kind of instrument the Agreement takes is crucial to understanding the methodology used to interpret both its ambiguous language, as well as the power it has to bind both Parties. Thus, key to its application is determining *what* exactly it is. While this exercise may appear trite at first glance, the ramifications of following the Agreement to the letter obviate such concerns. Is the Agreement a treaty, that most sacred and venerable of international accords? Does the Agreement better fit the form of an MOU, or perhaps a more informal (but still influential) exchange of notes? Or does it best fit the odd quasi-legislative tool so often utilized by the executive branch in the United States—the executive agreement?

Of these and other options, treaties have the most varied and complete legal history from which to draw conclusions. Entire volumes are dedicated this sacrosanct form, written by scholars with far greater expertise in the matter than this author. This thesis, then, does not claim to espouse novel theoretical understandings of the treaty form, nor does it have the room for fleshing out every iteration and formality associated therewith. It does, however, intend to show that treaties lend themselves to analysis in somewhat predictable and reliable ways, as the next section will demonstrate.

MOUs and exchanges of notes, while much less formal than treaties, are still international interactions worthy of consideration. Their weaker legal abilities can render a starkly different picture of future interactions under the Agreement than if it were thought of as a treaty, but they produce intriguing results regardless. Moreover, these instruments can be highly persuasive in the arena of international public opinion and this, in turn, affects policy decisions that impinge on global navigation satellite systems and their derivative aspects.

Finally, the curious case could arise in which one Party sees the Agreement as one type of instrument, and the other Party sees it as another. Presumably, diplomats would endeavor to avoid such a bungling of intentions, but one cannot discount the possibility that, e.g., the United States may consider the Agreement an MOU, while the EU thinks of it as an exchange of notes. Determining this essential quality would expedite smoother applications of the obligations contained within, and assure end-users that the promised bounties would in fact be forthcoming.

B. Treaty Law and Other International Agreements

1. *The Treaty*

Before swirling down the eddies of international legal interpretation of the Agreement, it is sensible to first assess the concept of that most potent of international agreements—the treaty. Defining a treaty is deceptively challenging. The common perception is that a treaty is an accord between two States, formalized typically in writing, signed by the appropriate sovereigns, and, in some instances, ratified by State legislatures. This conception is not far from the truth, and much jurisprudence has identified it with similar language. Chief Justice Marshall of the United States Supreme Court, writing in 1829 about a case involving the Treaty of St. Ildefonso, noted that "a treaty is in its nature a contract between two nations, not a legislative act. If does not generally effect of itself the object to be accomplished, especially so far as its operation is infra-territorial, but is carried into execution by the sovereign power of the respective parties to the instrument."[202] In a later case, Justice Miller of the Supreme Court stated more succinctly, "a treaty is primarily a compact between independent nations. It depends for the enforcement of its provisions on the interest and the honor of the

[202] *Foster v. Neilson*, 2 Pet. 253 at 314 (1829).

governments which are party to it."[203] Shaw largely agrees, defining a treaty as "basically an agreement between parties on the international scene."[204]

Not only is this kind of agreement characteristically simple in form (though often ranging from trifling to monumental in effect), it is well established in the international community. Treaties are ingrained as a customary method of settling debates, defining terms, sorting business, ending wars, establishing alliances, determining borders, and granting rights or privileges. Their tendency at shaping much of the world's history has given treaties an exalted place in among academicians and politicians alike. Indeed, "in my judgment the solemn treaty form which traditionally has characterized international covenants of grave importance should always be used when nations expect to be bound over long periods of time in matters affecting the general public welfare. Treaties are not easily amended nor do peace loving peoples easily disregard them."[205]

Custom, of course, is comprised of state practice—typically built over a lengthy period of time—and *opinio juris*, [206] and the treaty has been the beneficiary of both for thousands of years. If States are thought of as distinctive international personalities, then "no simpler method of reflecting the agreed objectives of states really exists".[207] Additionally, these agreements can be between two States, or many—bilateral, or

[203] *Head Money Cases*, 112 U.S. 589, at 598 (1884).
[204] Malcolm N. Shaw, *International Law* 6th ed. (Cambridge: Cambridge University Press, 2008) at 903.
[205] John Cobb Cooper, "The Proposed Multilateral Agreement on Commercial Rights in International Civil Air Transport" (1947) 14 J. Air L. & Com. 129.
[206] This is not always necessary, according to some authorities. Ben Cheng strenuously defends the possibility of instantaneous customary law in his text, *Studies in International Space Law* (Oxford: Oxford University Press, 1997) at 138-39. This is especially true in the era of space flight where, as was seen with Sputnik and other satellites, most States did not complain about the passage of these satellites over their territory, creating, in the minds of some scholars, instant custom that this type of activity was acceptable, even in the absence of a treaty (at the time) confirming this belief.
[207] Shaw *supra* note 204 at 903.

multilateral. It is even feasible to have a treaty between a State and an international organization, or between one organization and another.[208]

But as is typical of law, nothing is ever quite so simple. There are many types of agreements between States, many of which would never be accorded the status of 'treaty' in modern times. Thus, deciding whether an instrument is or is not a treaty sometimes requires divining the intent of the parties involved. This process can involve many avenues of investigation, including the drafting history, the circumstances—both internationally and domestically—that led to the drafting, the history of interaction between the States, the language of the instrument, and, to a lesser extent, the name of the instrument. Complicating matters, the instrument is not always called a 'treaty' in its title. Sometimes these agreements go by concord, protocol, covenant, charter, or act, among others.[209] In others, States may call an agreement a treaty, even though it is merely a MOU or contractual arrangement.[210] Language that often lends itself to treaties includes strong wording such as "'shall', 'agree', 'undertake', 'rights', 'obligations' and 'enter into force'"[211] Circumstances that lend credence to the belief an agreement is a treaty are sometimes fortuitously obvious, as when two States at war come together to end hostilities by the signing of a formal document (e.g., the Treaty of Versailles ending World War I). In other instances, the situation that gives rise to the treaty is less overt.

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[208] *See* the *Vienna Convention on Treaties Between States and International Organizations*, Doc. A/CONF.129/15 [hereinafter Vienna Convention Organizations]. This Convention, though, is not yet in force. *See* online: United Nations Treaty Collections <http://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXIII-3&chapter=23&lang=en>.

[209] Shaw, *supra* note 204 at 904.

[210] Anthony Aust, *Modern Treaty Law and Practice* (Cambridge: Cambridge University Press, 2007) at 40-41.

[211] *Ibid.* at 33.

Formalities often distinguish the treaty from its less-restrictive siblings. Typically, a treaty is a signed agreement, and the individuals signing the document are authorized governmental agents who speak with the authority of their sovereign. The signing is a form of publicly declared consent to be bound, but it is not always needed to constitute a treaty.[212] The format of the instrument will often have typical provisions regarding entry into force and deposition of instruments of ratification. Also, States tend to register their treaties with the United Nations Secretariat, an action they must take if they foresee the possibility that they will need to discuss the instrument before the UN.[213]

Parties' behavior towards one another can also serve as a clue about their intention to form a treaty or not. Consistent application of the instrument's provisions is a positive sign. Treaty obligations must be fulfilled by the parties in good faith[214], following the timeworn rule of *pacta sunt servanda*. After all, the functions of a treaty would be meaningless without the active attempt, by all involved, to follow the very guidelines they contractually agreed to by the most formal of means. Most international law depends, for its efficacy, on the self-enforcement of the concerned States. Furthermore, States would not agree so readily to form compacts with one another in the absence of the expectation that the resultant provisions would be carried out.

2. *The Vienna Convention*

Perhaps the most convincing method for determining whether something is a treaty, and for analyzing its meaning once said determination has been made, is to consult

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[212] *Ibid.* at 24.
[213] *Charter of the United Nations and Statute of the International Court of Justice* [hereinafter UN Charter], 26 June 1945, 1 UNTS XVI,
art. 102(1-2).
[214] Shaw, *supra* note 204 at 903.

the 1969 Vienna Convention on the Law of Treaties.[215] Sometimes nick-named the Convention on Conventions, this instrument grew out of the need States saw for formalizing procedure for analyzing the treaties they signed with one another. One might think that States would know what they meant when they wrote down and signed such agreements, but differences of opinions as to specifics crop up often enough to legitimize the need for formal assistance. The number of parties and signatories evidence this world-wide need, what with there being 111 of the former and 45 of the latter as of July 21, 2011.[216] "The Vienna Convention on the Law of Treaties partly reflects customary international law and constitutes the basic framework for any discussion of the nature and characteristics of treaties."[217]

The Vienna Convention defines treaty as "an international agreement concluded between States in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments and whatever its particular designation".[218] This definition may be parsed into several sections. First, the agreement must be between States. This particular factor was, as noted above, expanded to include international organizations with the Vienna Convention on Treaties Between States and International Organizations.[219] Secondly, the agreement must be written—precluding any 'oral' agreements or traditions or customs that may exist between States. The third factor is that the agreement must be subject to international law, thereby subjecting States

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[215] *Vienna Convention on the Law of Treaties*, UN Doc. A/Conf.39/27; 1155 UNTS 331; 8 ILM 679 (1969) [hereinafter Vienna Convention], online: United Nations Treaty <http://untreaty.un.org/ilc/texts/instruments/english/conventions/1_1_1969.pdf>.
[216] "Vienna Convention, Treaty Status", online: United Nations Treaty Collection <http://treaties.un.org/Pages/ViewDetailsIII.aspx?&src=TREATY&mtdsg_no=XXIII~1&chapter=23&Temp=mtdsg3&lang=en>.
[217] Shaw, *supra* note 204 at 903.
[218] Vienna Convention, *supra* note 215 at art. 2(1)(a).
[219] Vienna Convention Organizations, *supra* note 208.

to the sizeable body of well-established global statutes, jurisprudence, and regulations. Fourthly, there may be one or more instruments comprising the agreement. Finally, the title of the instrument does not matter—it may be called an agreement, pact, treaty, et al.

The Vienna Convention's chief asset may be its articles assisting in treaty interpretation. Articles 31 through 33 provide a clear framework, with 31 and 32 of paramount significance. Article 33 primarily concerns interpretation of treaties that have been authenticated in two or more languages. Article 31 constitutes the crux of the Convention's efforts at consolidating interpretation. Article 32 provides further support, should Article 31 prove insufficient to solve the question at hand.

Article 31 lays out a fundamental principle already enshrined in customary international law: treaties are to be interpreted in good faith "in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose".[220] Art. 31 notes an exception to the 'ordinary meaning' test comes when the parties have agreed to a special meaning for a term. Presumably, this special meaning would be available in the definitions section commonly found in international agreements. Context should also take account of other agreements that accompany or follow the primary agreement, so long as they are related. A treaty's preamble and annexes are also to give context. Finally, Article 31 makes clear that all relevant rules of international law that are applicable between the parties should also be taken into consideration.

Seated in its linguistic malleability, Art. 31's power enables inquisitive scholars and judicious policy-makers with a practical tool for resolving potential dilemma. The concept of a word or phrase's ordinary meaning seems intuitively simple to most, and it

[220] Vienna Convention *supra* note 215 at art. 31(1).

alleviates temptation to burrow into obfuscatory legal doctrine or dicker with philosophical complexity. The weakness in the problem with using the 'ordinary meaning' of a word, however, is that this itself is an ambiguous phrase, open to a multiplicity of interpretations depending on subjective worldviews and experiences. Much of language is flitting, effervescent, or fluid, while the meaning of language is rarely truly and absolutely definitive. Even so, this is the mechanism set forth by the Convention, and it is a pragmatic, if imperfect, interpretive implement.

The Convention also provides Article 32 as a means to enhance treaty interpretation with other sources, noting "recourse may be had to supplementary means of interpretation…", including the drafting history of the work and the circumstances in which the agreement was concluded in instances where they are needed to interpret the meaning that results from applying Art. 31. In situations where Art. 31 would lead to ridiculous results, or where following it would confuse the matter further, alternate sources may be consulted.[221] The question naturally arises as to what sources may be consulted, and which should be, as opposed to those that should be discarded. Since the Convention is not clear on the matter, according to its own Art. 31, one would need to interpret 'supplementary means of interpretation' according to its ordinary meaning, which, unrestricted by further instruction, could mean just about anything. It would be folly to suggest a court or congress between States would utilize frivolous or superficial sources, but the absence of defining modifiers certainly opens the gates of interpretation quite wide.

Perhaps one would do well to utilize the Statute of the International Court of Justice as an exemplar. The Statute identifies four primary methods the Court can utilize

[221] *Ibid.* at art. 32(a-b).

to decide cases submitted to its jurisdiction. These include: 1) international conventions (treaties, etc.) that establish rules recognized by the States involved; 2) customary international law; 3) general principles of international law; and 4) opinions and writings of the most qualified publicists in a field, as well as judicial proceedings.[222] Certainly in determining the meaning behind a treaty, a State could find some guidance from other similar treaties it has adopted. State practice and *opinio juris* provide customary international law perspectives. General principles of international law—such as that States are sovereign over their territory, or instances of *jus cogens*, such as States may not commit genocide—are readily available for application; furthermore, the 'most qualified publicists' could serve to identify the helpful norms. Along with the *travaux préparatoires*, the context in which it was drafted, and the practice of each State in fulfilling its obligations, even the most indecipherable treaty will eventually yield to a certain understanding.

After the information presented above, one might undertake to consider whether the GPS-Galileo Agreement constitutes a treaty. Utilizing the Vienna Convention, as well as customary language and formalities associated with treaty-making, the Agreement may be subjected to a cursory analysis.

First, the 'treaty language' of the Agreement should be determined. Indeed, the Agreement is replete with such terminology; indeed, the word 'shall', conveying a sense of absolute requirement, appears no fewer than sixty-four times in the Agreement. 'Agree', and its various iterations (agreement, have agreed, etc.), appears seventy-one times, while obligation(s), conveying a sense of international expectation and

[222] Statute of the International Court of Justice [hereinafter ICJ Statute], UN Charter, *supra* note 213 at art. 38(1).

responsibility, occurs five times. Right(s) occurs three times, while Article 20 specifically governs 'entry into force'. There is even a procedure for amending the Agreement that requires States to utilize their internal approval procedures if they wish to accede to a change—suggestive of a need to ratify any changes.[223]

Structurally, the Agreement has the visual appearance often seen in treaties. There is a preamble, describing sentiments, past procedures, and future desires, and an Annex (containing critical information on GPS and Galileo signal structures). Sandwiched in between are twenty articles, including a significant 'definitions' section designed to remove questions about terminology, some of which is technical. Finally, the Agreement was signed by both sides at a formal gathering, being completed at Dromoland Castle, Ireland.

The context surrounding the drafting suggest both Parties believed the subject matter to be critical for continued civil, commercial, and scientific progress. Both Parties have repeatedly stated their industries rely on global navigation satellite services, and that the continued services of a Galileo-GPS effort would be worth tens and possibly hundreds of billions of euros. The Agreement focuses on civil service provision, but does not fail to deflect concerns regarding military usage of GNSS. The Preamble states that the U.S. intends to continue its free-of-direct-user-fees GPS service, confirming what multiple U.S. PNT policies have claimed. The multiple critical interests at stake provide persuasive evidence that the Parties saw the Agreement as more than a mere gentlemen's agreement.

The continued actions of the Parties involved demonstrate that both sides take their obligations under the Agreement with the utmost seriousness. Multiple further

[223] Agreement, *supra* note 5 at art. 20(6).

agreements, joint statement, working group reports, the U.S. 2011 COPUOS report, and even the 2009 US Trade Report eliminate any doubt that the Parties intend to continue with the Agreement as written, making every effort along the way to ensure GPS and Galileo will work ably together in the near future.

Even though it does not explicitly self-identify as such, the above factors weigh in favor of determining the Agreement is a treaty—at least from an international law perspective. It remains, then, to subject the Agreement's ambiguous language to the test of treaty interpretation, using the toolkit Article 31 of the Vienna Convention provides.

Article 4(2) deserves first analysis. The first sentence concerning radio compatibility is a technical issue, and need not be dissected here. The diabolical confusion created in this clause is the agreement that neither Party shall 'unduly disrupt or degrade' signals. The damage such confusion could cause was alluded to above; thus, clarifying the issue is in the interest of both Parties. Art. 31 recommends using the ordinary meaning in interpreting uncertain treaty language. In this instance, the adverb 'unduly' can be reduced to its adjectival root 'undue', practically meaning undeserved or unwarranted. The Oxford English Dictionary defines undue as "unwarranted or inappropriate because excessive or disproportionate".[224] This definition suggests a somewhat subjective, deontological judgment, since by claiming something is unwarranted or inappropriate, the Agreement is essentially claiming there is a standard by which the parties *ought* to adhere. Not defining what exactly that standard is—i.e., what might be 'due' or deserved degradation or disruption—the Agreement then sets the reviewer in a linguistic loop: once we know what undue means, we then ask what might be due, only to discover it is not defined and be forced back to ask the original question

[224] *Concise Oxford English Dictionary, Luxury Edition*, *s.v.* "undue" at 1574.

once more. Indeed, the language implicitly suggests there could be a range of disruption and degradation that is acceptable, which in turn means that the Parties and their respective industries must be ready for potential interference with their interests.

Furthermore, it is unclear whether 'unduly disrupt or degrade' signals refers to the *extent* of disruption and degradation, or, rather, the triggering event which would allow such behavior. Could the U.S. decide again to consistently degrade its signals to all end-users in the future, as was done long ago under older PNT policies? Perhaps it could degrade the signal only enough to be off by five or six meters—perhaps the amount necessary to interfere with reliance on GPS signals for aviation landing and takeoff procedures. Would this be 'undue'? Could the E.U. disrupt Galileo signals for an hour here or there simply to see how the markets and end-users might respond? Would either Party need to wait to act until the other issues a diplomatic insult or international policy with which the other Party heartily disagrees? Common sense may aid the reviewer here. The clause probably indicates that both Parties undertake not to disrupt or degrade signals but for highly exceptional circumstances. Defining undue as 'unwarranted' suggests a rather serious event would need to pass to create acceptable instances of degradation and disruption. Additionally, it may be necessary to occasionally disrupt GNSS signals due to repositioning of satellites—an innocent act that would likely not incur the ire of the Agreement. Such acts may be the only instances in which disruption or degradation would not be 'undue'. Ultimately, though, the language alone does not solve the ambiguity.

If Art. 31 cannot provide a definitive solution, then Art. 32 allows additional sources to assist in clarification. Since provision of global navigation satellite systems is

a relatively recent phenomenon, not much customary international law on when these signals may or may not be degraded exists. However, the U.S. has over several years and presidents suggested, in its national PNT policy and related announcements, that it would continue to provide PNT signals free of direct user fees to end-users, and without degradation. Since millions of euros in world commerce already depend on the fidelity of GPS, and as States and commercial interests have planned long-term strategies on the use of these signals, one might argue this dependence, coupled with U.S. State practice, has created a customary international law that GPS signals should always be provided in this manner. If so, then it would perhaps never be acceptable for the U.S., at least, to disrupt or degrade signals. General international law on satellite signal provision, like customary international law, is something of a legal Loch Ness Monster—it may exist, but most experts would claim to the contrary.

Insofar as information provided by a State's best publicized experts, little is written on this subject. Perhaps a tangential and markedly tenuous relationship exists with the concept of proportionality in the law of war. In that doctrine, one State's response to the attack of another ought to be proportional to the first attack, i.e., not excessive. This principle, sometimes identified as the Webster Doctrine[225], has achieved international recognition. Speaking of the German invasion of Denmark and Norway in the events surround World War II, the International Military Tribunal at Nuremberg noted "it must be remembered that preventative action in foreign territory is justified only in case of an instant and overwhelming necessity for self-defense, *leaving no choice of*

[225] *See* John Cobb Cooper, "Self-Defense in Outer Space…and the United Nations" (1962) 5:2 Space Digest 51 at 53.

means, and no moment of deliberation".[226] The doctrine thus allows a State to react to another's transgression, but only when there is no other choice, and the means by which they react must also be the only one warranted by the original act, i.e., it must be proportional. Though in a radically different situation, interpretation of the Agreement's 4(2) may suggest that one State may only avoid unduly disrupting or degrading signals if such actions represent a proportional response to other actions of proportional weight and import. If, God forbid, the U.S. were ever to declare war on a Member of the EU, and in so doing disrupted its GPS signal to users in the theatre of battle, surely it would not be undue for Europe to respond in kind with Galileo.[227]

This interpretive process could be repeated for many of the questionable provisions in the Agreement. Potentially damaging to this analysis is the fact that neither the European Union, as a multinational body, nor the United States are parties to the Vienna Convention on the Law of Treaties.[228] The U.S. perspective is addressed below, but it should be noted that many of the States of the European Union are individually signatories of the Convention.

3. *U.S. Domestic Treaty Interpretation*

While interpretive evidence strongly suggests that under international law, the Agreement is a treaty, the United States has additional laws and hurdles to clear before an agreement may be said to become a treaty. Many States can adopt treaties into their domestic province merely through the act of signing—the United States is not such a State. Treaties hold a special power over U.S. domestic law, and are therefore governed

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[226] *International Military Tribunal at Nuremberg*, *The Caroline Case*, Moore's International Law Digest, vol. II, p. 412.
[227] Then again, if these two parties were at war with one another, it is likely they would not consider any treaties between them to be valid, at least for the duration of the conflict.
[228] Vienna Convention, Treaty Status, *supra* note 216.

by the Constitution of the United States. Of principle interest in describing the powers of the President of the United States, the U.S. Constitution notes that "He shall have Power, by and with the Advice and Consent of the Senate, to make Treaties, provided two thirds of the Senators present concur…."[229]

The treaty power, then, is assigned to both the executive and the upper chamber of the legislature, and the threshold for compliance with the Constitution is fairly high. Both divisions of the government must find a way to concur in order to adopt a treaty, and as each branch serves as a check on the power of the other, this can, at times, prove challenging. This stringent requirement was designed to protect U.S. domestic law from too readily being replaced or supplemented by agreements with foreign States, and this, in turn, was of importance considering that according the Constitution, "This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land".[230]

The notion of treaties as the 'law of the land' means that these agreements are given the same weight and legal significance as any other law passed by the United States Congress. As Justice Marshall wrote, "In the United States, a different principle is established. Our constitution declares a treaty to be the law of the land. It is, consequently, to be regarded in courts of justice as equivalent to an act of the legislature…."[231] When the United States commits to a treaty, that instrument affects the

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[229] *Constitution of the United States*, Art. II, Sec. 2, Cl. 2—Treaty Making Power.
[230] *Constitution of the United States*, Art. VI, Cl. 2.
[231] *Foster*, *supra* note 202 at 314. *See also The Federalist* No. 75 (J. Cooke ed. 1961), 504-505. In *Hauenstein v. Lynham*, 100 U.S. 483 (1879) the Court noted "It must always be borne in mind that the Constitution, laws, and treaties of the United States are as much a part of the law of every State as its own local laws and Constitution. This is a fundamental principle in our system of complex national polity." 100 U.S. at 489-490.

entire State, even though legislatively, only the Senate had a hand in passing it into existence. Typically, the House of Representatives would need to assist in the creation of law, but this Constitutional exception abrogates that normality.

A natural question follows: if the Congress has passed a statute governing global navigation satellite systems, and then the President and Senate adopt a new treaty (the GPS-Galileo Agreement, e.g.), and, furthermore, provisions in the treaty conflict with certain parts of the statute, then is a conflict of laws generated? "The answer is, that neither has any intrinsic superiority over the other and that therefore the one of later date will prevail...."[232] Corwin notes that "a few judicial *dicta*…assert that the maxim '*leges posteriors priores contrarias abrogant* (later laws repeal earlier contradictory ones)'…carry the implication that the treaty-making power is capable of imparting to its engagements the quality of the 'law of the land'…."[233] The system thereby precludes international agreements of this kind from clashing with extant laws in insoluble ways, and the old makes room for the new. Thus, if it is determined that the GPS-Galileo Agreement is a treaty, its provisions should not be seen to conflict with any extant U.S. domestic obligations.

The specific method by which treaties are crafted in the United States deserves more detailed attention. The president is given the ability and mandate to craft treaties on behalf of the United States. Though the aforementioned Constitutional provision establishes a required symbiosis between the Senate and presidency, "he alone negotiates. Into the field of negotiation, the Senate cannot intrude; and Congress itself is powerless

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[232] *Constitution of the United States Analysis and Interpretation* [hereinafter Constitution Analysis], Senate Document No. 108-17 (2004) at 499.
[233] Edward S. Corwin, *The Constitution and What it Means Today* 1973 ed. (Princeton: Princeton University Press, 1973) at 134.

to invade it."[234] In the instance of the GPS-Galileo Agreement, it was the executive, under the ambit of the powers of the president, which negotiated on behalf of the United States—not the U.S. Senate. Despite its eventual veto power over treaty-making, the Senate does not have to be consulted by the president at any point before or during the drafting process.

However, the power to craft treaties is not exclusively in the hands of the president and Senate. The House of Representatives, although not given explicit mandate to interfere in creating these singular international agreements, nevertheless has *de facto* power over the implementation of any treaties requiring funds to operate. The Constitution gives the Congress the power to collect taxes and spend money on behalf of the United States[235], and this cannot be achieved without the will of the House. This is true even when a treaty, properly entered into via the president-Senate constitutional mechanism, requires an explicit expenditure of funds by the United States. Willoughby notes "though the treaty making power is able to obligate the United States internationally to the payment of sums of money, it is not able itself to appropriate from the United States treasury the amounts called for, or compel the legislature to provide for their payment."[236] Something of an oddity, this fact enables the House of Representatives to have more power over the treaty-making process than was apparently intended by Art. II. Despite this, negotiating treaties remains vested solely in the president.[237]

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[234] *United States v. Curtiss-Wright Corp.*, 299 U.S. 304, 319 (1936).
[235] U.S. Constitution, Art. I, Secs. 8-9.
[236] Westel Woodbury Willoughby, *The Constitutional Law of the United States,* vol. 1, 2d ed. (New York: Baker, Voorhis and Company, 1929) at 549.
[237] Some case law has suggested that the president even has the power to determine whether a treaty is or is not any longer binding on the United States after a breach of obligations from the other State Party. *Charlton v. Kelly*, 229 U.S. 447 (1913). This author would be sceptical of this power, as even if the president could determine, for domestic purposes, whether a treaty remained a governing force over the United States, failure to withdrawal from the agreement via means provided in the instrument itself, or

Yet, unlike many States, the U.S. decided not to invest the power of treaty-making exclusively to the president. Though, indeed, it was his power to negotiate such instruments, he was denied the unilateral authority so seemingly natural to an executive. Ultimately, the Framers decided the Senate would, by a two-thirds vote, hold approval for the president's efforts at international state-crafting. The reasons for this restriction are varied, but essentially they boil down to a distrust of executive power in the earliest days of the republic, borne of generations of conflict with the British Crown, culminating in an historic decision by a brazen colony to separate from its sovereign.[238] Mindful of the struggle with Britain just years before, "the usurpation of power on the part of a single executive was a present and continuous danger…."[239]

The first attempt at governing the United States culminated in the Articles of Confederation, whose articles greatly restricted the power of a centralized government. The Articles even delegated, in its ninth provision, that the power to craft treaties was vested in the Congress, albeit with the assent of the several states.[240] Eventually the

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otherwise under principles of international law, could cause the president to unwittingly commit a breach of international law on behalf of the United States. Additionally, *see also Taylor v. Morton*, Fed. Cas. No. 13,799 (1855)--With Justice Curtis noting that whether a foreign sovereign has violated a treaty or withdrawn voluntarily, amongst other things, is a political question that the judicial departments are not qualified to decide. Political questions were given to the executive and the legislature, and denied to the judiciary. Thus, if a conflict arose in which the U.S. claimed the EU was violating provisions on unduly degrading satellite signals, it would be for the President and/or the Congress to make that conclusion, rather than the Supreme Court.

[238] *See The United States Declaration of Independence*, July 4, 1776. The list of grievances against King George III was extensive, noting, among other delinquencies, "He has refused his Assent to Laws, the most wholesome and necessary for the public good…He has forbidden his Governors to pass Laws of immediate and pressing importance…He has dissolved Representative Houses repeatedly…He has obstructed the Administration of Justice by refusing his Assent to Laws for establishing Judiciary Powers…For quartering large bodies of armed troops among us…For imposing Taxes on us without our Consent…He has plundered our seas, ravaged our coasts, burnt our towns, and destroyed the lives of our people…", et al.

[239] B. M. Thomson, "The Power of the Senate to Amend a Treaty", 3 Mich. L. Rev. 441 (1905).

[240] Denna Frank Fleming, *The Treaty Veto of the American Senate* (New York: G.P. Putnam's Sons, 1930), at 4; for a general understanding of the evolution of the 2/3 treaty power of the U.S. Senate, *see generally* Fleming's "The Origins of the Senate's Power over Treaties", in his Treaty Veto of the American Senate, p. 3-15; *see also Missouri Pacific R. Co. v. Kansas*, 248 U.S. 276, 283 (1919): "But this is not all, for the Journal of the Senate contains further evidence that the character of the two-thirds vote exacted by the

Articles were determined to be insufficient to govern the new American Experiment, and the Constitution of the United States of America was drafted to replace and improve upon previous law. Eventually, the Senate was given less power over treaties than in the Articles, but it nevertheless had a critical role to play in giving (or not) consent to treaties negotiated by the president. This role, drafted by the 'Committee of Eleven', gave to the Senate the power to approve of presidential treaty-making with the advice and consent of two-thirds of the Senators present.[241] No doubt, this solution was hoped to enable the executive to function with the quality of power denied it in the Articles, whilst simultaneously denying autocratic power to unscrupulous leaders, "and withal there would be enough collaboration to prevent the President from seizing a sceptre and crown, especially in the making of peace."[242] Succinctly: the power to negotiate treaties is the president's alone; the power to ratify them, the Senate's.

4. *The Vienna Convention and U.S. Law*

Considering its importance in discerning meaning behind treaty provisions, the status of the Vienna Convention in the United States deserves attention. The most obvious question is whether the U.S. is a Party to the Convention. For better or worse,

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Constitution (that is, two-thirds of a quorum) could not have been overlooked, since that Journal shows that at the very time the amendments just referred to were under consideration there were also pending other proposed amendments, dealing with the treaty and lawmaking power. Those concerning the treaty-making power provided that a two-thirds vote of all the members (instead of that proportion of a quorum) should be necessary to ratify a treaty dealing with enumerated subjects, and exacted even a larger proportionate vote of all the members in order to ratify a treaty dealing with other mentioned subjects…."

[241] *See James Madison's Journal of the Debates in the Constitutional Convention of 1787*, II, 240, 262, 299.

[242] Fleming, *supra* note 240 at 15. Indeed, this temptation unto power has not abated in the human spirit with the passing of years. Speaking to the controversial organization La Raza, President Obama recently opined: "The idea of doing things on my own is very tempting, I promise you, not just on immigration reform. But that's not how our system works. That's not how our democracy functions.", from Catherine E. Shoichet, "Obama: 'I need a dance partner' on immigration reform" *CNN* (25 July 2011), online: CNN <http://edition.cnn.com/2011/POLITICS/07/25/obama.la.raza/>.

the United States has signed, but not ratified, the Vienna Convention.[243] As a result, the Convention is not the 'law of the land', and cannot be said to override any conflicting provisions in U.S. statutory law. This fact does not mean the discussion should end here. Rather, judicial discord continues to crop up in discussion of the proper role, if any, of the Convention as applied to U.S. treaty obligations. Some lower courts have cited to the Convention positively, while the Supreme Court has over-ridden this sentiment. For instance, the Court of Appeals for the Second Circuit has noted "When resolving [questions about treaties]…we apply the rules of customary international law enunciated in the Vienna Convention on the Law of Treaties."[244] The Second Court noted, in another case, that the Convention "binds states together regardless of whether they are parties" as it is a "restatement of customary rules".[245]

In contrast, "notwithstanding the Vienna Convention's internationally authoritative status, the Supreme Court has never applied the Convention as U.S. law. In fact, since its entry into force in 1980, only two Supreme Court opinions have cited the Vienna Convention…no member of the Court has ever appealed to the Vienna Convention for an independent and controlling decision."[246]

The Supreme Court's reticence to apply the Vienna Convention notwithstanding, would it be appropriate for U.S. courts to apply it in any event, using it, e.g., to solve the riddle of ambiguous language in the GPS-Galileo Agreement? The short answer is no—although there is a strong argument to be made that its provisions, independent of the

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[243] Vienna Convention, Treaty Status, *supra* note 216; *see also* "U.S. Treaties in Force, 2010", online: State Department <http://www.state.gov/documents/organization/143863.pdf>.
[244] *Fujitsu Ltd. v Fed. Exp. Corp.*, 247 F.3d 423, 433 (2d Cir. 2001).
[245] *Chubb & Son, Inc. v Asiana Airlines*, 214 F.3d 301, 308 (2d Cir. 2000).
[246] Evan Criddle, "The Vienna Convention on the Law of Treaties in U.S. Treaty Interpretation", 44 Va. J. Int'l L. 433-34 (2004).

Convention itself, are customary law that should be applied to the U.S. and its treaty relations regardless of the ratification status of the Convention which enshrines them. As to applying the Convention *qua* Convention, it is a matter of logic. If the United States could apply the Vienna Convention as law of the land, then, of necessity, it would have ratified the Convention in the Senate. The Senate has not ratified the Convention. Therefore, the U.S. cannot apply the Convention as law of the land—modus tollens.

Even if the United States had ratified the Convention, it is doubtful whether it could be applied without accompanying implementing legislation. The Supreme Court has repeatedly held that mere accession to a treaty, including ratification thereof, is insufficient to apply such law to the U.S. *unless* there is accompanying implementing law from the Congress, or if the treaty was self-executing. In the latter case, treaties merely addressing rights of private individuals could be once such instance.[247] In the former case, treaties typically require Congressional action to implement because they essentially establish a contract by one State with another, depending on each to fulfil its part in some grand bargain.[248] Justice Marshall noted "when the terms of the stipulation import a contract—when either of the parties engages to perform a particular act, the treaty addresses itself to the political, not the judicial department; and the legislature must execute the contract, before it can become a rule for the Court."[249]

Following *stare decisis*, modern incarnations of the Supreme Court have continued to cite to the need for implementing legislation, and that this is required to

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[247] Constitution Analysis, *supra* note 232 at 502.
[248] *Ibid.* at 501-02.
[249] *Foster*, *supra* note 202 at 314; *accord Whitney v. Robertson*, 124 U.S. 190, 194 (1888): ''When the stipulations are not self-executing they can only be enforced pursuant to legislation to carry them into effect . . . . If the treaty contains stipulations which are self-executing that is, require no legislation to make them operative, to that extent they have the force and effect of a legislative enactment.''

enforce U.S. treaty obligations domestically. Two recent controversies involving Mexican nationals sentenced to be executed in the state of Texas are germane. In one, *Medellin v. Texas*, the Court took the case of Medellin because of the reliance on the International Court of Justice decision *Case Concerning Avena and Other Mexican Nationals*[250], which determined Avena and several other Mexican nationals in the United States were entitled to review of their state convictions due to violations of the Vienna Convention on Consular Relations.[251] The Court wished to review the argument that the ICJ decision was applicable to the United States, and concluded that it did not.[252] After noting that the United States had withdrawn from general ICJ jurisdiction in 1985, and specific jurisdiction in 2005[253], the Court also rejected the claim that the Optional Protocol, UN Charter, or ICJ Statute would create binding federal law in the United States without the appropriate implementing legislation which, the Court noted, was unquestionably absent.[254] To be clear, the Court did agree that international obligations existed on the part of the United States, "but not all international law obligations automatically constitute binding federal law enforceable in United States courts."[255]

Taking up a similar case in 2011, the Court, in *Leal v. Texas*, refuted international legal pressure to apply ICJ decisions in the United States without Congress enacting legislation to that effect.[256] Leal, a Mexican national convicted of kidnapping Adrea Sauceda, raping her with a stick, and finally beating her to death with a piece of

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[250] *Case Concerning Avena and Other Mexican Nationals* (*Mex.* v. *U. S.*), 2004 I. C. J. 12 (Judgment of Mar. 31) (*Avena*).
[251] *U.S. v. Medellin* 552 U.S. 491 (2008).
[252] *Ibid.*; the Court also determined that a decision by the Bush administration to enforce its obligations under the *Avena* case was not binding on the U.S.
[253] *Ibid.* at Part I(A).
[254] *Ibid.* at Part II.
[255] *Ibid.*
[256] *Leal v. Texas*, 564 U.S. __ (2011), at p. 3 of slip decision.

asphalt[257], relied on the defense that Congress should be allowed time to pass implementing legislation:

> Leal and the United States ask us to stay the execution so that Congress may consider whether to enact legislation implementing the *Avena* decision. Leal contends that the Due Process Clause prohibits Texas from executing him while such legislation is under consideration. This argument is meritless. The Due Process Clause does not prohibit a State from carrying out a lawful judgment in light of unenacted legislation that might someday authorize a collateral attack on that judgment.[258]

No matter how much the Justices or anyone else may wish the U.S. to follow its international law obligations (assuming such even continued to exist after the withdrawal from the ICJ jurisdiction), echoing the famous language of *Marbury v. Madison*[259], the Per Curiam decision noted "Our task is to rule on what the law is, not what it might eventually be."[260] Thus, if the Congress decides to enact legislation making ICJ cases the law of the land, inmates such as Leal would have a legal leg on which they might stand. The same necessity would be true of the GPS-Galileo Agreement, should that ever be ratified by the Senate.

Intriguingly, even if Congress did ratify the Convention, it could not be forced to pass the required implementing legislation. The Constitution leaves it to the Congress to

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[257] *Ibid.* at 1.; Leal admitted his complicity in the crime before his eventual execution, *see* Michelle Mondo, "S.A. Teen's Killer Dies with an Apology" My SA (8 July 2011), online: My SA <http://www.mysanantonio.com/news/local_news/article/About-to-die-Leal-apologizes-for-killing-S-A-1456909.php>; *see also* Nathan Koppel, "Texas Executes Leal Despite White House Objections" *The Wall Street Journal* (8 July 2011), online: The Wall Street Journal Digital Network <http://blogs.wsj.com/law/2011/07/08/texas-executes-leal-despite-white-house-objections/>.
[258] *Leal*, *supra* note 256 at 2.
[259] *Marbury v. Madison*, 5 U.S. 137 (1803): "It is emphatically the province and duty of the Judicial Department to say what the law is." (i.e., what the law is, not what it should be), at 177.
[260] *Leal*, *supra* note 256 at 2.

decide when, if ever, to utilize its powers.[261] Neither a foreign entity, nor the president himself can do any more than pressure the Congress to act, though generally this is unnecessary, and in the case of an eventual ratification of the GPS-Galileo Agreement, the Congress would likely move willingly and without undue delay to pass implementing legislation. The provisions of the Agreement, suggestive of improving commercial relations between the U.S. and the E.U., would be incentive enough to pass the appropriate laws. Moreover, the United States ought to consider herself bound by, if not the Vienna Convention on the Law of Treaties itself, then at the very least by the principles it espouses—most of which, it is safe to claim, have already entered into customary international law.[262] Indeed, for no other reason than to avoid trammelling international good will—a key currency in global interaction—the U.S. would do well to consider ratifying and then supplementing, with appropriate implementing legislation, the Convention.[263]

5. *Executive Agreements*

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[261] Corwin, *supra* note 233 at 135.

[262] The United States Department of State has said that "the United States considers many of the provisions of the Vienna Convention on the Law of Treaties to constitute customary international law on the law of treaties.", "U.S. Dept. of State on the Vienna Convention", online: Dept. of State <http://www.state.gov/s/l/treaty/faqs/70139.htm>.

[263] Such a codification should not prove overly controversial. There is a strong tradition in the common law for rules of customary international law to become enshrined in official national law. *Cf.* William Blackstone, *Commentaries on the Laws of England*, Chapter the Fifth, of Offenses Against the Laws of Nations, vol. 4 (London: Cavendish Publishing Limited, 2001) at 53: "since in England no royal power can introduce a new law, or suspend the execution of the old, therefore the law of nations (wherever any question arises which is properly the object of its jurisdiction) is here adopted in its full extent by the common law, and is held to be a part of the law of the land. And those acts of parliament, which have from time to time been made to enforce this universal law, or to facilitate the execution of its decisions, are not to be considered as introductive of any new rule, but merely as declaratory of the old fundamental constitutions of the kingdom; without which it must cease to be a part of the civilized world." Substitute 'Congress' for 'Parliament', and you have an analogous situation in the modern United States as in Blackstone's England of centuries ago. The ratification process of the Senate, undertaken to enforce 'from time to time' the laws promulgated by treaties (including customary international laws), serves a similar function to the passage of the 'law of nations' by the parliament.

Many of the international agreements entered into by the United States do not possess the quality of being a treaty ratified by the Senate; yet, they still have legal force, and are a crucial aspect of U.S. foreign policy. These kinds of agreements are typically known by the moniker 'executive agreement', and come in at least two kinds: those that Congress authorizes the president to make on behalf of the United States, and those he may enter into by virtue of his powers as commander-in-chief.[264] Of the latter, the State Department's Foreign Affairs Manual notes the constitutional authority of the president extends from "the President's authority as Chief Executive to represent the nation in foreign affairs".[265] This vague description would seemingly allow the president to do quite a bit more than the Congress would perhaps prefer, though this is as much a political question as a constitutional one. However, some case law does support the president's ability to utilize executive agreements, noting that they too, like treaties, are to be treated as law of the land.[266]

One such example of Congressionally authorized executive agreements concerns trade relations with foreign States, where the president has been granted the authority to "enter into foreign trade agreements with foreign governments or instrumentalities thereof… to proclaim such modifications of existing duties and other import restrictions… as are required or appropriate to carry out any foreign trade agreement that the President has entered into hereunder".[267] The trade provisions of the GPS-Galileo

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[264] Corwin, *supra* note 233 at 135; *see also* the United States Department of State, Foreign Affairs Manual [hereinafter FAM] 721.2(2-3), online: Dept. of State <http://www.state.gov/g/oes/rls/rpts/175/1319.htm>.
[265] FAM 721.2(3)(a).
[266] *See, e.g.*, *United States v. Belmont*, 301 U.S. 324 (1937), and *United States v. Pink*, 315 U.S. 203 (1942); this in spite of logic, which might dictate that if a treaty cannot be said to affect the U.S. legal realm without it being either self-executing or being accompanied by implementing legislation, then all the more doubt is cast on the effect of EA's on the U.S. Thus, if the Agreement is an EA, a jurisprudential quagmire could await those would tread so perilously on such reliance.
[267] 19 U.S.C. 1351(a)(1)(A-B).

Agreement arguably would fall under this authority. Other such agreements include such momentous decisions as the annexation of Texas and Hawaii, as well as acquiring Samoa for the U.S.[268]

Insofar as executive agreements under the authority of the president as commander-in-chief, "many types of executive agreements comprise the ordinary daily grist of the diplomatic mill…[but they] become of constitutional significance when they constitute a determinative factor of future foreign policy and hence of the country's destiny."[269] Such agreements, affecting the destiny of the United States, have included agreements with Mexico over rights to pursue Indian raiders across the common border, as well as interactions with Spain over hostilities between the two States, and even procuring troops for, and then accepting the Protocol concerning the Boxer Rebellion in China.[270] The power of the president to undertake these agreements is surely necessary in foreign relations with other States; however, Congress may, from time to time, find disconcerting the power the president assumes unto himself without its approval. Corwin notes that "it would be more accordant with American ideas of government by law to require, before a purely executive agreement be applied in the field of private rights, that it be supplemented by a sanctioning act of Congress."[271] This notion, while amenable to ideas of proper democratic authority, might also take some of the force away from the ability of the commander-in-chief to accomplish goals on behalf of the United States—be this a good or bad potentiality.

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[268] W. McClure, *International Executive Agreements* (1941) at 62-67.
[269] Constitution Analysis, *supra* note 232 at 522.
[270] *Ibid.* at 523-24.
[271] Corwin, *supra* note 233 at 138.

Finally, some evidence suggests that the GPS-Galileo Agreement is an Executive Agreement, at least insofar as the U.S. is concerned. The aforementioned U.S. Trade Report notes that once the Member States of the EU had finished ratifying the Agreement, an exchange of notes would be made to bring "this executive agreement into force".[272] Coupled with the absence of the Agreement from the definitive list of U.S. Treaties in Force, prepared by the Treaty Affairs Staff at the U.S. Department of State, the GPS-Galileo Agreement is, by its omission, not considered a treaty by the U.S.[273] Moreover, the Department of State noted that they see the Agreement as a multilateral agreement that *is not* meant to set precedent for future agreements.[274] Presumably, if the Agreement is considered an executive agreement under U.S. law, it would be an instance of the president engaging in his responsibilities representing the United States in foreign affairs matters, per the Foreign Affairs Manual. Furthermore, if the Agreement is an executive agreement, and not a treaty, the Vienna Convention would be of little help in analyzing ambiguous language, unless its provisions are, as suggested earlier, customary international law by which the Parties could equally dissect meanings.

6. *MOUS*

A final kind of international agreement is the so-called memorandum of understanding. These agreements constitute efforts by States to engage in foreign relations, but with greater expediency and informality than with the treaty mechanism. Its strength rests with its ability to solidify bilateral and sometimes multilateral efforts at

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[272] USTR Report, *supra* note 139 at 3.
[273] State Department, U.S. Treaties in Force, 2011, online: Dept. of State <http://www.state.gov/documents/organization/169274.pdf>. *See also* "Treaties in Force", online: Dept. of State <http://www.state.gov/s/l/treaty/tif/index.htm>.
[274] *See* Exchange of Letters between Heinz Hilbrecht and Ralph Braibanti (in particular, May 10, 2004), online: Dept. of State <http://www.state.gov/documents/organization/82787.pdf>.

anything from trade to border disputes, but its weakness is that it possesses less power, and therefore international enforceability, than a treaty. "Because there is no intention that MOUs should create obligations in international law, it is also a mistake to think it is a treaty in simplified form."[275] Complicating matters is the fact that one cannot always tell an MOU by its name, as "sometimes one will find a treaty called a Memorandum of Understanding."[276]

7. *Clash of Agreements?*

The importance of discerning how the United States views the GPS-Galileo Agreement, i.e., what kind of agreement, exactly, it is, is that the possibility is raised that the E.U. may potentially see the Agreement as a treaty (or at least interpreted and enforced much as a more formal agreement might be), where the U.S. may consider it to be of lesser force. In this situation, two Parties may begin discussion of obligations with different mechanisms and levels of commitment depending on the status of the Agreement in the respective Party positions. In turn, this could lead to further confusion about how each party is to act, and it may leave achieving many of the obligations to the political winds (e.g., whether the U.S. Congress is willing to go along with what the executive has 'committed' the country to doing, or whether the funds will be appropriable from the E.U. dispensaries). Indeed, Aust is aware of at least two occasions when a disagreement as to the status of an instrument led to confusion and discord.[277] In the United States, "since less weight is given to terminology, it is more difficult to predict whether a particular instrument will be regarded by the United States as a treaty or an

[275] Aust, *supra* note 210 at 17.
[276] *Ibid.* at 25. Indeed, for multiple examples of this oddity, reference State Department, U.S. Treaties in Force, 2011, *supra* note 273.
[277] Aust, *supra* note 210 at 37.

MOU."[278] The possibility arises that the U.S. would see the Agreement as something of an MOU, all the while calling itself something else entirely—after all, MOUs do sometimes constitute 'multilateral agreements'.[279]

Should the Parties to the Agreement wish not only to clarify their obligations under ambiguous terminology and provisions therein, but also to determine the level of their commitment to one another and to the instrument itself, they would do well to arrange to agree on the kind of agreement with which they are dealing before proceeding further down the path to GPS-Galileo compatibility. In the end, this would potentially save international headache, as well as the billions invested in the future of the industry that could be endangered by the uncertain status of obligations between the Parties.

Chapter Three: GNSS Liability

Foremost among the issues surrounding the use of GNSS is the problem of liability. From the perspective of traditional conceptions of liability, global navigation satellite systems present a space-aged challenge worthy of attention. While there is not an overabundance of material on liability regarding space law, Christol reminds us that "international law, generally, as well as the COPUOS-negotiated international agreements, applies to claims for damages resulting from space activities."[280] Though this thesis is not intended to serve as an in-depth exposition of liability law[281], it would be an oversight not to include a survey of the most current law, as well as its evolution. Accordingly, this final chapter attempts to expound on liability law, beginning with the international treaty regime, followed by domestic and regional laws of the United States

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[278] *Ibid.* at 40.
[279] *See, e.g.* Exchange of Letters, *supra* note 274.
[280] Carl Q. Christol, *The Modern International Law of Outer Space* (New York: Pergamon Press, 1982) at 88.
[281] For a fuller description of GNSS liability issues, *see* Rodriguez-Contreras Perez, *supra* note 8.

and European Union, continuing with the liability issues created by virtue of the GPS-Galileo Agreement, and concluding with suggestions for future law.

A. *The International Treaty Regime*

1. *The Outer Space Treaty*

In providing the first definitive guidance on space law, the Outer Space Treaty of 1967 briefly addressed liability in its Article VII. That article states that:

> Each Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies.

The OST thereby established the conception of liability for space-based incidents, be they those that occur on the planet itself, or beyond. The nations of the world thereby accepted that Earth-bound notions of liability would have to follow humanity into space. Unfortunately, the conspicuous absence of specific liability provisions, including what exactly constitutes a 'launching state', as well as what kind of liability would apply, and to what extent, cast the usefulness of this provision into some doubt.

2. *The Liability Convention*

Sensitive of the weaknesses of liability in space matters, States Party to the Liability Convention of 1972 recognized the need for further action to supplement the OST's

good-intentions.[282] To that end, the Liability Convention[283] undertook to resolve the existing lacuna and remove lingering uncertainty. Of particular interest include:

- Article I, which defines damage as "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of intergovernmental organization", and launching States as being those States who launch or procure the launching of a space object, as well as those States from whose territory or facilities space objects are launched.
- Article II, which notes "a launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight", establishes a strict regime for compensation on Earth, leaving no room for contributory or comparative negligence.[284]
- Article III, establishing a negligence standard for incidents in space itself: "in the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible."
- Article IV, In the event that one Party's space object causes damage in space (or on a celestial body) to another State Party, thereby causing damage to yet a

[282] Liability Convention, Preamble, "Recognizing the need to elaborate effective international rules and procedures concerning liability for damage caused by space objects and to ensure, in particular, the prompt payment under the terms of this Convention of a full and equitable measure of compensation to victims of such damage…."
[283] *Convention on the International Liability for Damage Caused by Space Objects*, 29 March 1972, 24 U.S.T., TIAS 7762, 961 U.N.T.S. 187.
[284] *But see* Liability Convention, at art. VI.

> third Party, then the first two Parties "shall be jointly and severally liable to the third State". The Article goes on to describe the extent to which each Party would be liable, noting that damage caused on earth to a third Party would make the first two Parties absolutely liable, whereas damage caused elsewhere would be apportioned according to the negligence theory articulated in Article III. The joint and several liability of this Article was influenced by a similar provision in the Rome Convention of 1952[285] for damage caused to third parties on the surface due to aircraft.[286]

3. *The Rescue and Return Agreement*

The Rescue and Return Agreement discusses the ramifications of discovering space objects or their component parts in their jurisdictions (or on the high seas), noting that they shall do what they can practically do, with the help of the launching State if necessary, to return or hold the objects of the other State upon the latter's request. If the object or component parts are thought to be a hazard to the State in which they landed, the launching State is required to help take steps, under the direction of the Party in whose territory the object landed, to eliminate the harm. Finally, "expenses incurred in fulfilling obligations to recover and return a space object or its component parts…shall be borne by the launching authority". Thus, the R&R Agreement establishes liability of a kind for the launching State whose materials land in another State's jurisdictional areas, especially in instances in which the materials are deemed to be hazardous.

4. *The GPS-Galileo Agreement and Liability*

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[285] *Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface*, 7 Oct. 1952, ICAO Doc. 7634 [hereinafter Rome Convention].
[286] I.H.Ph. Diederiks-Verschoor, *An Introduction to Space Law*, 2d (The Hague: Kluwer Law International, 1999) at 40.

Finally, the GPS-Galileo Agreement's Article 19 governs State responsibility and liability for the purposes of that instrument. Art. 19's first clause notes that States will have responsibility for breaches of obligations under the Agreement, whereas the second clause governs instances in which it may be unclear whether an obligation is under the ambit of the EC or its Members States, requiring those entities to clarify questions about obligations proffered by the United States. Failure to provide this information upon request of the United States, or provision of contradictory information, results in joint and several liability between the EC and the Member States.

5. *Liability Applied*

To illustrate the above provisions, consider the example of a German State aircraft[287] carrying diplomats travelling from Berlin to Rome. En route, the aircraft is hit with debris from a defunct Canadian weather satellite that had begun re-entry into the atmosphere earlier in the day. After being hit by the debris, the aircraft is forced to make an emergency landing, whereupon the crew discovers that four passengers have been physically injured by the turbulence that resulted when the aircraft was hit, and one additional passenger appears to have suffered post-traumatic stress from what he believed was impending death. The aircraft itself was damaged to the tune of 3 million Euro. A cursory application of the above treaty law would indicate that Germany would have recourse to the outer space treaty regime to compensate the damaged parties. Indeed, the OST's Article VII places international liability on Canada, while the Liability Convention provides specific guidance as to how to proceed, in addition to clarifying the concept of damage—thereby simplifying the task of compensation.

[287] For the purposes of simplification, a State aircraft not operating on the carriage of persons for reward, has been chosen to avoid the clutches of the Chicago Convention of 1944, as well as the Warsaw regime and the Montreal Convention of 1999.

As to the damage to the aircraft, Germany would request compensation under Art. II of the Liability Convention, noting that the damage caused to its plane was due to components of a space object harming the aircraft while it was in flight, thereby resulting in absolute liability. Canada would not have a defense to this compensation, unless it could exonerate itself under Article VI of the Liability Convention, and even then they could claim this only "to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents". Thus, Canada would need to show Germany intentionally flew its aircraft into the falling debris, either to cause damage to its own aircraft, or perhaps in spite of dire and repeated warnings on the part of the launching State that the debris would be falling in the particular area of the aircraft's trajectory at the time of the accident.

Barring such an exoneration, the four physically injured passengers would be entitled to compensation as damaged persons (Art. I), and also under the absolute schema of Art. II. Whether the passenger who suffered mental 'damages' is entitled to recover is somewhat less obvious, although Art. I does include, within the definition of damage, "or other impairment to health", and this could very well include mental health.[288]

Insofar as Art. 19 of the GPS-Galileo Agreement is concerned, one might imagine a situation in which an aircraft operated by the United States is flying over some

[288] *Compare* case law in the United States that has precluded recovery for mental anguish or other mental health issues in aviation accidents, at least when these health problems lack a physical element; *Burnett v. Trans World Airlines*, 368 F. Supp. 1152 (D.N.Mex. 1973); *Rosman v. Trans World Airlines*, 314 N.E.2nd 848 (N.Y. 1974); *Eastern Airlines v. Floyd*, 499 U.S. 530, 111 S.Ct. 1489 (1991). *See generally* Paul S. Dempsey and Michael Milde, *International Air Carrier Liability: The Montreal Convention of 1999* (Montreal: McGill University Centre for Research in Air & Space Law, 2005) at chp. 7.

treacherous terrain in Northern Europe, depending on the provision of the joint GPS-Galileo signal input in its avionics. Assuming, *ad arguendo*, that the signal coming from the Galileo constellation had been 'unduly degraded' somehow, and assuming this loss of data caused the aircraft to veer off course and collide into rough terrain, the United States would naturally request information about how this accident occurred. In so doing, a determination would need to be made as to which entity was responsible for the degradation or loss of signal—either the E.U., or one of its Member States. Failure to provide this information, or providing contradictory information would, as noted above, create a joint and several liability situation in Europe between the E.U. and the Member States.

While possible real-world liability situations would possibly be far more complex than the above example, the simplicity of the fiction should help evidence demonstrable application of international liability according to the space law treaty regime. With further clarification of the meaning behind certain provisions in the GPS-Galileo Agreement, that instrument could serve to refine the current regime and reify questions heretofore left to the abstractions of scholars. Without such an attempt, even the longstanding Outer Space Treaty regime may prove insufficient to ameliorate difficulties that could arise between the U.S. and E.U. when one or the other claims a breach of a poorly understood clause. The Parties should, therefor, endeavor to hasten discourse on the above mentioned ambiguous phraseology, not only for the prevention of damage to trade, commerce, safety of life, or efficient air transit, but also to avoid potentially devastating international liability.

6. *State Responsibility*

Before delving into the world of domestic law, a brief foray into conceptions of State responsibility is warranted. This is due, in part, to the fact that responsibility is often the first step in the legal chain that leads to liability. After all, if a State were not responsible for its acts, it could never truly be held liable for instances in which those acts violated international law. The discourse on what constitutes State responsibility, and how it establishes relationships between States, was eventually written into the International Law Commission's Draft Articles on the Responsibility of States for Internationally Wrongful Acts.[289] The Draft Articles were commended to the States of the world by the United Nations General Assembly in Resolution 56/83 of 12 December 2001[290], and "commended them to the attention of Governments without prejudice to the question of their future adoption."[291]

Article 1 of the Draft Articles establishes that "Every internationally wrongful act of a State entails the international responsibility of that State."[292] Article 2 further defines such acts as those that can be attributed to the State under international law, and that constitute a breach of an obligation. Thus, when a State is a Party to an international agreement, and especially a treaty, that State is internationally responsible for fulfilling its obligations, and if it breaches those obligations (e.g., with the GPS-Galileo

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[289] ILA, *Draft Articles on the Responsibility of States for Internationally Wrongful Acts* [hereinafter Draft Articles], online: UN Treaties <http://untreaty.un.org/ilc/texts/instruments/english/draft%20articles/9_6_2001.pdf>.

[290] UN Resolution 56/83 of 12 December 2001; The United Nations again commended the Articles to the States with UN Resolution 59/35 of 2 December 2004.

[291] ILA, "State Responsibility", online: UN Treaties <http://untreaty.un.org/ilc/summaries/9_6.htm>.

[292] Commentary on the Draft Articles indicates that Article 1 represents a strongly held conviction in international law. Indeed, "The principle that any conduct of a State which international law characterizes as a wrongful act entails the responsibility of that State in international law is one of the principles most strongly upheld by State
practice and judicial decisions and most deeply rooted in the doctrine of international law." *Draft Articles on State Responsibility with Commentaries Thereto, Adopted by the International Law Commission on First Reading*, (1997), Part One, Origin of International Responsibility, Chapter 1, General Principles, Commentary, Article 1(1), p. 1, online: UN Treaties <http://untreaty.un.org/ilc/texts/instruments/english/commentaries/9_6_1996.pdf>.

Agreement, 'unduly disrupting or degrading signals'), then it has committed an internationally wrongful act—something each State would do well to avoid. There is a long tradition of States being held to account for internationally wrongful acts, and the International Court of Justice is often the arbiter of such cases and controversies.[293]

This conception of international responsibility is echoed by the Outer Space Treaty's Article VI, which establishes that each State is internationally responsible for national activities in outer space, no matter if these activities are carried out by the government or non-governmental entities.[294] These space-based activities require the State Party to continue to authorize and supervise the actors in space. This Article, in conjunction with the rest of the space law treaty regime, establishes that the well-honed principle of international responsibility for wrongful acts is not restricted to terrestrial applications.

It is also important to remember that liability and responsibility are close cousins, but they are certainly not exactly the same thing. Traditionally, liability carries with it a sense of damage, and responsibility a notion of ownership—not of property, but rather of an almost ethical ownership acknowledging that a State has a duty to do one thing or another. Some authors have suggested that many academics have overlooked the difference between the two concepts, and that even the International Law Commission

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[293] *See generally* Case of the *S.S. Wimbledon,* P.C.I.J., Series A, No. 1 . p . 15.; *Case concerning the factory at Chorzdw* (Jurisdiction), Judgment No. 8 of 26 July 1927, P.C.I.J., Series A, No.9, p. 21 and *idem.* (Merits), Judgment No. 13 of 13 September 1927, P.C.I.J., Series A, No. 17, p. 29; *Phosphates in Morocco* case (Preliminary Objections) 14 June 1938, P.C.I.J., Series A/B, No. 74, p. 28; and *Corfu Channel* case (Merits), Judgment of 9 April 1949, *I.CJ. Reports, 1949,* p. 23.

[294] For an example of recent academic discourse on the nature of Article VI, *see generally* the 3rd Eilene M. Galloway Symposium on Critical Issues in Space Law *Article VI of the Outer Space Treaty: Issues and Implementation* Cosmos Club, Washington D.C. December 11, 2008 [hereinafter Galloway Symposium], online: Space Law at Ole Miss <http://www.spacelaw.olemiss.edu/events/notable/galloway.html>.

has erred in creating a misconception about the terms.[295] Still, the terms share some meaning: "international liability is closely related to damage…damage however, although not an indispensable criterion for responsibility, is far from unimportant in that concept, and it is here that more confusion arises due to the resulting partial overlap with liability."[296] A further confusion can result when one considers the traditional role of international responsibility as a creature of States, whereas the Outer Space Treaty allowed, in Art. VI, for the actions of non-State actors to be imputed unto those States.[297]

Whatever its complexities, it is obvious that "all rights of an international character involve international responsibility", an observation that harkens back to the ILC's definition of responsibility as being intimately related to breaches of obligations. In this way, an obligation of one State may be said to be the right of another—the crux of which entitles one State with a reasonable *expectation* that the obligation shall be upheld. Proceeding on this assumption, the State which is wronged by another's breach in obligation often suffers damages, and this, in turn, leads that State to claim reparation under whatsoever liability mechanisms are available. In instruments where the language may be unclear, the corresponding obligations may be encumbered with the same cloudy understanding of what obligations exist in the first place. Such is the trouble with the GPS-Galileo Agreement, and another reason why its provisions should be thoroughly sussed out before either Party comes to rely too heavily thereon.

B. U.S. Domestic Law

1. *Background Law*

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[295] Frans G. von der Dunk, "Liability versus Responsibility in Space Law: Misconception or Misconstruction?", Proceedings of the Thirty-Fourth Colloquium on the Law of Outer Space 363 (1991).
[296] *Ibid.* at 364.
[297] Ram Jakhu, "Implementation of Article VI of Outer Space Treaty in North America", PowerPoint Presentation, Galloway Symposium, 2008.

Since most global navigation satellite services are provided by the U.S. Global Positioning Service, any liability stemming from the use of GNSS enhanced equipment is likely to attach itself to the provider of that service, i.e., the United States government. Especially in the arena of aviation, there is a strong tradition of injured passengers, or the families of passengers killed in aircraft accidents, being compensated for their damages. The private air law regime set up by the Warsaw Convention and its progeny, and the replacement treaty (for those States which have switched) of the Montreal Convention of 1999, have been addressing liability in this particular mode of transport for many decades. Transportation via satellite guidance, however, is comparatively quite new. As such, there is more uncertainty regarding the liability to be associated with GNSS. If the situation could be remedied with a readily available policy on GPS liability, passengers could rest more easily in the upcoming age of GNSS-guided take-offs, flight, and landings.

One primary difference between the current air traffic controlled aviation and GPS-guided aviation is that in the former system, the input of information to pilots and their craft is actively transmitted by other human actors, whereas GPS-guidance is a passive system that avoids direct involvement of the human element.[298] This factor may be applicable in any future court cases, for how can the provider of GPS be liable for aviation accidents if it is not actively controlling the path of the aircraft—the pilot is completing this task.

Either way, should a GPS-related accident occur, the logical party to sue would be the United States government. The U.S., however, believes that as a provider of a free

[298] Larsen, in Jakhu, *supra* note 52 at chp. 20, p. 463.

service, civilians do not have a valid reason for suit when the service proves faulty[299], and that in any event current mechanisms (read: Warsaw and M99 in the various States' court systems) are more than sufficient to handle any new instances resulting from the increased use of PNT services in air navigation.[300] From a common law perspective, one might argue that there has not been a contract formed between the users and provider of GPS—the one party provides a service to the other in the absence of any consideration for a contract. As such, there is no contractual ground on which the user may sue the provider; whether an argument from equity may proceed is another matter altogether. Additionally, it is doubtful whether such a contractual analysis would apply to civil law jurisdictions.

If a suit did proceed against the United States, it would have to do so under an exception to the well-established international rule of sovereign immunity. Indeed, if the "King can do no Wrong", then he must allow himself to be sued if he is to be brought to his own courts at all. The concept of sovereignty itself is somewhat fluid, although it has taken on a certain legal solidity over time. Originally, States were not even the wielders of sovereignty[301], though this has changed with time, as evidenced by Black's Law Dictionary, which defines sovereignty as "1. Supreme dominion, authority, or rule; 2. The Supreme political authority of an independent state; 3. The state itself."[302]

2. *The Federal Tort Claims Act*

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[299] Lyall, *supra* note 22 at 393.
[300] ICAO Doc. SSG-CSN/2-WP/6, 10.
[301] Jonathan F. Galloway, "Limits to Sovereignty: Antarctica Outer Space and the Sea Bed", in Proceedings, Forty-First Colloquium on the Law of Outer Space, 81 (IISL, 1998); for a fuller explanation about the evolution of sovereignty into the modern State-based doctrine, *see generally* Michael Dodge, "Sovereignty and the Delimitation of Airspace: A Philosophical and Historical Survey Supported by the Resources of the Andrew G. Haley Archive" (2009) 35:1 J. Space L. 5 at 5-35.
[302] *Black's Law Dictionary*, *8th ed*, *s.v.* sovereignty at 1430.

Thus, if one is to sue a sovereign State, it must do so under the curious instance of that State waiving its sovereign immunity. In the United States, such is the function facilitated by the Federal Tort Claims Act (FTCA).[303] The Congress provided that the government could be sued: "for injury or loss of property, or personal injury or death caused by the negligent or wrongful act or omission of any employee of the Government while acting within the scope of his office or employment, under circumstances where the United States, if a private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred."[304] This process could is excepted when the government is acting under its discretionary authority[305]—an ill-defined term, to be sure.

In *Dalehite v. United States*[306], the Supreme Court began to identify instances in which the government was performing a discretionary act and, consequently, was not liable under the FTCA. In *Dalehite*, the government had established a program by which ammonium nitrate fertilizer had been stored in an effort to increase food production for areas under military occupation after World War II; unfortunately, this led to a disastrous explosion which resulted in a death.[307] In discussing the FTCA, the Court divined that the exception to liability included not only the establishment of programs, but also the decisions made by administrators "in establishing plans, specifications, or schedules of operations…it necessarily follows that acts of subordinates in carrying out the operations of government in accordance with official directions cannot be actionable. If it were not

[303] 28 U.S.C. § 1346.
[304] *Ibid.* at (b)(1).
[305] 28 U.S.C. § 2680(a).
[306] *Dalehite v. United States*, 346 U.S. 15 (1953).
[307] *Ibid.* at Syllabus.

so, the protection of § 2680(a) would fail at the time it would be needed -- that is, when a subordinate performs or fails to perform a causal step."[308]

In *United States v. Union Trust*, the Court cited an instance in which the government was able to be sued. In this case, an air traffic controller cleared two different planes for landing at the same time and on the same runway, and that this is clearly an operational act—not a discretionary one.[309] Thus, with no defenses against it, the U.S. government was able to be sued under the provisions of the FTCA. Since GNSS so ably lends itself to the future of air traffic management, the question immediately presents itself: does reliance on GNSS allow aircraft owners and victims of airline crashes to claim compensation under the FTCA? Furthermore, when these aircraft begin relying on the combined might of GPS and Galileo, per the Agreement, which Party would be eligible for suit, if either? While decent interrogatories, the fact remains that a useful combination of the two constellations is still years to come, and up until then all is speculation rebuffed by the U.S. government claims that GPS is provided for free, and that it washes its hands of resultant liability. Furthermore, Larsen is skeptical that the current GPS system and its relationship to ATM is sufficiently analogous to current management systems to warrant treatment under the FTCA similar to that of *Union Trust*-like situations.[310] The truth may have to wait for an edifying, if altogether undesirable, disaster to occur in an aircraft depending on proper GPS guidance to land, take-off, or fly.

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[308] *Dalehite*, *supra* note 306 at 36.
[309] *United States v. Union Trust*, 350 U.S. 907 (1955), *cited in* Lyall, *supra* note 22 at 464; for more information on the government's negligence and the concept of compensation, *see* "The Federal Employees' Compensation Act: Effect of Government's Negligence on Reimbursement", *Duke Law Journal* Vol. 1961, No. 1 (Winter, 1961), at 160-166, online: JSTOR <http://www.jstor.org/stable/1370993>.
[310] Larsen, *supra* note 52 at 464.

Adding to the limitations of the FTCA, in incidents outside the jurisdictional scope of the United States' territory, victims of a GPS-based accident could not hope to sue even if that GPS service were considered an operational activity.[311] Thus, plaintiffs may be forced to find alternative means of compensation. One such arena would be to sue the manufacturer of the satellite, especially if it can be shown the fault which led to the incident was due to a flaw in the satellite, or in its design. As these manufacturers are not government entities in the United States, they cannot—technically—shield themselves with sovereign immunity. They may be able to claim a measure of protection in certain instances, particularly when the manufacturer is simply complying with specifications provided by the government.

In *Boyle v. United Technologies*, the Supreme Court noted that "We agree [that]… liability for design defects in military equipment cannot be imposed, pursuant to state law, when (1) the United States approved reasonably precise specifications; (2) the equipment conformed to those specifications; and (3) the supplier warned the United States about the dangers in the use of the equipment that were known to the supplier but not to the United States."[312] Whether this exemption from the FTCA is specifically restricted to military equipment is, with respect to the U.S. military asset GPS, irrelevant.

Finally, the United States has repeatedly stated that it will continue to provide SPS GPS free of direct user charges to anyone or any State in the world, but what would happen if it changed its mind, and shut down its satellite access for foreign States and their citizens? Does the US policy of providing GPS free to all for so long mean a

[311] 28 U.S. 2680(k). An exception to the FTCA occurs when the accident occurs as "any claim arising in a foreign country."; *See Smith v. United States*, 507 U.S. 197 (1993), in which a claim arising in Antarctica was barred.
[312] *Boyle v. United Technologies*, 487 U.S. 500, 512 (1988).

customary rule in international law has been created? So many depend on the service, that to take it away now would cause substantial harm to global markets--not to mention the danger to US allies that need the system for military or counter-terrorism aspects. States know the US could turn it off it they liked, but would they ever? The practical ability to shut it off, and the customary prohibition from so doing may be two very different truths. If it could be argued that the U.S. has created a customary international law via expectation of continued provision of GPS, then failing to continue its provision would arguably constitute an internationally wrongful act that results in the United States being taken to task under general principles of international law governing the resultant liability.

3. *E.U. Law*

Liability in the European Union is governed by several instruments, but it is unclear to what extent the E.U. would be liable in the event of accidents involving reliance on the Galileo constellation, or with incidents involving the joint GPS-Galileo efforts. While the European Space Agency has made clear the importance of Galileo to the future of Europe, it is protected from almost all forms of liability.[313] Annex I of the Convention provides an exceptions to this exception in instances where the Council waves immunity, or where "reliance upon it would impede the course of justice and it can be waived without prejudicing the interests of the Agency".[314] The ESA may also be liable in instances where their activities that rely on Galileo are explicitly for commercial

[313] *Convention for the Establishment of a European Space Agency*, Art. XV(2) notes "The Agency, its staff members and experts, and the representatives of its Member States, shall enjoy the legal capacity, privileges and
immunities provided for in Annex I.", online: European Space Agency <http://esamultimedia.esa.int/docs/SP1271En_final.pdf>.
[314] *Ibid.*, Annex I, Art. IV(1)(a).

purposes[315], and, given their insistence on how much commerce and revenue Galileo is predicted to bring to Europe, this may be more often than with which the Agency would be comfortable.

The Treaty of Amsterdam's Article 288 notes that "the Community shall, in accordance with the general principles common to the laws of the Member States, make good any damage caused by its institutions or by its servants in the performance of their duties."[316] Since the EU is party to the GPS-Galileo Agreement, they may find this article forces compensation for accidents involving Galileo or any GPS-Galileo cooperation, although this remains to be litigated.

Finally, as one of the primary functions of Galileo is to improve aviation travel, Eurocontrol is, of necessity, implicated in potential problems with the GPS-Galileo Agreement. The Eurocontrol Convention provides that liability for that agency is governed by the law of the concerned contract, and that in instances of non-contractual liability, "the Organisation shall make reparation for damage caused by the negligence of its organs, or of its servants in the scope of their employment, in so far as that damage can be attributed to them."[317]

4. *Future Law*

With the future of liability tentative and illusory, one wonders if another path could be crafted to head off potential problems before they are created. Along these lines,

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[315] *See* Jaugey, *supra* note 74 at 66.

[316] *Treaty of Amsterdam Amending the Treaty on European Union, The Treaties Establishing the European Communities and Related Acts*, Art. 288 (ex. Art. 215), online: Eur-lex <http://eur-lex.europa.eu/en/treaties/dat/11997D/htm/11997D.html>.

[317] *Protocol consolidating the Eurocontrol International Convention relating to Co-operation for the Safety of Air Navigation of 13 December 1960, as variously amended, Consolidated Version Which Incorporates the Texts Remaining in Force of the Existing Convention and the Amendments Made by the Diplomatic Congress of 27 June 1997, Consolidated Text of the Enacting Terms of the Convention*, Art. 28, online: PCA-CPA <http://www.pca-cpa.org/upload/files/03%20Eurocontrol.PDF>.; for a fuller accounting of European liability law and GNSS, *see* Rodriguez-Contreras Perez, *supra* note 8.

future research should ask if there is there a jurisprudential duty, international or domestic, for the major GNSS providers to change their restrictive and protectionist stances on liability for system failures. Would voluntarily adopting such an international duty place undue restraints on the proper powers of State sovereignty? Could the U.S. president and Congress alter domestic legal policy and demonstrate a new commitment to multi-nationalism in keeping with the European Union's belief, after the election of President Obama, in an unprecedented era of international cooperation?[318] Certainly, while his priority is his own State, the President could go far in alleviating uncertainties in the future of GNSS by committing the United States to talks, for example, concerning a new agreement between the U.S. and Europe that would comprehensively remedy questions about liability, compatibility between systems, new air traffic management systems, and ambiguous language in the currently operating GPS-Galileo Agreement.

Some argue that any new agreement on GNSS liability is unnecessary.[319] After all, such an agreement is not needed for the continued provision of GNSS[320], though it could nevertheless be desirable. While a new agreement might go far in cementing understanding of various States' obligations towards one another (and increase confidence in future ATM systems)[321], it could also create new problems, and it any

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[318] Bruno Waterfield, "European Union: Barack Obama 'will bring new era of international co-operation'" *The Telegraph* (5 Nov. 2008), online: Telegraph Online <http://www.telegraph.co.uk/news/worldnews/barackobama/3385456/European-Union-Barack-Obama-will-bring-new-era-of-international-co-operation.html>.

[319] Jaugey, *supra* note 74 at 76.

[320] *See* Francis P. Schubert, "An International Convention on GNSS Liability: When Does Desirable Become Necessary?" (1999) XXIV Annals of Air and Space Law 1; *see also* memorandum from Francis P. Schubert on Global Navigation Satellite Systems (2004); and ICAO, *Report on the Establishment of a Legal Framework with Regard to CNS/ATM System Including GNSS*, ICAO Doc. A35-WP/75 (2004).

[321] Hon. K.O. Rattray, QC, "Legal and Institutional Challenges for GNSS, the Need for Fundamental Obligatory Norms" (paper presented to the World-wide CNS/ATM Conference in Rio de Janeiro, May 1998); *see also* Air Safety Week, "National Interests Collide at Global Navigation and Airspace Management Conference", (8 June 1998), online: <http://findarticles.com/p/articles/mi_m0UBT/is_23_12/ai_50058817/>.

elimination in ambiguity regarding a State's obligations towards another could be seen as an imposition on sovereignty—something any State is loath to allow. Following this mentality, it seems provider States desire a future agreement on liability much less than developing States, possibly because the latter have much less to lose in such a convention.[322] Indeed, one notable suggestion for creating an international GNSS liability convention is that all claims could be brought to a single jurisdiction, rather than those of individual provider States or entities[323]—the United States would likely see such a move, forcing legal decisions regarding its own GNSS system out of the hands of its own courts, as an unacceptable imposition on its sovereignty.

This author would recommend that the current U.S. President, as well as current leaders in the European Union, such as the President of the European Commission, should set up mirroring commissions that examine the possibility of a future agreement, assessing both the positive and negative aspects of any such future instrument. If both sides determine the idea is worth discussing on an international scale, then they could begin the diplomatic dance that could create this future agreement. If States do nothing, they ought to hope their obligations appear clear enough when the time comes to implement them, and when disagreements start to arise.

Conclusion

Global Navigation Satellite Systems are a key technology in the modern age, and their use and integration into daily life continues to grow. Many millions of individual users exist, utilizing GPS or GLONASS to do everything from navigate automobiles, pilot sea vessels, synchronize laboratory experiments with highly accurate atomic clocks,

[322] Jaugey, *supra* note 74 at 76-77.
[323] ICAO, *Proposal by Certain Members of the Study Group Relating to Main Elements of an International Convention*, ICAO Doc. A35-WP/75 Appendix Attachment H (2004).

and find one's position on the surface of the Earth. Realizing its potential, perspicacious policy makers dreamt up a future in which GNSS could be used to improve aviation navigation, allowing greater efficiency in transit by decreasing the needed separation between aircraft, enabling swifter and more accurate takeoffs and landings, and correct directionality whilst in the air.

The 2004 GPS-Galileo Agreement, signed between the United States and the (then) European Community serves as an example of current GNSS law and policy, and demonstrates that both the United States and the European Union have an interest in making the future Galileo GNSS compatible with the GPS system, both in terms of general signal redundancy, and also in creating new safety-of-life applications that should increase response times in emergencies and natural disasters. The fact that several joint-statements and working group reports have been released ever since the signing the Agreement is encouraging, and suggestive that both Parties are interested in continuing their peaceful and productive cooperation towards creating a truly global navigation satellite system, the continued independence of each system notwithstanding. Several problems with language in the Agreement have been revealed, most especially language involving the promise that neither Party will unduly degrade or disrupt the PNT signals they provide—an obligation that leaves much to interpretation, and opens the possibility to confusion both in operations performed by policy makers, and in the end-users so heavily dependent on GNSS for their everyday needs, whether commercial, scientific, or recreational.

That many billions of dollars and euros, as well as continued international good-will, ride on amenable interpretation of this and other ambiguous language suggests that

States should endeavor to clarify their obligations towards one another under this Agreement. Whether this task will be fulfilled in a future agreement or treaty is unknown, but end-users, investors, and corporations alike, along with States across the globe, would be well-served if this problem could come to a quick, yet thorough, conclusion. The issue of liability may remain a sticking point for any such deal, and would especially be so for the GNSS providers; however, this should not negate their responsibility to ensure the safest and most consistent application of their technology to GNSS users.

This thesis intended to provide a survey of the current GNSS law and policy throughout the world, and in particular in the U.S. and E.U. The history of codification in the U.S., and the varied uses to which this technology (originally intended as a military asset) has spread were relayed to provide a basis for understanding the massive international commercial and navigational reliance on GNSS technology. Additionally, the example of the GPS-Galileo Agreement, it is hoped, served to demonstrate the intricacies of international legal relations, as well as the inherent difficulties in analyzing and interpreting the meaning of language. These problems notwithstanding, efforts by both Parties could clarify ambiguities before problems arise, and the author of this thesis is hopeful these discussions will be effectuated in the near future.

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Appendix

AGREEMENT ON THE PROMOTION, PROVISION AND USE OF GALILEO AND GPS SATELLITE-BASED NAVIGATION SYSTEMS AND RELATED APPLICATIONS

THE UNITED STATES OF AMERICA,

of the one part,

and

THE KINGDOM OF BELGIUM,

THE CZECH REPUBLIC,

THE KINGDOM OF DENMARK,

THE FEDERAL REPUBLIC OF GERMANY,

THE REPUBLIC OF ESTONIA,

THE HELLENIC REPUBLIC,

THE KINGDOM OF SPAIN,

THE FRENCH REPUBLIC,

IRELAND,

THE ITALIAN REPUBLIC,

THE REPUBLIC OF CYPRUS,

THE REPUBLIC OF LATVIA,

THE REPUBLIC OF LITHUANIA,

THE GRAND DUCHY OF LUXEMBOURG,

THE REPUBLIC OF HUNGARY,

THE REPUBLIC OF MALTA,

THE KINGDOM OF THE NETHERLANDS,

THE REPUBLIC OF AUSTRIA,

THE REPUBLIC OF POLAND,

THE PORTUGUESE REPUBLIC,

THE REPUBLIC OF SLOVENIA,

THE SLOVAK REPUBLIC,

THE REPUBLIC OF FINLAND,

THE KINGDOM OF SWEDEN,

THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND,

CONTRACTING PARTIES to the Treaty establishing THE EUROPEAN COMMUNITY,

hereinafter referred to as the "Member States", and THE EUROPEAN COMMUNITY, of the other part,

RECOGNISING that the United States operates a satellite-based navigation system known as the Global Positioning System, a dual use system that provides precision timing, navigation, and position location signals for civil and military purposes,

RECOGNISING that the United States is currently providing the GPS Standard Positioning Service for peaceful civil, commercial, and scientific use on a continuous, worldwide basis, free of direct user fees, and noting that the United States intends to continue providing it, and similar future civil services under the same conditions,

RECOGNISING that the European Community is developing and plans to operate a civil global satellite navigation, timing and positioning system, GALILEO, which would be

radio frequency compatible with GPS and interoperable with civil GPS services at the user level,

RECOGNISING that GPS signals are used worldwide for satellite-based navigation services including augmentations,

RECOGNISING that civil GPS and GALILEO, if radio frequency compatible and interoperable at the user level, could increase the number of satellites visible from any location on the Earth and aid accessibility to navigation signals for civil users worldwide,

RECOGNISING that the International Civil Aviation Organisation (ICAO) establishes international standards and recommended practices and other guidance applicable to the use of global satellite-based navigation systems for civil aviation, that the International Maritime Organisation (IMO) establishes international standards and other guidance applicable to the use of global satellite-based navigation systems for maritime navigation, and that the International Telecommunication Union (ITU) establishes multilateral regulations and procedures applicable to the operation of global radio-navigation systems, as well as to other radio communication systems,

DESIRING to provide satellite navigation users and equipment providers with a broader range of services and capabilities, leading to increased user applications, while assuring radio frequency compatibility with systems and equipment already in use,

DESIRING to promote open markets and to facilitate growth in trade with respect to commerce in global navigation and timing goods, value-added services, and augmentations,

CONVINCED of the need to prevent and protect against the misuse of global satellite-based navigation and timing services without unduly disrupting or degrading signals available for civilian uses,

CONVINCED of the need to cooperate so that the benefits of this important technology are fully achieved for all relevant applications,

RECOGNISING that consultations are desirable for the purpose of avoiding or resolving any disputes that may arise under this Agreement, including those relating to the way in which the Parties discharge their respective responsibilities for the obligations within their areas of competence,

HAVE AGREED AS FOLLOWS:

ARTICLE 1

Objectives

1. The objective of this Agreement is to provide a framework for cooperation between the Parties in the promotion, provision and use of civil GPS and GALILEO navigation and timing signals and services, value-added services, augmentations, and global navigation and timing goods. The Parties intend to work together, both bilaterally and in multilateral fora, as provided herein, to promote and facilitate the use of these signals, services, and equipment for peaceful civil, commercial, and scientific uses, consistent with and in furtherance of mutual security interests. This Agreement is intended to complement and facilitate agreements in force, or which may be negotiated in the future, between the Parties related to the design and implementation of civil satellite-based navigation and timing signals and services, augmentations, or value-added services.

2. Nothing in this Agreement shall supersede, modify or derogate from standards, procedures, rules, regulations and recommended practices adopted in ICAO, or IMO. The Parties confirm their intent to act in a manner consistent with these bodies' regulatory framework and processes.

3. Nothing in this Agreement shall affect the rights and obligations of the Parties under the Marrakech Agreement Establishing the World Trade Organisation (hereinafter "the WTO Agreements").

ARTICLE 2

Definitions

For the purposes of this Agreement, the following definitions shall apply:

(a) "Augmentation" means civil mechanisms, which provide the users of satellite-based navigation and timing signals with input information, extra to that derived from the main constellation(s) in use, and additional range/pseudo-range inputs or corrections to, or enhancements of, existing pseudo-range inputs. These mechanisms enable users to obtain enhanced performance, such as increased accuracy, availability, integrity, and reliability.

(b) "Civil satellite-based navigation and timing service" means the civil satellite-based navigation or timing service provided by GPS or GALILEO, including secured governmental service.

(c) "Civil satellite-based navigation and timing service provider" means any government or other entity that provides civil satellite-based navigation or timing service.

(d) "Civil satellite-based navigation and timing signals" means the civil satellite-based navigation or timing signals provided by GPS or GALILEO, including secured governmental service signals.

(e) "Civil satellite-based navigation and timing signals provider" means any government or other entity that supplies GPS and/or GALILEO signals or augmentations.

(f) "Classified information" means official information that requires protection in the interests of national defense or foreign relations of the Parties, and is classified in accordance with applicable laws and regulations.

(g) "GALILEO" means an autonomous civil European global satellite-based navigation and timing system under civil control, developed by the European Community, its Member States, the European Space Agency and other entities. GALILEO includes an open service and one or more other services, such as a safety of life, commercial, and a secured governmental service, such as the Public Regulated Service ("PRS"), and any augmentations provided by the European Community, its Member States or other entities.

(h) "Global navigation and timing equipment" means any civil end user equipment designed to transmit, receive, or process satellite-based navigation and timing signals, to provide value-added services, or to operate with an augmentation.

(i) "GNSS" means Global Navigation Satellite System.

(j) "GPS" means the Global Positioning System Standard Positioning Service, an open service, (or future civil services) provided by the United States Government for civil use. GPS is currently provided by the United States in its exercise of governmental authority as it is neither supplied on a commercial basis nor offered in competition with one or more service suppliers. GPS includes any augmentation or improvements to that service provided directly by the United States Government.

(k) "Intellectual property" shall have the meaning found in Article 2 of the Convention

Establishing the World Intellectual Property Organisation, done at Stockholm, 14 July 1967.

(l) "Interoperability at the user level" is a situation whereby a combined system receiver with a mix of multiple GPS or GALILEO satellites in view can achieve position, navigation and timing solutions at the user level that are equivalent to or better than the position, navigation or timing solutions that could be achieved by either system alone.

(m) "Measure" means any law, regulation, rule, procedure, decision, administrative action or similar binding action by the Parties at the national or supranational level.

(n) "Military satellite-based navigation and timing service" means a satellite-based navigation and timing service provided by a Party and specifically designed to meet the needs of defense forces.

(o) "Radio frequency compatibility" means the assurance that one system will not cause interference that unacceptably degrades the stand-alone service that the other system provides.

(p) "Secured governmental service" means a secured, restricted access satellite-based navigation and timing service provided by a Party and specifically designed to meet the needs of authorised governmental users.

(q) "Value-added service" means a downstream service or application, excluding augmentations, that uses civil satellite-based navigation and timing signals or services in a manner intended to provide additional utility or benefit to the user.

ARTICLE 3

Scope

Except as otherwise provided herein, this Agreement pertains to all measures established by the Parties concerning civil satellite-based navigation and timing signals and signal providers, civil satellite-based navigation and timing services and service providers, augmentations, value-added services and value-added service providers, and global navigation and timing goods. The provision of military satellite-based navigation and timing services is outside the scope of this Agreement, except as provided in Article 4 as far as radiofrequency compatibility is concerned, Article 11 and in the Annex to this Agreement.

Secured governmental services are outside the scope of Articles 5 and 6, Article 8 paragraph 2, and Article 10, paragraph 3.

ARTICLE 4

Interoperability and Radio Frequency Compatibility

1. This Article is applicable to GPS and GALILEO as defined and, as far as radiofrequency compatibility is concerned, to all satellite-based navigation and timing services.

2. The Parties agree that GPS and GALILEO shall be radio frequency compatible. This paragraph shall not apply locally to areas of military operations. The Parties shall not unduly disrupt or degrade signals available for civil use.

3. The Parties also agree that GPS and GALILEO shall be, to the greatest extent possible, interoperable at the non-military user level. In order to achieve this interoperability and facilitate the joint use of the two systems, the Parties agree to realise their geodetic coordinate reference frames as closely as possible to the International Terrestrial Reference System. The Parties also agree to transmit the time offsets between GALILEO

and GPS system times in the navigation messages of their respective services, as outlined in the document entitled "GPS/GALILEO Time Offset Preliminary Interface Definition" referred to in the Annex.

4. The Parties agree that the radio frequency compatibility and interoperability working group established pursuant to Article 13 shall continue work already underway with a view toward achieving, inter alia:

(a) radio frequency compatibility in the modernisation or evolution of either system; (The Parties need to assess further the radiofrequency compatibility of GALILEO and GPS III).

(b) enhanced signal availability and reliability through complementary system architectures for the benefit of users worldwide.

(c) interoperability at the non-military user level.

5. To further ensure radio frequency compatibility and non-military service interoperability, the Parties shall ensure that their augmentations meet the requirements of ICAO, IMO and the ITU to which such Parties are bound and such other requirements as the Parties may find mutually acceptable.

6. Nothing in this Agreement shall supersede, modify or derogate from standards, procedures, rules, regulations and recommended practices adopted in the ITU. The Parties confirm their intent to act in a manner consistent with this body's regulatory framework and processes.

ARTICLE 5

Standards, Certification, Regulatory Measures, and Mandates

The Parties agree to consult with each other before the establishment of any measures:

(1) establishing, directly or indirectly (such as through a regional organisation), design or performance standards, certification requirements, licensing requirements, technical regulations or similar requirements applicable to civil satellite-based navigation and timing signals or services, augmentations, value-added services, global navigation and timing equipment, civil satellite-based navigation and timing signals or service providers, or value-added service providers; or

(2) that have the effect, directly or indirectly, of mandating the use of any civil satellite-based navigation and timing signals or services, value-added service, augmentation, or global navigation and timing equipment within its respective territory (unless the mandating of such use is expressly authorised by ICAO, or IMO).

ARTICLE 6

Non-Discrimination and Trade

1. The Parties affirm their non-discriminatory approach with respect to trade in goods and services related to civil satellite-based navigation and timing signals, augmentations, and value-added services.

2. The Parties affirm that measures with respect to goods and services related to civil satellite-based navigation and timing signals or services, augmentations, and value-added services should not be used as a disguised restriction on or an unnecessary obstacle to international trade.

3. The trade and civil applications working group established pursuant to Article 13 shall consider, inter alia, non-discrimination and other trade related issues concerning civil satellite-based navigation and timing signals or services, augmentations, value-added

services, and global navigation and timing goods, including the potential for additional commitments in relevant bilateral or multilateral fora.

ARTICLE 7

Open Access to Civil Satellite-based Navigation or Timing Signals

1. Except for reasons of national security, the Parties shall not restrict either use of or access to the positioning, navigation and timing information of their respective open services by end users, including for augmentation. This provision does not preclude the ability to make access to such information by other entities, such as manufacturers of satellite based navigation and timing equipment, subject to non-discriminatory commercial arrangements.

2. The Parties shall endeavour to provide signals intended for safety of life services with the required level of safety as recognised by competent international bodies.

ARTICLE 8

Open Access to Information

1. Subject to applicable export controls, the Parties agree to make publicly available on a non-discriminatory basis, sufficient information concerning their respective unencrypted civil satellite-based navigation and timing signals and augmentations, to ensure equal opportunity for persons who seek to use these signals, manufacture equipment to use these signals, or provide value-added services which use these signals. Such information shall include, but not be limited to, signal specifications, including elements such as minimum usage conditions, radio frequency characteristics, and navigation message structure.

2. To the extent that a Party provides civil satellite-based navigation and timing signals or

services, augmentation, or value-added service for civil users that is encrypted or otherwise has features that allow the global navigation service provider to deny access, the Party shall, subject to applicable export controls, afford to the other Party's manufacturers of global navigation and timing equipment or augmentation or value-added services providers, on a non-discriminatory basis, access to the information necessary to incorporate such encryption or other similar features into their equipment, through licensing of necessary information or other means at market prices.

ARTICLE 9

Intellectual Property

Nothing in this Agreement is intended to affect intellectual property rights related to global satellite-based navigation and timing signals, services or goods.

ARTICLE 10

Cost Recovery for Civil Satellite-Based Navigation and Timing Signals

1. The Parties shall each endeavour to provide open service navigation and timing signals without direct fees for end use or for augmentation.

2. To the extent that a Party pursues a system that would be used for charging fees for international aviation or maritime safety of life users, it intends to do so in a manner consistent with ICAO and IMO.

3. The Parties shall consult each other where appropriate on cost recovery policies. The Parties shall encourage practicable steps to ensure transparency and accountability for fees incurred in providing their services.

ARTICLE 11

National Security Compatibility and Spectrum Use

1. The Parties shall work together to promote adequate frequency allocations for satellite-based navigation and timing signals, to ensure radio frequency compatibility in spectrum use between each other's signals, to make all practicable efforts to protect each other's signals from interference by the radio frequency emissions of other systems, and to promote harmonised use of spectrum on a global basis, notably at the ITU. The Parties shall cooperate with respect to identifying sources of interference and taking appropriate follow-on actions.

2. The Parties intend to prevent hostile use of satellite-based navigation and timing services while simultaneously preserving services outside areas of hostilities. To this end, their respective satellite based navigation and timing signals shall comply with the National Security Compatibility criteria set forth in the documents entitled "National Security Compatibility Compliance for GPS and GALILEO Signals in the 1559-1610 MHz Band, Part 1, Part 2 and Part 3" (hereinafter "Criteria, Assumption and Methodology Documents"), referenced in the attached Annex, using the methodology and assumptions contained in the Criteria, Assumption and Methodology Documents.

3. The Parties agree that the signal structures specified in the Annex to this Agreement comply with the National Security Compatibility criteria set forth in the Criteria, Assumption and Methodology Documents.

4. In order to maintain and continuously improve the quality and security of services, the systems will need to respond effectively to unforeseen changes in technology, user needs and the spectrum environment. The Parties intend to pursue modernisation and development of their respective systems while maintaining the security and market benefits of compatible and interoperable common civil signals.

5. The Parties shall inform and consult one another on the implementation of the baseline signal structures specified in the Annex. A Party shall notify the other Party in writing through diplomatic channels if it desires in the future to change or add to the baseline signal structures specified and agreed to in the Annex.

6. Unless a Party voices concerns on the basis of National Security Compatibility, as taken into account in the Criteria, Assumption and Methodology Documents, or on the basis of radio-frequency compatibility, within a time period of three months after its receipt of the notification mentioned in paragraph 5, that Party will not oppose the adoption and implementation of the alternative signal structure specified in the notification. If a Party voices National Security or radio-frequency compatibility concerns within that time period, the Parties shall without delay enter into consultations to verify that the alternative signal structures comply with the National Security Compatibility criteria set forth in the Criteria, Assumption and Methodology Documents and with radio-frequency compatibility, using the respective Assumptions and Methodology documents referred to in the Annex for compatibility analysis.

7. The Parties agree to use the common baseline modulation for the GALILEO Open Service and the future GPS III civil signal (Standard Positioning Service) as described in the Annex. The Parties shall work together without delay toward achieving optimisation of that modulation for their respective systems. If a Party changes or adds to its modulation for the GALILEO Open Service or the future GPS III civil signal, pursuant to the process set forth in paragraphs 5 and 6, the other Party shall not be obliged to change or add to its modulation.

8. The Parties agree to study the means to protect the secured governmental service in the

context of national security compatibility, under the working group on security issues established in Article 13, paragraph (2)(d).

ARTICLE 12

GPS and GALILEO Search & Rescue Services

A global search and rescue service is planned for both GALILEO and future generations of GPS satellites. The Parties agree that these services shall be radio frequency compatible and to the greatest extent possible, interoperable at the user level. The Parties will cooperate as appropriate on matters related to global search and rescue services for GALILEO and future generations of GPS satellites at the COSPAS-SARSAT Council or at any other mutually agreeable forum.

ARTICLE 13

Modalities

1. The Parties shall establish working groups for mutually agreed upon topics. Each working group will include participation, as appropriate, from the competent authorities of the Parties. Third party participation in working groups shall be only by mutual consent of the Parties.

2. The following working groups shall be established pursuant to paragraph 1.

(a) A working group on radio frequency compatibility and interoperability for civil satellite-based navigation and timing services.

(b) A working group on trade and civil applications.

(c) A working group to promote cooperation on the design and development of the next generation of civil satellite-based navigation and timing systems.

(d) A working group on security issues relating to GPS and GALILEO, including information exchange on possible applications for secured governmental services, and including interactions between their respective signals. The group shall also work towards defining the details of the notification and consultation procedure referred to in Article 11, as well as possible interfaces.

3. The Parties may establish terms of reference for working groups established pursuant to paragraph 1, as appropriate.

4. All exchanges of information, equipment, technology or other data (including that which is classified), as well as the delivery of services, pursuant to this Agreement shall be subject to all applicable laws and regulations, including export control laws and regulations. All such information, equipment, technology or other data transferred shall be used only for the purposes of this Agreement and shall not be transferred to, or used by, any third country, firm, person, organisation or government without the prior written approval of the originating party.

5. Subject to applicable laws, regulations, and official governmental policies, the Parties agree to handle as expeditiously as possible license applications for the export of goods, information, technology or other data appropriate for the development and implementation of GALILEO or GPS.

6. Classified information relating to the implementation of this Agreement may be exchanged at working groups or otherwise only in accordance with the conditions set forth in paragraph 2 of the Annex to this Agreement.

7. The Parties shall meet as needed, and in principle once a year, to assess the need for working groups, define or modify working group terms of reference, and review working group progress.

ARTICLE 14

Follow-up Activities

The Parties intend to commence discussions of a follow-on agreement regarding potential cooperation between their respective independently funded and operated civil satellite-based navigation and timing systems for the period following achievement by GALILEO of initial operational capability. In those discussions the Parties intend to explore various coordination options, such as creating a high-level interface council that would meet once or twice a year to discuss policy issues and future system planning, a small GPS-GALILEO secretariat to share interface data and provide day-to-day coordination, and liaison officers as mutually agreed.

ARTICLE 15

Activities in International Fora

To promote and implement the objectives of this Agreement, the Parties shall, as appropriate, cooperate on matters of mutual interest related to civil satellite-based navigation and timing signals and systems, value-added services, and global navigation and timing goods in ICAO, ITU, IMO, WTO and other relevant organisations and fora.

ARTICLE 16

Funding

Each Party shall bear the costs of fulfilling its respective responsibilities under this Agreement.

Obligations of each Party pursuant to this Agreement are subject to the availability of appropriated funds.

ARTICLE 17

Consultation and Dispute Resolution

1. Any dispute arising under or related to the terms, interpretation or application of this Agreement shall be resolved by consultation.

2. Representatives of the Council of the European Union and the European Commission, of the one part, and of the United States, of the other part, shall meet as needed for the consultations foreseen in paragraph 1 and in Article 5, Article 10 paragraph 3, and Article 11 paragraphs 5 and 6.

3. Nothing in this Agreement shall affect the Parties' right to recourse to dispute settlement under WTO Agreements.

ARTICLE 18

Definition of the Parties

For the purpose of this Agreement, "the Parties" shall mean the European Community or its Member States or the European Community and its Member States, within their respective areas of competence, on the one hand, and the United States, on the other.

ARTICLE 19

Responsibility and Liability

1. The Parties shall have responsibility for failure to comply with obligations under this Agreement.

2. If it is unclear whether an obligation under this Agreement is within the competence of either the European Community or its Member States, at the request of the United States,

the European Community and its Member States shall provide the necessary information. Failure to provide this information with all due expediency or the provision of contradictory information shall result in joint and several liability.

ARTICLE 20

Entry into Force and Termination

1. This Agreement shall enter into force on the date on which the European Community and its Member States and the United States inform the Depository through diplomatic notes that their respective internal procedures necessary for its entry into force have been completed.

2. This Agreement shall be subject to accession by States that become Members of the European Union after the date it is signed by the Parties.

3. Notwithstanding paragraph 1, the Parties agree to provisionally apply this Agreement from the first day of the month following the date on which the Parties have notified each other of the completion of the procedures necessary for this purpose.

4. The European Community shall serve as the Depository for this Agreement.

5. This Agreement shall remain in force for ten years. At least three months before the end of the initial 10-year period, the Parties shall inform each other of their intention whether to extend the Agreement for a period of five years. Thereafter, it shall be extended automatically for additional five-year periods, unless the European Community and its Member States, on the one hand, or the United States, on the other, gives notice to the Depository in writing at least three months prior to the end of any subsequent five-year period, of its intention not to extend the Agreement.

6. This Agreement may only be amended by agreement of the Parties. Any amendment to this Agreement shall be subject to approval by the Parties in accordance with their respective internal procedures.

7. The Parties shall review the implementation of this Agreement in 2008 and, may consider at that time to amend it in accordance with the procedure in paragraph 6.

8. This Agreement may be terminated at any time upon one year's written notice.

Done at Dromoland Castle, Co. Clare, on the twenty-sixth day of June 2004, in duplicate in the Danish, Dutch, English, Finnish, French, German, Greek, Italian, Portuguese, Spanish, Swedish, Czech, Estonian, Hungarian, Latvian, Lithuanian, Maltese, Polish, Slovakian and Slovenian languages. English shall be the authentic language.

ANNEX

GPS AND GALILEO SIGNAL STRUCTURES

(1) For reasons of National Security Compatibility, avoidance of unacceptable radio-frequency interference, and suitability of GNSS performance, the Parties agree to the baseline signal structures described below:

• The GALILEO secured governmental service in the 1559-1610 MHz band using a Binary Offset Carrier (BOC) cosine phased modulation with a 15.345 MHz sub-carrier frequency and a code rate of 2.5575 mega-chips per second (Mcps) centred at 1575.42 MHz (cosine phased BOC (15, 2.5)), and a signal power as specified in the document, referred to below, entitled "Reference Assumptions for GPS/GALILEO Compatibility Analyses."

• The GALILEO signal structures used for any or all other services, including the Open Service (OS), Safety-of-Life service (SoL), and Commercial Service (CS), in the

1559-1610 MHz band using a Binary Offset Carrier (BOC) modulation with a 1.023 MHz sub-carrier frequency and a code rate of 1.023 mega-chips per second (Mcps) (BOC (1,1)) centred at 1575.42 MHz, and a signal power as specified in the document, referred to below, entitled "Reference Assumptions for GPS/GALILEO Compatibility Analyses."

• The GPS signal structure in the 1559-1610 MHz band, centred at 1575.42 MHz, will be a Binary Phase Shift Key (BPSK) modulation with a code rate of 1.023 Mcps; a BPSK modulation with a code rate of 10.23 Mcps; and a BOC modulation with a 10.23 MHz sub-carrier frequency and a code rate of 5.115 Mcps, and a signal power as specified in the document, referred to below, entitled "Reference Assumptions for GPS/GALILEO Compatibility Analyses." In the future, a BOC (1, 1) modulation centred at 1575.42 MHz will be added to this signal structure.

(2) The classified assumptions and methodology used to determine the National Security Compatibility criteria, and the criteria themselves, are contained in the following documents:

National Security Compatibility Compliance for GPS and GALILEO Signals in the 1559-1610 MHz Band, Part 1, Part 2 and Part 3, (hereinafter, "Part 1," "Part 2," and "Part 3," respectively) dated 9 June 2004, including any future amendments, changes or modifications to these documents as mutually agreed in accordance with paragraph 6.a. of this Annex.

Access to Part 1, Part 2 and Part 3 shall be only by the United States and those Member States that are a party to a General Security of Military Information Agreement (hereinafter "GSOMIA") or a General Security of Information Agreement (hereinafter

"GSOIA") with the United States, which shall apply to the access, maintenance, use and release of these classified documents. Should an applicable agreement regarding security of information between the European Community and the United States be concluded in the future, it shall govern the access, maintenance, use and release of Part 1, Part 2 and Part 3. For the time being, representatives of the European Commission and staff members of the GALILEO Joint Undertaking and European Space Agency shall be granted oral and visual access to Part 2 for the purposes of implementation of and compliance with this Agreement, on the basis of an established security clearance with a Member State that has a GSOMIA or GSOIA with the United States, in accordance with the national security procedures and laws of the Member State, and with the GSOMIA or GSOIA with the United States.

Representatives of the European Commission and staff members of the GALILEO Joint Undertaking and European Space Agency shall be granted access to Part 1 and Part 3 in accordance with applicable security rules. The classified information shall at all times be protected and handled only in facilities with an appropriate facility security clearance in accordance with the applicable security procedures, laws and the GSOMIA or GSOIA.

(3) Assumptions for radio frequency signal compatibility analyses are contained in the following document: "Reference Assumptions for GPS/GALILEO Compatibility Analyses", 9 June 2004 including any future amendments, changes or modifications to this document as mutually agreed by the Parties.

(4) Methodology for radio frequency compatibility analysis is contained in the following

document: "Models and Methodology for GPS/GALILEO Radio Frequency Compatibility Analyses", dated 18 June 2004, including any future amendments, changes or modifications to this document as mutually agreed by the Parties.

(5) The provision of the time offsets between GALILEO and GPS system time in the navigation messages of their respective services is outlined in the following document: "GPS/GALILEO Time Offset Preliminary Interface Definition" dated 20 March 2003, including any future amendments, changes or modifications to this document as mutually agreed by the Parties.

(6) (a) Notwithstanding Article 20, paragraph 6, any future amendments, changes or modifications to the documents entitled "National Security Compatibility Compliance for GPS and GALILEO Signals in the 1559-1610 MHz Band, Part 1, Part 2 and Part 3" shall be decided by mutual agreement by a sub-group of the working group established under Article 13, paragraph 2 (d), composed of representatives of the United States on the one hand, and representatives of the European Commission, acting on behalf of the European Community, who have access to these classified documents in accordance with paragraph 2 of this Annex, and representatives of those Member States who have access to these classified documents in accordance with paragraph 2 of this Annex, on the other hand. These decisions shall be binding on the Parties.

(b) Notwithstanding Article 20, paragraph 6, any future amendments, changes or modification to the following documents shall be adopted by mutual agreement between appropriate representatives of the Parties in the working group established under Article 13, paragraph 2(a), including the United States: "Reference Assumptions for GPS/GALILEO Compatibility Analyses"; "Models and Methodology for

GPS/GALILEO Radio Frequency Compatibility Analyses"; "GPS/GALILEO Time Offset Preliminary Interface Definition." These decisions shall be binding on the Parties.