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CURRENT LEGAL ISSUES RELATING TO GNSS

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ABSTRACT

Although GNSS has been active since 1970, there are still many legal issues surrounding its operation and applications that are unresolved. GNSS is engrained in the daily lives of millions of people, often without their knowledge. Its applications are numerous, spanning both military and civilian uses, from navigation of missiles and vehicles to recreation and safety. The economic market potential of GNSS is expected to reach $40 billion in the foreseeable future. These factors make the control of GNSS an important issue between countries. National and international policy making bodies should consider and understand the status of global GNSS systems – GPS, GLONASS, and Galileo – when making policy regarding GNSS.† Other legal issues, such as liability, control of GNSS, militarization of space, and coexistence of the several systems, surround GNSS and its potential applications. The international community must find solutions to these issues to ensure a seamless operation of GNSS for the common interest of mankind.

INTRODUCTION

Tomahawk cruise missiles, fired from hundreds of miles away, and guided by GPS, drop into a target with pinpoint accuracy. Hikers search for hidden caches in a popular recreational activity, geocaching, using GPS locators.[1] Drivers navigate through cities with GPS receivers in their cars.

These are only a fraction of the current worldwide uses of the Global Navigation Satellite System (GNSS). While GNSS has been active since 1970, with a decrease in the cost and size of receivers and an increase in accuracy, the use of GNSS has exploded. The yearly market for GNSS related services is expected to reach $40 billion in the foreseeable future.[2] The United States plans to begin phase down of several other radionavigation systems in 2010, increasing dependence on GNSS.[3] At the 2000 World Radiocommunication Conference, the International Telecommunication Union (ITU) allotted additional frequencies to GPS and GLONASS for upgrades to the systems, as well as providing spectrum to the proposed European system, Galileo.[4] The potential of GNSS has only begun to be tapped.

GNSS has become engrained in the daily lives of millions of people, whether they know it or not. The integrity of GNSS needs to be protected and maintained to ensure the safety of those dependent on the system. This paper will outline some of the outstanding questions and concerns that still face the GNSS industry. Section I will discuss the current status of the worldwide GNSS systems – GPS, GLONASS, and Galileo. Section II will explain some legal issues surrounding GNSS, such as liability, control of GNSS, militarization of space, and coexistence of the several systems. While many of these legal issues have surrounded GNSS from its conception, a continuing dialogue is necessary as GNSS applications affect more people and more nations.

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† In this paper, GNSS will refer to the global navigation satellite system in general, while GPS will refer to the U.S. system specifically.

I. BACKGROUND: THE CURRENT STATUS OF WORLDWIDE GNSS SYSTEMS

Currently, the U.S. GPS is the only system that is fully operational. The Russian GLOSNASS system does not have the full number of operational satellites in orbit necessary to provide full worldwide service to users, and the Europeans are still developing their Galileo system.

A. United States – Global Positioning System (GPS)

In 1995, the United States GPS system achieved full operational capability.[5] The $12 billion[6] GPS constellation currently consists of 29 Block II satellites[7] that are in orbit 12,500 miles above the earth and situated in six 55-degree orbit planes.[8] GPS is managed jointly by the Department of Defense (DOD) and Department of Transportation (DOT) through the Interagency GPS Executive Board (IGEB).[9] Because the DOD is heavily involved in the management of GPS, the funding necessary to maintain the system is more easily obtained in military appropriations from Congress than if GPS only had civilian uses.

In the early days of GPS, the United States purposely degraded civilian GPS signals to 100-meter accuracy, while maintaining a much higher accuracy for the US military.[10] However, numerous reports in the 1990s argued that this restriction should be lifted.[11] On May 1, 2000, President Clinton lifted the restriction on GPS signals, allowing civilian users to gain accuracy within 20 meters of their actual position.[12] The move was part of a 1996 presidential directive to spur civil, commercial and scientific use of the GPS worldwide.[13] Interestingly, this change also allowed NASA to access to the improved signals, an access it did not previously have, and enabled spacecraft to navigate by GPS rather than by bouncing radar signals off earth-based tracking systems.[14] The U.S. is constantly upgrading the GPS constellation to improve signal strength and accuracy as well.

Around July 2004, the Air Force will begin launches for a series of eight new "modernized" satellites (GPS-2RM) that will feature additional military and civilian signals, as well as increased power for the military signal. When power is increased for the military, the civilian signal power will probably also increase, meaning less interference from natural or manmade sources. At least two more series of satellites are planned, the GPS-2F and the GPS-3. The launch of the upgraded GPS-3 system is currently scheduled to begin launching in 2012, but possibly as early as 2010.[15]

B. Russia – Global Navigation Satellite System (GLONASS)

The Russian GLONASS was developed in the 1980s and was fully deployed by 1996[16] under the control of the Russian military.[17] Currently the system is operating in a partial mode, with less than the operational quota of 21 satellites deployed.[18] The Russians did launch several satellites in late 2002 to gradually begin an upgrade of service.[19] Europe considers GLONASS to be more of an augmentation to GPS, rather than a stand-alone system, especially considering the economic situation of the country.[20] It does not appear that GLONASS will be a viable competitor or back up system to GPS in the foreseeable future.

C. European Union – Galileo

The European Union (EU) and European Space Agency (ESA) are now developing their own GNSS system, known as Galileo. Galileo is designed to be a stand-alone system that is also fully compatible with both GPS and GLONASS.[21] Specific plans for the service include: increased coverage over all of Europe, revenue generation through charging for high accuracy and/or data transmission over the navigation signal, Safety and Rescue uses, such as weather alerts or distress acknowledgments, and temporary map changes such as accident reports or tourist information.[22] However, the biggest unprecedented promise Galileo makes is to

deliver real-time positioning accuracy down to the meter range to the civilian sector by using dual frequencies.[23] Galileo also will guarantee availability of the service under all but the most extreme circumstances and will inform users within seconds of a failure of any satellite, making the system more suitable for when safety is crucial, such as landing aircraft.[24]

The first experimental satellite is scheduled for launch in late 2004, with the full constellation of thirty satellites (twenty-seven operational plus three active spares) operational by 2008.[25] ESA estimates that it will have 1.8 million users of Galileo by 2010, doubling to 3.6 million users by 2020.[26] The total investment cost for the Galileo system is estimated to be 3.2 billion Euros, with an annual cost of 220 million Euros, including operations, maintenance and replenishment.[27]

Europe does not attempt to hide the fact that Galileo is an issue of European independence – it is developing Galileo because the military operators of GPS and GLONASS will not make any guarantees that they will maintain an uninterrupted service of GNSS.[28] Therefore, Galileo is planned as a civilian service, and will not be run by the military. ESA claims Galileo will be "guaranteed to operate at all times, bar the direst emergency."[29]

Europe gives several other reasons for Galileo as well.[30] After the constellation is in place, the number of GNSS satellites will more than double, allowing for more accurate readings globally, even in high-rise cities. Better coverage will be achieved at higher latitudes, such as in northern Europe, because the satellites will be at a greater inclination to the equatorial plane than GPS. Lastly, the increased civilian accuracy will allow for more commercial applications of GNSS. European manufacturers would like to get an increased share of the $40 billion GNSS market by developing equipment for these new applications.

Galileo may face several hurdles before it gets off the ground. For instance, in December of 2001, the transport ministers of the European countries involved with Galileo refused to endorse the project; some European officials voiced the opinion that this was due to the military applications of the proposed Public Restricted Service, an encrypted communications functionality for use by European security authorities.[31] As discussed in Section II.A. *infra*, there may be liability concerns if a fee is charged for Galileo's signal, and some experts question whether anyone will pay for GNSS access when GPS is free.

D. Augmentation

GNSS satellite signals are not currently accurate enough on their own to provide the precise location that some applications need. Additional ground-based stations or satellites provide a secondary signal to establish an additional reference point, which provides greater accuracy and integrity to the GNSS signal.[32] The U.S. Coast Guard maintains the Maritime Differential GPS (MDGPS) to provide coastal coverage around the United States and other navigable waters.[33] The Federal Aviation Administration (FAA) is developing two systems, the Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS), to aid air navigation as well as landing and maneuvering. The FAA has recently commissioned WAAS for instrument flight use, allowing pilots to navigate as low as 350 feet above the runway end using satellite navigation.[34] The MDGPS is also being expanded to provide coverage to all surface areas of the United States, forming the Nationwide Differential GPS (NDGPS) for surface users, providing an accuracy of 10 meters or better in all areas.[35]

Europe is developing an augmentation system known as the European Geostationary Navigation Overlay System (EGNOS).[36] This system uses additional satellites in geostationary orbit to provide supplemental signals and correction data, rather than ground-based stations like DGPS. Japan has coordinated its Multifunctional Transport Satellite-based augmentation system (MSAS) to operate with the U.S. WAAS, mainly for navigation purposes. More countries are sure to soon follow with their own augmentation

systems as GNSS becomes cheaper, more common, and more powerful.

II. LEGAL ISSUES

A. Liability

Several possibilities for assigning liability for GNSS failure exist: The Convention on International Liability for Damage Caused by Space Objects, a new liability treaty, or existing national laws. The Convention on International Liability for Damage Caused by Space Objects provides that the launching state of a registered space object should be absolutely liable for damages caused by that object on the surface of the earth or to aircraft flight.[37] There is some suggestion that this should be extended to damages caused by the failure of GNSS, although causation, the fact that damage would be indirect, and the doubt that a GNSS signal is a "space object" under the Liability Convention, makes the Convention unlikely to cover GNSS liability.[38] For instance, GNSS failure could cause ships to wreck or run aground or cause an aircraft to crash on landing, but this damage was not created directly by a satellite hitting the ship; determining which system the GNSS signal actually came from would also be problematic.

With many navigation systems now dependent on GNSS, it is scary to imagine what could happen if GNSS was suddenly and globally knocked out. Understandably, the United States would not sign on to any convention that accepted liability for such a catastrophe. The United States argues that the cost of maintaining the GPS system, while at the same time providing it free of charge to the world, alleviates any liability responsibility.[39] As long as the United States refuses to join any liability convention, it will be a useless endeavor.

The U.S. is aware of potential weaknesses in the GPS system. A 2001 report for the DOT included the following recommendations: identify and develop appropriate low-cost back-up systems, implement systems to monitor, report, and locate unintentional interference, create awareness among GPS users about the vulnerability of GPS, and continue development of higher broadcast power and more civilian frequencies.[40] Liability aside, these are all common sense measures that the DOT and DOD are pursuing in most cases to ensure a stable GPS system for all users.

An interesting question arises with the possibility of Galileo charging user fees in order to pay for the GNSS signal. Without military funding behind it like what GPS receives, Galileo might be forced to charge the transportation industries a fee to maintain the highly accurate signals that are necessary for the industry.[41] If the service fails, liability might be more readily imposed than if the service was free. It is possible that insurance coverage could be included in the package if a subscription cost or annual fee is charged.[42] The U.S. Air Force conducted studies on the feasibility of user costs on GPS services and determined that a tax/trust fund method could be used to collect fees on DGPS.[43] The United States has decided not to pursue any revenue generation from GPS, partially because the military funding it receives has not made it a necessity and partially to avoid potential liability.

Liability arising under the provision of augmented GNSS signals is a serious concern. Generally, international governmental organizations that provide GNSS, such as EGNOS, would be immune, unless they submit to international or national liability laws.[44] Governmental organizations in the United States, such as the U.S. Coast Guard, are subject to the Federal Tort Claims Act (FTCA). Under the FTCA, federal agencies can be held liable for negligent acts except for discretionary acts. Air traffic control is not a discretionary act under case law, so it follows that the FAA or Coast Guard could be liable for any act that is "legally analogous to traffic control of airplanes and ships."[45] Private organizations that provide augmentation would be liable for negligence under the applicable Torts law.

Michael Jennison argues that liability should be kept separate from any international GNSS scheme for several reasons.[46] First, in most states surveyed, victims could recover

for injury, death, and damages resulting from a negligent failure of a navaid under national laws, like under the FTCA. However, the FTCA does not cover claims arising in a foreign country or claims arising out of combatant activities of the military or naval forces, or Coast Guard, during time of war.[47] This substantially limits the type of liability claim arising from GPS failure that could be brought against the United States, and the United States is unlikely to expand the waiver of sovereign immunity for GPS. Second, Jennison says fact-finding liability systems can handle complex relationships and factual situations. But if the claims cannot even make it statutorily to the U.S. court system under the FTCA, this will be a moot point; there will be no way to recover or to enforce damages.

Third, Jennison argues linking liability reform with GNSS will weaken the prospects for both because the United States would be unlikely to sign on to such a convention, and the agreement would limit liability to one navaid. The United States would not sign onto such an agreement, unless it was an express waiver of liability, and such an agreement could cause the United States to limit service to the rest of the world. Fourth, Jennison says GNSS will be cheaper and safer than the current reliable systems, and it is rare for the negligent failure of a navaid to be the primary cause of an accident. Lastly, ICAO has previously spent years trying to develop a liability scheme for air traffic control, but removed the item from the agenda due to lack of interest. Therefore, there is not likely to be any change in the current liability scheme soon; users of GNSS seem to bear the risk of liability by using the system free of charge.

B. Control of the GNSS system

With GPS as the only fully operational GNSS system in use, many States are concerned about the control of GPS and that it could be shut down without notice. Concerns include who will control standards and quality. Despite the recent U.S. military conflicts and the availability of the free GPS signal to anyone with a receiver, U.S. officials have said there are no plans to restrict access to the civilian signal – a move that would require a presidential directive.[48] However, this assurance is not guaranteed or enforceable under international law.[49] Also, GNSS is vulnerable to interference from both intentional and unintentional sources, natural and manmade.[50] Simple, low cost jammers can disrupt the GNSS signal over large areas.[51] This rightfully has many users concerned.

The U.S. military is seeking money to provide higher power signals to the military, and therefore likely improve civilian signals as well.[52] The boosted signal "would make it easier for receivers to find other, low-power satellites, even in an environment full of electronic noise thrown up to drown out the GPS signal."[53] This would allow the U.S. military to jam an adversary's over-the-counter GNSS equipment on a battlefield, but still use its own. The Air Force has scheduled these power boosts to begin with the GPS-2F satellites that will be launched beginning in 2005, and continuing GPS-3 system in 2011.[54] DOD vehicles also carry secondary, non-GPS navigation system in case of GPS failure.[55] Civilians may benefit from increased GNSS power signals from upgraded satellites, but may not have access to secondary systems or cutting edge anti-jamming technology that would give greater assurances of seamless navigation.

As such, many people are skeptical about leaving GNSS in the hands of one country or one person – Europe cites this concern as one of its main reasons for building Galileo. Francis Lyall advocates an international public operational entity to ensure the public interest in GNSS is met.[56] Lyall would like to see an independent international organization charged with the operation of an international GNSS, possibly modeling itself after the pre-privatized Intelsat. Such an organization would not likely be joined by the United States, who would be reluctant to give up their military control, and it could lead to liability or anti-trust suits.

Langhorne Bond, former FAA Administrator, suggests that a multi-lateral treaty is the answer to the control problems.[57] Such a treaty would allow GNSS-provider

states to maintain sovereignty over their systems, while stating the conditions under which they provide the signal to other nations. Bond believes a treaty should require the civilian signal to be provided continuously to all with the following exceptions: specific causes for signal withdraw or alteration, including terrorism and military causes at a minimum, and possibly economic sanctions. Turning off a signal as part of economic sanctions may create other problems, because the signals cannot be turned off along national boundaries, but rather over a region, potentially affecting other states as well. Bond argues that user charges should be decided outside of the treaty, no GNSS providers should assume liability for loss of signal, and the treaty should use ICAO SARPS to ensure interoperability. Bond believes the GNSS-providers will have the bargaining power to achieve the terms they want in the treaty and thus be held responsible under international law to the terms of the treaty.

However, the only real difference between the current scheme and the treaty proposed by Bond is that the United States would have to lay out all the possible scenarios in which it might turn off the signal and give notice of service disruption. Currently, the United States may turn off the GPS signal for any reason without notice, although it has promised ICAO that it will continue the signal.[58] It is unlikely that the U.S. would be willing to create such certain terms, especially in the interest of national security. Also, if liability is still assumed by the user, what is the penalty if service is disrupted outside of the terms of the treaty? The GNSS provider holds all the cards and may threaten to discontinue service altogether if penalized.

While Bond's argument for a multi-lateral treaty might not be feasible, his suggestion for ensuring interoperability in general is a good idea.[59] The bigger question is what international institutions, if any, should become the caretaker of GNSS. Several organizations, such as the International Civil Aviation Organization (ICAO) or the International Maritime Organization (IMO), are possibilities.

Of all the international groups, ICAO has been widely suggested because of its mandate under the 1944 Chicago Convention to create international Standards and Recommended Practices (SARPS) for aircraft navigation.[60] Article 37 of the Convention gives ICAO the authority to adopt SARPS for "air navigation aids,"Article 28 provides that each contracting state will provide facilities in accordance with the SARPS, and Article 44 charges ICAO to develop "the principles and techniques of international air navigation and to foster the planning and development of international air transport." These Articles appear to give ICAO the legal authority it needs to regulate air navigation by GNSS, and indeed, the United States has pledged to fully cooperate with ICAO in establishing those SARPS.[61]

In 1991, ICAO developed plans for a new navigation regime called Communications, Navigation, Surveillance/Air Traffic Management (CNT/ATM) that depends heavily on GPS and GLONASS.[62] ICAO created a panel of Legal and Technical Experts (LTEP) in 1995 in an attempt to create consensus on GNSS issues. The panel created a Charter of Rights and Obligations of States Relating to GNSS Services that was adopted by the ICAO Assembly in 1998 as a nonbinding charter. The Charter makes several pronouncements such as safety shall be the paramount principle, aircraft of all states shall have nondiscriminatory access to GNSS services, states retain responsibility and authority for air traffic control in their airspace, states providing GNSS services shall ensure their "continuity, availability, integrity, accuracy, and reliability," and will comply with ICAO standards.[63] These pronouncements are mostly policy restatements or implied by the Chicago Convention and existing policy guidance, suggesting that GNSS is simply another navaid for legal purposes.[64] Although ICAO has the authority to create SARPS for air navigation, it is unlikely that ICAO will gain regulatory control of the entire spectrum of GNSS applications.

C. Dual-Use: Militarization of Space?

GPS was developed by the DOD as the Defense Navigation Satellite System.[65] The satellites are designed with all the common military survivability measures, such as protection against electro-magnetic pulse effects of a nuclear blast.[66] Even with the current civilian uses overtaking the military uses, the DOD maintains responsibility for management and operations of the ground control and space-borne segments of the system.[67] If the military is so involved in the use and control of GPS, how can GPS be a "peaceful purpose" as aspired to under the Outer Space Treaty?[68]

Many satellites can have a military aspect, as well as a scientific or civilian purpose – weather, direct broadcasting, communication, remote sensing, etc.[69] The military uses GPS in personal, vehicle, marine and air navigation and for missile and bomb guidance. The U.S. military can locally jam or disrupt an enemy's GPS signal to yield a tactical advantage.[70] GPS satellites carry a secondary payload that can detect nuclear detonations (and therefore testing) anywhere on the earth's surface in near real time.[71] The background of GPS and many of its uses would seem to make it a military use in outer space, and not peaceful.

Several arguments exist to justify GNSS as a peaceful purpose. First, GNSS now has more civilian and peaceful uses than military uses, and the system is available for international use. Second, the specific language of the Outer Space Treaty does not appear to ban national security uses or defensive uses of space because it expressly forbids some activities in Article 4.

The theme of the peaceful use of outer space was established by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and was inserted in the preamble of the Outer Space Treaty in 1967. It was subsequently affirmed in later space treaties and UN resolutions relating to space, as well as in U.S. law.[72] The Outer Space Treaty first recognizes that the use of outer space for peaceful purposes is in the common interest of all mankind, and then continues that it is desirable "to contribute to broad international cooperation in the . . . use of outer space for peaceful purposes."[73]

Yasuaki Hashimoto suggested that a test for legality of an outer space use might be a triangle with common interest at the top and international cooperation and peaceful use at the bottom corners.[74] Using this test, it might seem clear that GPS is a legal use. GPS is free for all people in the world with a receiver. It is used for numerous peaceful applications and many are international in use, such as ship and aviation navigation.

However, on the other side of the puzzle, GPS is maintained exclusively by the United States, and is not a product of international cooperation. In fact, Europe is creating its Galileo system partially because of concerns that the United States has full control over GPS and could turn it off without notice.[75]

Another argument is that the peaceful applications are secondary to the military applications for which GPS was developed. The United States' position is that the Outer Space Treaty explicitly prohibits nuclear weapons or weapons of mass destruction in orbit, as well as military bases, installations, and fortifications, the testing of weapons, and military maneuvers on any celestial body.[76] By limiting Article IV to celestial bodies, the United States argues that the States did not desire to create a broad prohibition on military uses in outer space and that "peaceful" means "non-aggressive" rather than "non-military."[77]

This definition of "peaceful" is in conflict with other existing interpretations found in international law – the Antarctic Treaty defines "peaceful" as "non-military," and specific references to military installations are regarded as exemplificative rather than exhaustive in nature.[78] But the United States' interpretation is probably not in bad faith, and it is therefore a permissible interpretation under international law.[79] Even so, some authors still argue that allowing any military action in space is a wrongful literal interpretation of the treaty, rather than the proper interpretation in light of the objectives and purposes of the treaty.[80]

The Outer Space Treaty does allow for the use of space in the interest of maintaining international peace and security.[81] Harry Almond argues that Article III of the Outer Space Treaty is in fact a reservation by the States of their full rights to pursue measures for self-defense in outer space.[82] If a State believes outer space is a strategic and appropriate arena in which to deter or prevent aggression or other conduct contrary to a State's fundamental goals or policy, the State will use outer space to that means. Thus, the fact that outer space is a useful arena to the United States' military may mean that more beneficial commercial uses are created there are well, as demonstrated by the dual use satellite systems currently in place.

It does not appear that the dual use quality of GPS will change anytime soon in the United States, even after the introduction of Galileo. Domestic policy ensures funding for GPS maintenance, upgrade, and operation because of the military purposes. The United States has placed the DOT in control of civilian uses of GPS in order to make sure the military applications do not overrun civilian uses. GPS is probably too engrained in peaceful, civilian applications to be turned off any time soon, with the possible exception of a major military escalation.

D. Coexistence of the three systems (GPS, GLONASS, Galileo)

Because GPS is currently the only fully operational system, equipment design and standardization is fairly simple. However, the upcoming Galileo system and the potential for other future systems mean coexistence and interoperability could become a major issue for GNSS. To ensure the safety and usability of GNSS, all the systems should use the same language, receiving equipment should allow for seamless transition from system to system, access should be nondiscriminatory, true redundancy should be built into the system, and enough radio frequencies must be allotted to allow all the systems to operate.

The United States has recommended that GPS and augmentation standards be the standards for international use.[83] Japan has developed its augmentation system based on U.S. standards.[84] Because the U.S. is essentially the only GNSS provider in the world today, and all current equipment is based on that system, it makes sense for new systems to standardize to the GPS system.

Currently, a user can use GPS and GLONASS seamlessly.[85] It is anticipated that Galileo will be interoperable with GPS and GLONASS as well.[86] The European Commission states that one objective of cooperation with the United States is to ensure users will be able to GPS and Galileo with a single receiver, important for users who do want to have separate receivers for each system.[87] Users should also be able to access each system without discrimination, possibly not even knowing when a receiver has changed systems. However, in certain situations it might be important for a user to know which system he is currently receiving information from. One such situation could develop if the data received is wrong or the system stops transmitting and liability needs to be determined. A user might prefer to be on one system rather than on another, especially if Galileo provides the high accuracy signal it anticipates, charges for its signal, or admits liability. Receiver designs and the information they provide to users could alleviate most of these concerns, as well as signal disruption notification that GNSS providers plan to provide.

Another important consideration for GNSS providers is redundancy. If a natural electrical phenomenon or a jammer knocks out satellites or signals from one provider, there should be guarantees that the other system will not also be knocked offline. Future satellite designs increase the GNSS signal power, alleviating some jamming concerns. Also, it is possible that the U.S. military could be persuaded to release some of its older anti-jamming technology in a technology transfer program as it develops new equipment. However, it does not appear that Galileo would somehow be protected from electrical phenomena that would disrupt GPS, so true redundancy may still need to be pursued.

It is also important that the delegates at the 2003 World Radiocommunication

Conference recognize the importance of GNSS and allocate enough frequencies to the major GNSS providers so that they may continue to upgrade the quality of GNSS. The WRC 2000 did allot more frequencies to both GPS and GLONASS for upgrades and provided spectrum for Galileo.[88] This hopefully shows the international commitment to developing accurate and powerful GNSS worldwide.

CONCLUSION

With great power comes great responsibility. GNSS is a powerful tool that increasingly affects more of our everyday lives. Fortunately, so far the major players have recognized the importance of GNSS and have cooperated with each other. Many scholars have suggested that some type of legally binding international agreement ensuring the quality and availability of GNSS would be desirable that would put the force of international law behind the current assurances that the States active in GNSS have made. Liability, international control, dual use, and interoperability will all be major points of issue for any such agreement.

"The politics of GNSS is the politics of arrogance, veiled and competing national (and regional interests) in all its forms, frustration and coercion. It embodies all that is bad in international relations . . . [i]t involves finding a delicate balance. . ."[89] Therein lies the problem with an international agreement. The United States will not sign an agreement unless liability is waived for provider states and dual use is preserved. These concessions would make any agreement worthless.

Therefore the approach of ICAO seems more prudent: an internationally recognized body allows provider States to maintain their systems, but creates standards that are reasonable and based around safety. Once Galileo is operational, there will be less concern about what the United States *might* do with GPS. A more feasible agreement might then focus on ensuring global access to standardized GNSS, since it is in the provider states' interests to build and market standardized equipment and to use one navigation system worldwide. A predicted $40 billion market might alone be an assurance that those who provide GNSS will continue to do so to the best of their abilities. While GNSS might make for bad politics, it continues to open doors for innovative and creative applications and is here to stay.

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[37] The Convention on International Liability for Damage Caused by Space Objects, March 29, 1972, 24 U.S.T. 2389, at Art. II.
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[45] *Id.*at 274.
[46] Michael Jennison, *Editorial: Satellite Navigation: The Dubious Quest for a Legal Framework*, 16 AIR & SPACE LAW 10, 11 (2002).
[47] 28 U.S.C. § 2680(j)-(k) (2003). *See also* Smith v. United States, 507 U.S. 197, 204 (1993) (holding that FTCA's waiver of sovereign immunity does not apply to tort claims arising in Antarctica, even though it has no government).
[48] Banke, *supra* note 15.
[49] Larsen, *supra* note 2, at 111.
[50] Report of the Commission to Assess United States National Security Space Management and Organization at 20, 23, 36 (January 11, 2001) [hereinafter Rumsfeld Report]. *See also* Langhorne Bond, *The GNSS Safety and Sovereignty Convention of 2000 AD*, 65 J. AIR L. & COM. 445, 446 (2000) (discussing the vulnerability of GPS to jamming).
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[57] Bond, *supra* note 50, 449.
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[68] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, preamble, 18 U.S.T. 2410 [hereinafter the Outer Space Treaty].
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[89] HENAKU, *supra* note 38, at 250.