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The Emerging GNSS: Galileo, the European Alternative to the Global Positioning System

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Abstract

The Global Satellite Navigation System (GNSS), the core of the International Civil Aviation Organization (ICAO) Communication, Navigation, Surveillance/Air Traffic Management concept is capable of supporting future aviation needs. The implementation of this revolutionary technology however remains overshadowed by a series of complex institutional and legal issues. The extraterritorial control and ownership of existing GNSS systems coupled with the dual character of this technology poses a serious threat to the concept of national sovereignty as traditionally understood. This is further aggravated by the fact that there exists only one *de facto* GNSS signal provider, thus placed in a position to impose its own conditions without reference to the requirements of the rest of the world.

In an attempt to secure both European political independence and a fair share in the global GNSS market Europe has decided to play an active role by launching Galileo, an autonomous global constellation under the control of civil authorities scheduled to be operational by 2008.

The present thesis analyses the desirability of a suitable legal and institutional GNSS framework to achieve universal acceptance of the GNSS. However, in the context of the present *status quo* it is unrealistic to expect that the only GNSS signal provider surrender its nationally procured system under the umbrella of an international instrument. National security concerns and industrial policy goals underlie this tendency. The present situation may turn different when the incumbent GPS faces the competition of Galileo, an alternative civil system willing to offer firm legal guarantees of service performance albeit in exchange for a fee. The entire viability of this theory remains however dependent upon the European capability of defining a successful business case for Galileo.

Résumé

Le système mondial de navigation par satellite (GNSS), au cœur du concept de communication, de surveillance et de contrôle de trafic aérien de l'Organisation de l'Aviation Civile Internationale (OACI) est en mesure d'accueillir de nouvelles avancées dans le domaine de l'aviation. Cependant, cette technologie révolutionnaire demeure en partie éclipsée par un ensemble de problèmes légaux et institutionnels. L'extraterritorialité du contrôle et de la propriété de systèmes GNSS existants, associée à la dualité de cette technologie, constitue une menace pour le concept de souveraineté nationale, tel qu'il est communément admis. Le problème est amplifié par le fait qu'il n'existe, en fait, qu'un seul fournisseur de signal GNSS, dont la position monopolistique lui permet d'imposer ses propres conditions au mépris des besoins spécifiques du reste du monde.

A fin d'assurer à la fois une indépendance politique européenne et une part équitable dans le marché GNSS mondial, l'Union Européenne a conçu le système Galileo, une constellation autonome sous contrôle d'autorités civiles, dont la mise en service est prévue pour 2008.

La présente thèse a pour but d'étudier l'opportunité de l'établissement d'un cadre juridique et institutionnel adéquat, encourageant l'universalisation du système GNSS. Cependant, dans l'actuel contexte de *statu quo*, il est difficilement concevable que l'unique fournisseur de signal GNSS accepte de placer son système national sous la tutelle d'un organe international. Cette tendance, naturellement due à des soucis de sécurité publique et de politiques industrielles nationales, risque d'évoluer lorsque GPS subira la concurrence directe de Galileo, offrant alors une protection juridique fiable en échange d'une participation financière. La viabilité de ce projet dépendra toutefois de la volonté des organisations européennes d'établir pour Galileo un solide plan commercial.

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Introduction:

The growing air traffic demand constitutes a common trend affecting several parts of the world and although the rate of growth varies between different regions, they are all expected to face major increases in air traffic volume in the future. In Europe, of all forms of transport, aviation has shown by far the most prominent growth in the last twenty years. Traffic in terms of passengers per kilometre has risen at an average of 7.4% a year since 1980, whilst traffic through the airports has become as much as five times greater than in the 70s.[1] The region has been characterized as the world's most crowded and compact air traffic environment[2] and the route structure described as a "problem of staggering proportions."[3] The airlines complain that the European airspace is fragmented thus leading to major inefficiencies and delays. Member States organize their airspace differently and the military dimension makes matters even worse as the civil route framework is forced to avoid military areas.[4] The air traffic demand is predicted to double over the next fifteen years, thus placing a heavy burden on the capacity limits of the existing ground-based Air Traffic Management (ATM) infrastructure.[5]

A variety of reasons lie beneath this trend, namely the economic growth and the liberalization of the air transport sector resulting in the reduction of fares and the development of the "hub and spoke" approach as survival strategies developed by the airlines.[6] The rate of air traffic movements will continue to augment at a rapid pace in the future and it needs to be accommodated without jeopardizing safety. Current Air Navigation Services (ANS) infrastructure however, "is reaching its limits and is becoming increasingly strained in terms of safety, regularity and efficiency."[7]

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[1] See <http://www.europa.eu.int/comm/transport/themes/air/english/at_0_en.html> (Date accessed: 09/06/2002).
[2] A. Lawter, "Free Flight or Free Fall?" (1997) 62 J. Air. L. & Com. at 949.
[3] See *ibid* citing D. Hugues.
[4] See EU, European Commission, *A Single European Sky in 2004: Short Presentation of the Commission's Air Traffic Management Package* (October 2002) at slides 8, 9 and 10. Available online at <http://www.europa.eu.int/comm/transport/library/press-kit-package-en.pdf> (Date accessed: 08/05/2002).
[5] See *ibid* at slide 3.
[6] S. Andries, "A European Contribution to the Global Navigation Satellite System (GNSS)" (2000) XXV Ann. & Air Sp. L. at 44.
[7] See ICAO, *World-wide CNS/ATM Systems Implementation Conference* (Rio de Janeiro, 1-15 May 1998) [Hereinafter WW/IMP]. Address by the Director of the Air Navigation Bureau of the International Civil

Since the limitations are inherent to the infrastructure itself, there is little hope that the present Air Traffic Management system be improved without the development of new systems that are more responsive to future air navigation needs. This can only be achieved through the implementation of new technologies (with particular emphasis in the use of satellites) capable of improving present means of communications, navigation and surveillance and allowing for the present ATM system to develop into a global dimension.[8]

Already in the early eighties, the International Civil Aviation Organization (ICAO)[9] recognized the limitations of the present systems and the urge for the modernization of the existing air navigation structures. As a consequence in 1983 the ICAO Council established the Special Committee on Future Air Navigation Systems (FANS) with the mandate to study, identify and assess new concepts and new technology in the field of air navigation, including satellite technology, and to make recommendations for the development of air navigation for international civil aviation over a period of twenty five years.[10] The original FANS Committee completed its work in 1988 with a comprehensive documentation, the "FANS I Report"[11] envisaging a revolutionary concept presently known as Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM).[12] The ICAO concept for CNS allows for a careful combination of satellite

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(...*continued*)
Aviation Organization (ICAO) Mr. Jack Howell at the Official Opening of the Conference (11/05/1998). Available online at <http://www.icao.int/allpirg/danb.htm> (Date accessed 02/06/2002).

[8] See ICAO, *Global Air Navigation Plan for CNS/ATM* Systems, version I, (Montreal: ICAO, 1998) vol. I at 1-4 para 1.2.2. [Hereinafter *Global Plan*].

[9] In 1993 in the context of a post-war environment, the United States initiated a series of consultations between major allies to address civil aviation problems. As a consequence, the US invited 55 States to attend an International Civil Aviation Conference that was held in Chicago in November 1944. The outcome was the *Convention on International Civil Aviation* initially signed by 32 States. The Convention created the International Civil Aviation Organization (Article 43) of a permanent character and aimed at developing the principles and techniques of international civil aviation and at fostering the development of air transport (Article 44). The Convention envisaged that ICAO would not come into being until the Convention was ratified by 26 States (Article 91(b)). On 4 April 1947, ICAO officially came into existence. Further information on ICAO can be obtained at <http://www.icao.org> (Date accessed: 02/06/2002).

[10] See ICAO, *Report of the Fourth Meeting of the Special Committee on Future Air Navigation Systems (FANS),* ICAO Doc. 9524-FANS/4 (2-20 May 1988) at 1 para 1.1. [Hereinafter FANS/4].

[11] See *ibid.*

[12] The present CNS/ATM concept is based upon the FANS concept endorsed in 1991 by the 10th Air Navigation Conference. On 11th December 1991, the ICAO Council at its 134th Session agreed that the FANS concept would in the future be referred to as the 'ICAO CNS/ATM concept'. See excerpt from Doc. C-Dec 134/20 at Guldimann & Kaiser *infra* note 33 at 126.

technology and the best line of sight systems to overcome the shortcomings of the present infrastructure. The concept aims at the development of a global Air Traffic Management supported by the use of new technologies in the communication, navigation and surveillance.[13]

The Global Navigation Satellite System (GNSS), the core of ICAO's CNS/ATM systems, will be capable of accommodating the future air traffic demands. At present, only two GNSS systems are operational, the US Global Positioning System (GPS) and the Russian Federation's Global Orbiting Navigation Satellite System (GLONASS). The regional approach chosen by Europe has been to play an active role in this field by launching Galileo, a new satellite navigation constellation global in coverage from the outset and autonomous from GPS but fully interoperable with it.[14] Urgent needs to secure European independence as well as the desire for European industries to acquire their corresponding market share lie behind this initiative.

GNSS raises a number of complex legal and institutional issues due mainly to the dual character of this technology, the extraterritorial control and ownership of existing GNSS systems, and the multimode applications offered by GNSS. The principal issues relate to liability, operational structures as well as certification. A suitable legal and institutional framework is needed so as to provide a sufficient level of guarantee to potential users. ICAO has clearly acknowledged the need for a long-term legal framework. Such further work, should not however delay the implementation of CNS/ATM systems.[15]

The present work attempts to give a general presentation on the main critical issues raised by GNSS in general and Galileo in particular. Chapter I gives a succinct explanation of CNS/ATM systems, first describing the current situation determined by the existing systems and then giving a brief overview of the CNS/ATM concept envisaged by ICAO with GNSS as the main point of interest. Chapter II is dedicated to GNSS systems in general with particular attention to Galileo, the European initiative regarding the

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[13] See *Global Plan supra* note 8 at 1-2 para 1.1.3.

[14] See EU, European Commission, *Communication COM (1999) 54 final of 10 February 1999, Galileo Involving Europe in a New Generation of Satellite Navigation Services* [1999] at V. Available online at<http://www.genesis-office.org/indexgl.htm> (Date accessed: 02/06/2002). [Hereinafter *COM (1999) 54 final*].

[15] See WW/IMP *supra* note 7 *Declaration on Global Air Navigation Systems for the Twenty-First Century* (15/05/1998). Available online at <http://www.icao.int/allpirg/declar.htm> (Date accessed 02/06/2002).[Hereinafter *WW/IMP Declaration*].

Global Navigation Satellite System. The role of ICAO in the planning and implementation of GNSS is analysed in Chapter III considering in particular the GNSS short and long-term legal frameworks. Chapter IV is dedicated to the most prominent GNSS legal issues particularly focusing on liability. Specific legal issues raised by Galileo are considered in Chapter V.

Chapter I: CNS/ATM Systems:

I. Present Systems.

The current system has been described as a

> rather rigid and largely procedural, analog, and ground-based system comprising HF/VHF-voice communications, terrestrial-based navigation systems, radar surveillance, and limited air traffic decision support.[16]

The existing communications technology for air traffic control purposes is served primarily by two-way voice communications using where available very high frequencies (VHF) over domestic portions of routes and high frequency (HF) in oceanic and remote areas where it is impractical or impossible to achieve VHF coverage.[17]

A variety of navigational aids are currently used for the purposes of civil aviation:

- OMEGA and LORAN-C are ground-based long-range systems for navigation guidance over uninhabited areas and the high seas.[18]
- Inertial Navigation and Inertial Reference Systems (INS/IRS) are entirely self-contained in the aircraft for the purpose of long-range navigation. Whereas capable of determining the aircraft position independently from ground-based stations, inertial navigation aids lose accuracy with time without an update.[19]
- Non Directional Beacons (NDB) are short/medium range ground-based radio navigation aids naturally limited to line-of-sight navigation used to determine the direction where the NDB ground transmitter is located.[20]

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[16] B. Elder, "Free Flight: The Future of Air Transportation Entering the Twenty-First Century" (1997) 62 J. Air. L. & Com. at 877 citing the Federal Aviation Regulations and Aeronautical Information Manual (ASA 1996).
[17] See *ibid* at 878.
[18] W. & R. Schwenk, *Aspects of International Co-operation in Air Traffic Management* (The Hague/Boston/London: Martinus Nijhoff Publishers, 1998) at 63.
[19] See *ibid* at 64.
[20] See *ibid* at 63.

- Very High Frequency omnidirectional radio range (VOR) is a short/medium range aid providing the aircraft with its relative position with respect to the VOR station in a maximum range of the line-of-sight.[21]
- Distance Measuring Equipment (DME) provides the pilot with a completely fixed position by measuring the distance between the aircraft and the DME ground station. DME transmitters are most frequently placed with VOR beacons for maximum efficiency.[22]
- The Instrument Landing System (ILS) constitutes the standardized aid for precision approach and landing. The system achieves high accuracy by means of two separate radio beams, one defining the approach path in the horizontal plane and another, which determines the path in the vertical plane.[23]

As for surveillance, the current means rely primarily on ground-based radar to determine the aircraft's whereabouts. In continental airspaces with high traffic densities, secondary surveillance radars (SSR) constitute the backbone for air traffic control (ATC) because they allow application of radar-separation which is much closer that the mandatory separation in non-radar airspace.[24]

II. Shortcomings of the Present Systems:

Upon completion of its mandate, the FANS Committee ascertained that the shortcomings of the present systems amount essentially to three factors:

> a) The propagation limitations of current line-of-sight systems and/or accuracy and reliability limitations imposed by the variability of propagation characteristics of other systems;
> b) The difficulty, caused by a variety of reasons, to implement present CNS systems and operate them in a consistent manner in large parts of the world;

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[21] See *ibid* at 63.
[22] L. Mortimer, "1944-1994, A Half Century of Technological Change and Progress" (1994) 49:7 ICAO J. at 42.
[23] See *ibid.*
[24] See Schwenk *supra* note 18 at 65.

> c) The limitations of voice communications and the lack of digital air-ground data interchange systems to support modern automated systems in the air and on the ground.[25]

Communication is vital to all areas of aviation. In today's system each step of an Instrument Flight Rules (IFR)[26] operation requires a clearance from the air traffic controller to the pilot via two-way voice communication systems using VHF where available or HF over oceanic and remote areas. Severe limitations however derive from present communication infrastructure. Firstly, it is to be noted that reliance on voice communications entail a tedious and time-consuming process, which increases the workload of the air traffic controller thus limiting the number of aircraft that he/she can manage at a given time.[27] Language difficulties likely to arise in the world of international civil aviation further aggravate this problem. Moreover, VHF communications are limited to line-of-sight distance and thus of relatively short range speaking on aeronautical terms.[28] In such airspace where communications rely on HF, negative repercussions on the capacity of ATC result from the lack of clarity and accuracy inherent to HF transmissions.[29]

"To an even greater extent than with communications, the current navigation aids impose severe limitations on our use of the airspace."[30] Over continental airspace, the route network is primarily organized based upon VOR/DME and NBD ground stations.[31] As a result, the routes imposed to aircraft are similar to a highway or railway system in that they often take circuitous paths, which are often anything but direct[32] thus leading to major inefficiencies in the use of airspace.

The current means of surveillance impose further limitations on the system. Firstly, the information is presented only to the controller thus vesting the responsibility of aircraft separation upon the air traffic controller. Secondly, the information provided by

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[25] See FANS/4 *supra* note 10 at 2-1 para 2.1.1.
[26] The pilot must operate under instrument flight rules when fog or clouds limit visibility. To operate IFR the pilot must file an IFR plan and obtain a clearance from ATC.
[27] See Elder *supra* note 16 at 878.
[28] See Mortimer *supra* note 22 at 41.
[29] See Schwenk *supra* note 18 at 59.
[30] See Elder *supra* note 16 at 879.
[31] See Schwenk *supra* note 18 at 64.
[32] See Elder *supra* note 16 at 879- 880.

the use of radar is limited as present systems have imperfect accuracy providing for an error within the range of miles.[33] Moreover, there are large areas of the world, namely the high seas, where radar coverage cannot be provided. This has prompted the need to further limit the efficient use of the air space due to the implementation of an aerial track structure over the oceanic waters to ensure safe separation of aircrafts.[34]

Conventional ground-based equipment is genuinely incapable of supporting upcoming aviation needs. The future of air navigation lies with a cost-effective and efficient system capable of achieving global coverage.[35] What we presently have is a system reliant on two-way voice communications that leads to major ATC inefficiencies, a route structure defined in function of terrestrial navigation aids, which significantly reduces the possibilities of achieving a more efficient exploitation of the air space and a chain of inaccurate radars that leave large parts of the world out of coverage. Definitely new approaches are necessary to overcome the present shortcomings and to allow our current ATM system to be more responsive to future demands.

III. The Elements of the ICAO CNS/ATM Systems and Future Benefits:

"The ICAO concept allows for a judicious mix of satellite technology and the best line-of-sight systems to achieve an over-all optimum result"[36] This mixture of satellites and fast reliable computers operating at gigahertz frequencies brings the necessary infrastructure to overcome the shortcomings of present systems. The new CNS systems, envisaged by ICAO, can improve safety, ATC and prompt a more efficient use of the air space:[37]

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[33] W. Guldimann & S. Kaiser, *Future Air Navigation Systems* (Dordrecht/Boston /London: Martinus Nijhoff Publishers, 1993) at 152.
[34] See Mortimer *supra* note 22 at 44.
[35] See *Global Plan supra* note 8 at 1-4 para 1.2.1.
[36] See ICAO, *Report of the Fourth Meeting of the Special Committee for the Monitoring and Co-ordination of Development and Transition Planning for the Future Air Navigation System (FANS Phase II),* ICAO Doc. 9623-FANS (II)/4 (15 Sept.-1 Oct. 1993) at 8B-3. [Hereinafter FANS (II)/4].
[37] See Guldimann & Kaiser *supra* note 33 at 153.

1. Communications :

Methods of communication between ground and aircraft are moving towards the application of digital air-ground data communications ('data link') for the transmission of internal communications between the aircraft and air traffic controllers.[38] Increasing reliance on data linking of digital information nowadays by major airlines is bringing greater efficiency, reliability, punctuality and cost-effectiveness to their operations. In the field of ATC the use of data link can substitute routine two-way voice communications therefore significantly improving ATC productivity. Direct data communications for ATM purposes offers the potential to eliminate or at least reduce the need for manual intervention thus increasing capacity and safety.[39]

2. Navigation:

ICAO adopted the concept of required navigation performance (RNP)[40] defining the necessary capability (rather than a specific system) for an aircraft to navigate in a given airspace segment. Originally, it was intended that the Global Navigation Satellite System (GNSS), embedded in the RNP concept would "be able to provide a high-integrity, highly accurate navigation service, suitable as sole means of navigation for en-route, terminal and non-precision approach and perhaps Category I precision approach and landing."[41] After a carefully implemented transition period, navigation by satellite was intended to replace *all* other navaids.

The issue of 'sole means' however has prompted recent discussions at ICAO from which a more prudent approach has emerged. Albeit the full implementation of GNSS will offer States the possibility of dismantling *some* of the existing terrestrial air

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[38] See Elder *supra* note 16 at 884-885.
[39] See Schwenk *supra* note 18 at 59.
[40] When studying the modern development of aircraft navigation, particularly, due to the advent of satellite navigation, the FANS Committee realized that the then practice to require mandatory carriage of certain equipment would imply a difficult selection process by ICAO. With a view to a more flexible approach, the Committee introduced the required navigation performance concept thus enabling the required navigation performance capability to be achieved with a variety of different navigation equipment. See FANS/4 *supra* note 10 at 4 para 3.4.
[41] See FANS (II)/4 *supra note* 36 at 8B-4.

navigation infrastructure, the removal of *all* ground-based equipment should however be approached with caution.[42]

As it looks, the emphasis has been placed into achieving the implementation of GNSS as the primary means of navigation rather than as the 'sole means.' Technical difficulties in finding a satisfactory solution to overcome the vulnerability of the GNSS signal coupled with the absence in the part of the only *de facto* current signal provider of firm and binding assurances in terms of non-discriminatory access and continuity underlie this new tendency.[43]

3. Surveillance:

Secondary surveillance radars (SSR) constitute the primary means for surveillance in continental, high traffic density airspaces.[44] For oceanic operations, uninhabited landmasses or other areas where radar coverage cannot be achieved for geographical and economic reasons, the ICAO FANS Committee adopted the concept of automatic dependent surveillance (ADS), where the aircraft automatically transmits its identification, position and potential other data as required for ATM purposes.[45] "ADS offer a large potential for capacity and efficiency increase in oceanic and remote airspace which today lack adequate communications and surveillance infrastructure to cope with the increase of traffic"[46]

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[42] L. Weber & J. Huang, "ICAO and GNSS" (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 45 citing the GNSS Panel.
[43] For further study on the issue of vulnerability see *infra* Chapter III Section III.3.C As regards legal assurances in terms of continuity and accessibility see *infra* Chapter III Section III.3.A and B.
[44] See Schwenk *supra* note 18 at 65.
[45] See FANS (II)/4 *supra* note 36 at 8B-4.
[46] See Schwenk *supra* note 18 at 66.

IV. What is GNSS? Definition and Future Benefits:

GNSS is the term given to the satellite navigation component of the CNS/ ATM concept and can be defined as follows:

> The GNSS is a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers, and system integrity monitoring, augmented as necessary to support the RNP for the actual phase of operation.[47]

The advent of the Global Navigation Satellite System will bring remarkable benefits to the international aviation community. It will considerably enhance the safety of air navigation due to the fact that GNSS entails a significant level of the four parameters that are crucial for aviation safety, namely accuracy,[48] reliability,[49] integrity[50] and availability.[51] It is furthermore envisaged that GNSS bring major economic benefits to the States in the form of cost savings, as full implementation of the Global Navigation Satellite System will offer the possibility to dismantle certain conventional navigation aids. This might be even more notable from the perspective of those countries (*i.e.* developing countries) that have traditionally encountered financial difficulties in maintaining the costly present ground-based infrastructure due to a variety of factors such

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[47] See *Global Plan supra* note 8 at 6-3 para 6.3.1.

[48] GNSS 'accuracy' is the degree of conformance between the GNSS output of position and time, and the true position and time. See FANS (II)/4 *supra* note 36 at 4F-1. GNSS position error is the difference between the estimated position and the actual position. For an estimated position at a specified location, the probability should be at least 95% that the position error is within the accuracy requirement. See Annex 10 to the *International Convention on Civil Aviation*, I Attachment D, ATT D-2 para 3.2.1. The Annex is available online at <http://www.icao.int/icaonet/anx/an10_V1_5ed.pdf> (Date accessed: 17/06/2002) [Hereinafter Annex 10].

[49] GNSS 'reliability' is the probability that the GNSS will perform within defined performance limits for a specified period of time under given operating conditions. See FANS (II)/4 *supra* note 36 at 4F-2.

[50] GNSS 'integrity' is the assurance that all functions of the system perform within GNSS operational performance limits. See *ibid* at 4-1. Integrity included the ability of a system to provide timely and valid warnings to the user when the system must not be user for the intended operation. See Annex 10 *supra* note 48 I Attachment D, ATT D-2 para 3.3.1.

[51] GNSS 'availability' is characterized by the portion of time the system is to be used for navigation during which reliable navigation information is presented to the crew, autopilot, or other system managing the flight of the aircraft. See Annex 10 *supra* note 48 I Attachment D, ATT D-3 para 3.5.1.
See also Andries *supra* note 6 at 45.

as financial constrains, remoteness of some areas and political struggles.[52] This said, it cannot be forgotten however, that full implementation of GNSS requires a significant level of financial investment in the form of both airborne equipment and certain GNSS terrestrial aids to achieve optimal levels of accuracy and reliability of the GNSS signal.[53] It can only be hoped that these countries will find the financial strength to take the necessary steps that will allow for the theoretical benefits of GNSS to materialize.

GNSS will also very meaningfully enhance the efficiency of ATM by allowing the rationalization of air routes, the reduction of the mandatory separation between aircraft and of current levels of airport congestion. The ultimate benefit envisaged by the use of satellite navigation technology for civil aviation in terms of airspace management has been respectively designated as 'free flight' in the United States and 'free routing'[54] in Europe. Free flight is a revolutionary concept that will allow pilots to regain some of the freedom that they have lost over the years due to the terrestrial nature of the navigation technology currently in place.[55] GNSS combined with data link technology constitutes the basic architecture for the transition towards free flight.[56] Free flight essentially refers to a system where ATC functions are eliminated or significantly reduced. It would thus return many of the functions of ground based air traffic controllers to the aviation users themselves so that the ATM system would become a passive observer intervening only when safety of flight restrictions are considered necessary.[57]

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[52] T. Kok "Implementing GNSS in (African) Aviation: an Overview of Regulatory and Operational Demands" (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 52.

[53] See *ibid.*

[54] While the United States continues exploring the implementation of free flight, Europe is taking a more cautious approach. The European concept of 'free routing' affords a greater degree of freedom to pilots without going as far as the American concept of 'free flight'. Rationalizing air traffic management and looking into questions of congestion rather than implementing mature free flight are European priorities. F. Schubert, Lecture given at The Institute of Air And Space Law (McGill University) on February 2002. For further information on the European concept of free routing see J. Moxon "From Flying Free to Free Flight" (2000) at <http://www.eurocontrol.be/dgs/publications/skyway/1999/v5n16/p18.html> (Date accessed: 08/06/2002).

[55] K. M. Goodman & S. Davis, "Free Flight and the Pilot-in-Command Concept" (1997) 62 J. Air. L. & Com. at 654.

[56] R. C Keel & K. B. Levine, "U.S Airlines on Course for Free Flight" (1997) 62 J. Air. L. & Com. at 683. See also Elder *supra* note 16 at 872.

[57] G. M. Moore & J. C. Caven "Free Flight Technology Requirements and Liability Issues that may Arise for Equipment Manufacturers" (1997) 62 J. Air. L. & Com. at 688-689.

The return of the aircraft control to pilots will result in an increase in freedom, efficiency, economy and safety.[58] To the airlines, free flight represents efficiency advantages in the form of fuel savings and significant reductions of flight time.[59] Benefits are also likely to accrue for the general flying public in terms of increased safety of flight and timesaving.

Enormous benefits are likely to derive from the full implementation of GNSS. However, technology does not implement itself [60] and much work still needs to be done before commercial aviation can make use of the Global Navigation Satellite System as primary means of navigation. A number of regulatory, technical and financial challenges need to be solved in order to complete a much-needed successful transition to this revolutionary new technology capable of supporting the air navigation needs of the future. The main challenges will be analysed along the lines of this thesis.

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[58] See Elder *supra* note 16 at 873.

[59] See A. K. Lawter *supra* note 2 at 941: Utilizing free flight compatible equipment many of the major US carriers have already tested the free flight operational concept on long-haul flights. European carriers have inaugurated similar practices across Russia, China, North Korea and India thus significantly reducing fuel consumption and in some cases flight times in as much as two hours.

[60] M. Milde, "Solutions in Search of a Problem? Legal Aspects of the GNSS" (1997) XXII-II Ann. & Air Sp. L. at 197.

I. Existing Signal Providers:

1. Global Positioning System (GPS):

There are presently two independent applications of the GNSS concept, the US military Global Positioning System (GPS), the most widely used system and a rival Russian system, the Global Orbiting Navigation Satellite System (GLONASS).[61] Both of these systems have been offered to civil aviation users free of direct charge.[62]

The Global Positioning System operational since 1993[63] was designed as a dual-use system primarily aimed at enhancing the capabilities of U.S. and allied military forces.[64] The system consists of a minimum of 24 satellites and associated ground support facilities. The satellites emit signals that can be converted by users anywhere in the world into precise timing and positioning information.[65] GPS is operated by the U.S. Air Force, but managed by an Interagency GPS Executive Board (IGEB).[66]

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[61] P.B Larsen, "Future GNSS Legal Issues" (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 17.
See also, Larsen, "Expanding Global Navigation Services" (1999) Proceedings of the Workshop on Space Law in the Twenty-First Century, UNISPACE III Technical Forum (New York: UN Publication, 2000) at 155.

[62] See Letter from D. Hinson, FAA Administrator, to A. Kotaite, President of ICAO Council (14/10/1994) reiterating an oral offer by the US to provide GPS SPS signals to the civil aviation community free of direct charge for ten years.
See also Letter from N.P Tsakh, Minister of Transport of the Russian Federation to A. Kotaite, President of the ICAO Council (04/061996). [Hereinafter Exchange of Letters].
The letters can be found attached to H. Addison, *GNSS Legal Framework*, Master Thesis, Institute of Air and Space Law, McGill University, 1996 at Appendixes 5 and 6.

[63] See J.C Johns, "Enhanced Capability of GPS and Its Augmentation Systems Meets Navigation Needs of the 21st Century" (1997) 52:9 ICAO J. at 7.

[64] See US, *US Global Positioning Policy,* Presidential Decision Directive Document (The White House Office of Science and Technology Policy and the National Security Council) (29/03/1996). Available online at <http://www.ostp.gov/NSTC/html/pdd6.html> (Date accessed: 05/05/2002). [Hereinafter Presidential Decision Directive].

[65] See O. D. Kurtin & B. S. Noveck, "US Initiatives on GNSS", (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 6.

[66] See Presidential Decision Directive *supra* note 64. The President approved a comprehensive policy on the future management and use of the U.S. Global Positioning System (GPS) and related U.S. Government augmentations. Among other things, the Presidential Decision Directive (PDD) established that a permanent

Prior to May 1st 2000, GPS offered two distinct services, Standard Positioning Service (SPS), available to civilians and where accuracy had been intentionally degraded, and the more accurate Precise Positioning System (PPS), restricted to the US military and allied military users. Such intentional degradation of the signal for civilian users was aimed at providing an advantage to the military and came to be known as Selective Availability (SA).[67] The 1996 White House Policy Statement[68] promised an end to SA by the year 2006. Thus, termination has occurred earlier than expected.[69]

2. Global Orbiting Navigation Satellite System (GLONASS):

GLONASS is a military network controlled by Russian defence authorities theoretically based on a constellation of 24 satellites operational since 1982.[70] The spacing of satellites is conceived in a way that a minimum of five satellites are in view to an unlimited number of users thus enabling continuous and global navigation coverage to make all-weather 3D positioning, velocity measuring and timing anywhere in the world or near-Earth space. Like GPS, the system has two types of navigation signal, standard precision navigation signal (SP) and high precision navigation signal (HP). SP services are available to all civil users on a continuous global basis.[71] The Russian Federation however, does not intend to degrade the standard accuracy channel intended for civil users.[72]

(*...continued*)
IGEB manage GPS and U.S. Government augmentations to GPS. The Departments of Defence, Transportation, State, and Commerce (DOD, DOT, DOS, and DOC) are members of the IGEB.

[67] See *ibid* at Policy Guideline 2.

[68] See Presidential Decision Directive *supra* note 64.

[69] See US, *Statement by the President Regarding the United States Decision to Stop Degrading Global Positioning System Accuracy* (The White House Office of the Press Secretary) (01/05/2000). Available online at <http://www.ostp.gov/html/0053_2.html> (Date accessed: 04/06/2002).

[70] See A. D. Kuropyatnikov, "The Problem of the Legal Regulation of GLONASS" (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 7.
See also "GLONASS History" at <http://www.rssi.ru/SFCSIC/english.html> (Date accessed: 05/05/2002).

[71] Further information on GLONASS is available online at <http://www.rssi.ru/SFCSIC/english.html> (Date accessed: 02/05/2002).

[72] See V. Kuranov & Y. Iovenko "Capability and Performance Make GLONASS Suitable for Navigation in all Phases of Flight" (1997) 52:9 ICAO J. at 11.

The GLONASS constellation is not maintained at its full operational level.[73] Due to economic crisis in Russia, the system stopped being funded after 1995 leading to the degradation of the constellation. As of June 5th 2002, the constellation is operating only seven useable satellites.[74] The GLONASS system is presently only a candidate to complement GPS and Galileo.

II. Augmentation Systems:

The primary signals do not meet aviation requirements and thus they need to be augmented in order to make GNSS the primary aviation radio navigation system. Various augmentation systems are close to operability on a limited geographical scale.

The Wide Area Augmentation System (WAAS) is a satellite based GPS augmentation system being developed by the FAA and expected to provide sufficient accuracy, integrity and availability for lateral and vertical en-route navigation and Category I approaches.[75] Intended as a complement to the WAAS, the Local Area Augmentation System (LAAS) is a ground-based GPS augmentation system being developed by the FAA to provide the additional accuracy, integrity and availability for Category II and III approaches as well as to increase the availability of Category I services.[76]

The European Geostationary Navigation Overlay System (EGNOS) will provide European augmentation. Based on a Resolution from the Council of the European Union,[77] the European Commission, the European Space Agency (ESA) and the

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[73] See A. D. Kuropyatnikov *supra* note 70 at 8.
See also Moore & Caven *supra* note 57 at 694.
[74] See Russian Federation, "GLONASS Constellation Status." Available online at <http://www.rssi.ru/SFCSIC/english.html>
(Last updated: 05/06/2002).
[75] See US, *Federal Radionavigation Plan* [2001] (Department of Defence and Department of Transportation) at 2-3 para 2.2.2. Available online at <http://www.igeb.gov/FRP2001.pdf>
(Date accessed: 05/06/2002). [Hereinafter 2001 FRP].
[76] See *ibid* at 2-3.
[77] See EU, Council of the European Union, *Council Resolution of 19 December 1994 on the European Contribution to the Development of a Global Navigation Satellite System (GNSS)*, [1994] OJ C 379 p 0002-0003. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31994Y1231(03)&model=guichett> (Date accessed: 05/06/2002). [Hereinafter *Council Resolution of 19 December 1994*].

European Organization for the Safety of Air Navigation (EUROCONTROL),[78] agreed on a European augmentation of existing positioning systems so as to enhance the performance of these systems over Europe and make them suitable for safety critical applications such as flying aircraft.[79] EGNOS is a multimode satellite augmentation system using geostationary satellites to provide supplementary integrity for air, sea and surface uses. It is scheduled to become fully operational in 2004. In the meantime, a test signal, broadcast by two Inmarsat satellites,[80] allows potential users to acquaint themselves with the facility and test its usefulness.

The Japanese Civil Aviation Bureau is implementing the Multi-Functional Transport Satellite Augmentation System (MTSAS), which will cover the Flight Information Region of Japan. The system is composed of two satellites MTSAT- 1R and MTSAT- 2. MTSAT- 1R is scheduled for launch in 2002 and MTSAT- 2 in 2004.[81]

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[78] European Tripartite Group (ETG). The aim of the Group is to provide a European contribution to the Global navigation satellite System. EUROCONTROL will develop the aviation certification requirements, ESA is responsible for the development and operation of EGNOS and the European Commission for institutional and policy matters. See European Tripartite Group "Europe Pursuing a Broad Multimodal Satellite Navigation Programme as its Contribution to GNSS" (1997) 52:9 ICAO J. at 13-14.

[79] See *Agreement between the European Community, the European Space Agency and the European Organization for the Safety of Air Navigation of 10 July 1998 on a European Contribution to the Development of a Global Navigation Satellite System (GNSS)* [1998] OJ L 194 p. 0016-0024. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=21998A0710(01)&model=guichett > (Date accessed: 05/06/2002). [Hereinafter *Tripartite Agreement*].
See also Larsen, "GNSS Augmentation: Legal Issues" (1997) Proceedings of the 40th Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 272.

[80] France Telecom and Deutsche Telekom on behalf of ESA, the EC and EUROCONTROL leased Inmarsat III transponder capacity. Inmarsat also concluded transponder service agreements with the US COMSAT Corporation to enable the to provide augmentation for WAAS.
See also D. Sagar, "INMARSAT and GNSS" (2000) 3:1 Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 40.

[81] See Japanese Civil Aviation Bureau, "MTSAS Schedule" at <http://www.mlit.go.jp/koku/ats/e/mtsat/sche/01.html> (Date accessed: 05/06/2002). Further information on MTSAS can be obtained online at <http://www.mlit.go.jp/koku/ats/e/mtsat/role/01.html> (Date accessed: 05/06/2002).

III. Emerging GNSS Systems: Galileo, the European Initiative:

1. Background:

As early as 1990, the European Commission stressed the EC's intention to develop its satellite industry.[82] Title XII of the Maastricht Treaty,[83] introduced the concept of trans-European networks (TEN's).[84] In June 1994, the *Bangemann Report* was presented at the Corfu meeting of the European Council encouraging European Nations to participate in the global information society and more precisely to create an electronic airway for Europe in the field of air traffic services.[85]

In December 1994, a Council Resolution was passed inviting the Commission to initiate "the preparatory work needed for the design and organization of a Global Navigation Satellite System (GNSS 2) for civil use."[86] A European Parliament Resolution was passed on February 1995 stressing "the need for and the wide-ranging importance of the development of a completely civil multimodal system that forms part of the trans-European transport and telecommunications network and that will meet the requirements

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[82] See P. A. Salin, "An Update on GNSS before the Next ICAO Experts Meeting on the Legal and Technical Aspects of the Future Satellite Air Navigation Systems" (1997) XXII-I Ann. & Air Sp. L. at 512 citing European Commission, *Communication COM* (1990) *490 final of 14 November 1990, Towards Europe-Wide System and Services: Green Paper on a Common Approach in the Field of Satellite Communications in the European Community,* [1990].

[83] See *Treaty on European Union*, 7 February 1992 (entered into force 1 November 1993) [1997] OJ C 340, p. 145-172. Available online at <http://www.europa.eu.int/eur-lex/en/treaties/dat/eu_cons_treaty_en.pdf > (Date Accessed: 10/06/2002).

[84] The idea of 'trans-European networks' materialized in the late 1980s in conjunction with the proposal for a Single Market. To construct one Single Market, with freedom of movement within it for goods, persons and services, it appeared imperative that the various regions and national networks making up that market were adequately linked by a modern and efficient infrastructure. The idea of TEN's finds its legal basis under Title XV (ex Title XII) of the *EC Treaty* pursuant to which the Community is to contribute to the establishment of TEN's in the sectors of transport, telecommunications and energy.

Regulation (EC) No 1655/99 of 19 July 1999 of the European Parliament and of the Council on the Granting of Financial Aid in the Field of Trans-European Transport Networks Amending Regulation (EC) No. 2236/95 [1999] OJ L 197/1 p. 0001 - 0007 covering the period 2000-2006, adopted a higher ceiling for Community aid of up to 20% of the total cost of the project in the case of satellite positioning and navigation systems. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31999R1655&model=guichett > (Date accessed: 08/06/2002).

[85] See P. A. Salin, *supra* note 82 at 512 citing European Commission, *Europe and the Global Information Society- Recommendations of the High-Level Group on the Information Society to the Corfu European Council (Bangemann Group)*, Supplement 2/94 (Luxembourg: EU, 1994) at c.4. [*Bagemann Report*].

[86] See *Council Resolution of 19 December 1994 supra* note 77.

of industry and users throughout Europe (GNSS 2)."[87] In their Decision of July 1996, the European Parliament and the Council included the positioning and navigation systems as integral parts of the trans-European transport network[88] and the related projects as projects of common interest.[89]

On July 1998, having regard to the Council Resolution on the European contribution to the development of a Global Navigation Satellite System,[90] the European Community, the European Space Agency (ESA) and the European Organization for the Safety of Air Navigation (EUROCONTROL), based on Article 300 (ex Article 228) of the EC Treaty [91] signed an agreement on cooperation in the field of global navigation systems pursuant to which these three intergovernmental organizations agreed in a binding manner to a full operational capability GNSS-1 (EGNOS) and to prepare GNSS-2 (definition and design of Galileo).[92]

In their Regulation of 19 July 1999[93] the European Parliament and the Council, raised the level of Community aid for the positioning and navigation projects to 20% therefore affording them clear priority. In February 1999, the Commission presented Galileo, an autonomous Programme on satellite radio navigation to be developed in four phases: a definition phase in 2000, a development and validation phase up to 2005, a deployment

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[87] See EU, European Parliament, *European Parliament Resolution A4-0088/94 of 19 January 1995 on the Communication from the Commission Concerning the Draft Council Resolution on the European Contribution to the Development of a Global Satellite Navigation System* [1995] OJ C 043 p. 0071 at para 3. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=51994IP0088&model=guichett> (Date accessed: 08/06/2002).

[88] See EU, Council of the European Union and European Parliament, *Decision No. 1692/96/EC of 23 July 1996 of the European Parliament and of the Council on Community Guidelines for the Development of the Trans-European Transport Network* [1996] OJ L 228 p. 0001-0104 at Article 3: The trans-European transport network comprises transport infrastructure, traffic management systems and positioning and navigation systems. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31996D1692&model=guichett> (Date accessed: 08/06/2002).

[89] See *ibid* at Annex II Section 10: "Projects of common interest are deemed to include any project relating to the establishment of any component of the future European Radio Navigation Plan or of a *global satellite positioning and navigation system* (emphasis added)."

[90] See *Council Resolution of 19 December 1994 supra* note 77.

[91] See *Treaty Establishing the European Community* 25 March 1952 (entered into force 1 January 1958) as amended by the Treaty of Amsterdam [1997] OJ C 340, p. 173-308. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=11997E/TXT&model=guichett >
(Date accessed: 10/06/2002). [Hereinafter *EC Treaty*].

[92] See *Tripartite Agreement supra* note 79.

[93] See *Regulation No 1655/99 of 19 July 1999 supra* note 84 at Article 1.4.

phase up to 2007 and an operational phase thereafter.[94] The Cologne European Council in June 1999 emphasised the strategic importance of Galileo and the need to take a decision to continuing the Programme in December 2000.[95] On July 1999 the Council welcomed the Commission's Communication on Galileo and called on the Commission to develop a system for civil and global use managed by public civil authorities.[96] The definition phase was completed in 2000. A Communication from the Commission of November 2000 sets out the results of this phase and endorses a proposal that the Galileo project be continued beyond 2001 for the development and validation phase.[97] The Feira European Council recalled the strategic importance of Galileo.[98] On March 2001, the Stockholm European Council invited the Council to define the necessary arrangements for the next phase, in particular establishing a single and efficient management structure before the end of 2001.[99] Based on the November 2000 Communication from the Commission on Galileo,[100] the Council agreed on the necessary arrangements to launch the development phase of the Galileo project particularly by releasing EUR 100 million. A decision to

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[94] See *COM (1999) 54 final supra* note 14.

[95] See European Council, *Presidency Conclusions of the Cologne European Council (3 -4 June 1999)* at III-16. Available online at <http://ue.eu.int/Newsroom/LoadDoc.asp?BID=76&DID=57886&LANG=1> (Date accessed: 05/05/2002).
The European Council assembles the Heads of State or Government of the fifteen Member States of the EU and the President of the European Commission. The European Council is held in the Member State holding the Presidency of the Council of the EU and it meets at least twice a year (generally in June and December). These Summits were initially established by practice in the early 1960s, they started being regularly held in the early 1970s and eventually were officially named European Councils at the last Paris Summit in 1974. The role of the European Council is to define the general political guidelines of the European Union and to provide it with the necessary impetus for its development (Article 4 of the T*reaty on European Union, supra* note 83). Further information on the European Council is available online at <http://ue.eu.int/en/Info/eurocouncil/index.htm> (Date accessed: 26/07/2002).

[96] See EU, Council of the European Union, *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 p. 0001 - 0003. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31999Y0803(01)&model=guichett > (Date accessed: 0/06/2002) [Hereinafter *Council Resolution of 19 July 1999*].

[97] See EU, European Commission, *Communication COM (2000) 750 final of 22 November 2000 on Galileo* [2000] Available online at <http://www.europa.eu.int/comm/energy_transport/library/gal_com_2000_750_en.pdf > (Date accessed: 06/05/2002) [Hereinafter *COM (2000) 750 final*].

[98] See European Council, *Presidency Conclusions of the Feira European Council (19 and 20 June 2000)* at II.A.22. *Available online at* <http://ue.eu.int/Newsroom/LoadDoc.asp?BID=76&DID=62050&LANG=1> (Date accessed 06/06/2002).

[99] See European Council, *Presidency Conclusions of the Stockholm European Council (23-24 March 2001)* at VI. 42. Available online at <http://ue.eu.int/Newsroom/LoadDoc.asp?BID=76&DID=65786&LANG=1> (Date accessed: 06/05/2002).

[100] See *COM (2000) 750 final supra* note 97.

release the remaining TEN's budget appropriations, together with the decision to set up the entity in charge of the project was left to be taken by the Council in December 2001.[101] On June 2002, based on Article 171 (ex Article 130n) of the EC Treaty the Commission proposed to the Council the setting up of an undertaking to complete the development phase of Galileo.[102] The Transport Council of 6 –7 of December 2001 was expected to adopt the Joint undertaking Statutes as well as to release the EUR 450 million to fund the development phase. The decision however was postponed until March 2002 at the latest due to the need of European Union Member States to examine in more detail the results of a study on the economic viability of Galileo.[103] On March 26 indeed, following the unanimous conclusions of the Barcelona European Council,[104] the Council of Transport Ministers released the EUR 450 million necessary to develop the system and at the same time agreed on the Commission's proposal for a Council Regulation establishing the Joint Undertaking responsible for operating it.[105] Finally on May 2002, the Council adopted the Regulation setting up the Galileo Joint Undertaking.[106]

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[101] See EU, Council of the European Union, *Council Resolution of 5 April 2001 on Galileo* [2001] OJ C 157 p. 0001 - 0003. Available online at <http://www.europa.eu.int/comm/energy_transport/library/galileo_council_apr_2001_en.pdf > (Date accessed: 05/05/2002). [Hereinafter *Council Resolution of 5 April 2001 on Galileo*].

[102] See EU, European Commission, *Communication COM (2001) 336 final of 20 June 2001 Proposal for a Council Regulation on the Establishment of the Galileo Joint Undertaking* [2001] O J C 270 E p. 0119 - 0124. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=52001PC0336&model=guichett >(Date accessed: 05/05/2002). [Hereinafter *COM (2001) 336 final*].

[103] See "Decision on Galileo Postponed, but Work Carries On" (2001) 17 at 1, Galileo Newsletter, Genesis Office. Available online at <http://www.genesis-office.org/indexgl.htm> (Date accessed: 06/06/2002). Genesis is a project providing support to the European Commission in order to monitor and manage the overall Galileo activities. One of the major missions of the project is the communication and dissemination of information related to Galileo.

[104] See European Council, *Presidency Conclusions of the Barcelona European Council (15-16 March 2002)* Available online at <http://ue.eu.int/newsroom/up.asp?MAX=&BID=76&DID=69871&File=/pressData/en/ec/69871.pdf&LANG=1> (Date accessed: 06/06/2002).

[105] See EU, Council of the European Union, *Conclusions of the Transport Council of 26 March 2002.* Available online at <http://www.europa.eu.int/comm/energy_transport/library/gal_council_concl_03_2002_en.pdf> (Date accessed: 06/05/2002). [Hereinafter *Conclusions of the Transport Council of 26 March 2002*].

[106] See EU, Council of the European Union, *Council Regulation No. 876/2002 of 21 May 2002 Setting up the Galileo Joint Undertaking* [2002] OJ L 138 p. 0001 - 0008. Available online at <http://www.europa.eu.int/comm/energy_transport/library/gal_r876_2002_en.pdf> (Date accessed: 25/05/2002). [Hereinafter *Council Regulation Setting up the Galileo Joint Undertaking*].

2. The Need for Galileo:

Two major reasons have been stressed in support of the need for Galileo, namely the significant European political dependence on the US military GPS and the desire to reap the benefits deriving from the economic exploitation of the European space sector pursuant to its enhanced technological capabilities.

The European society is becoming increasingly reliant on the use of space-based technologies. An autonomous and competitive capability to develop and manage space-based technologies has become a crucial asset for strengthening the European Union political weight on a global basis. Furthermore, the emergence of new markets for satellites creates enhanced possibilities to generate revenues.[107]

Satellite radio navigation is a landmark technology coming up daily with new applications worldwide. The markets already available for these applications cover a wide array of activities ranging from all forms of transport[108] to medicine, law enforcement, customs and excise operations, energy, agriculture and fisheries.[109] There were more than 6 million users of GNSS in Europe in the year 2001 and studies have estimated that this will grow over to 800 million users by 2020.[110] This technology however is currently dominated by the United States with its GPS system and to a lesser extent by the Russian Federation with its system GLONASS both of a military nature.

Several major concerns arise from the reliance on GPS. Firstly, the signal is extremely weak, and thus regularly lost due to unintended causes, such as natural phenomena and

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[107] See EU, European Commission, *Communication COM (2000) 597 final of 27 September 2000, Europe and Space: Turning to a New Chapter* [2000] at 2. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=52000DC0597&model=guichett> (Date accessed: 10/05/2002).
See also EU, European Commission, *Communication COM (2001) 718 final of 7 December 2001 "Towards a European Space Policy"* [2001] at 8. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=52001DC0718&model=guichett> (Date accessed: 10/05/2002).[Hereinafter *COM (2001) 718 final*].

[108] The *EC White Paper on European Transport Policy for 2010* (October 2001) identifies GNSS as a critical technology that could revolutionize European Transport infrastructure. The full text is available online at <http://europa.eu.int/comm/energy_transport/library/lb_texte_complet_en.pdf> (Date accessed: 08/06/2002).

[109] See *Communication COM (2000) 750 final supra* note 97 at 3.

[110] See EU, *The European Dependence on US-GPS and the Galileo Initiative* (08/02/2002), Galileo Documents, at para 2.1. Available online at <http://europa.eu.int/comm/energy_transport/library/gal_european_dependence_on_gps_rev22.pdf> (Date accessed: 10/05/2002). [Hereinafter *The European Dependence on US-GPS and the Galileo Initiative*].

interference from other electronic transmissions. In the year 2000 for example, no navigation signal could be received for 18 minutes over the territories of Oklahoma, Kansas and Nebraska.[111] But the most worrisome issue is the signal's vulnerability to intentional interference such as jamming.[112] The US Department of Defence (DOD) has been long working secretly for a cure. US civil authorities are also studying the problem. So far they have both been unable to find a solution.[113] Moreover, whereas the capability of GPS to degrade the accuracy for mass-market users was deactivated in May 2000, the capability of reactivation has been maintained. Hence, the possibilities of interference with the GNSS signal are not circumscribed to the case of intended or unintended interference. It is also possible that disruption of the signal derive from an act of self-preservation due to national security concerns,[114] or even from a lack of funds.[115]

From a political perspective, reliance on GPS inevitably translates into the European dependence on US policy in this area. Given the military significance of the system it is evident that the US is not going to give up or share control of GPS with a foreign power.[116] Moreover, official available documentation reveals the US determination to maintain GPS as the dominant satellite navigation system in the world.[117] As a consequence, the US would be in exclusive control of the current and future performance of the one and only (*de facto*) Global Navigation Satellite System and the timing of changes to this performance without any reference whatsoever to the rest-of-the-world

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[111] See *ibid* at 1.

[112] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 1: As GPS uses very low power signal, GPS jamming does not require complex equipment. GPS jamming equipment is already available within the Russian market.

[113] L. Bond, "The GNSS Safety and Sovereignty Convention of 2000 AD" (2000) 65 J. Air. L. & Com. at 448-449.

[114] See Presidential Decision Directive *supra* note 64 at Policy Guideline 6.

[115] See Exchange of Letters *supra* note 62. The US offer of GPS services was specifically made "subject to the availability of funds as required by United States Law." The Russian offer was made "subject to the allocation of resources as required under the legislation of the Russian Federation".

[116] See Presidential Decision Directive *supra* note 64 at Policy Guideline 3: The GPS and U.S. Government augmentations will remain responsive to the National Command Authorities.
See also *COM (1999) 54 final supra* note 14 at 5: The March 1998 Council requested the Commission to explore the possibility of constructing a common US-European system. Three sessions of discussion took place in May, July and November 1998. It however soon became evident that "the US could not consider future joint ownership and a full role for Europe in the control of the basis 24-GPS satellite constellation (primarily because of military considerations)."

[117] See for example Presidential Decision Directive *supra* note 64: "The Department of Transportation will in cooperation with the Departments of Commerce, Defense and State, take the lead in promoting commercial applications of GPS technologies and the acceptance of GPS and U.S. Government augmentations as standards in domestic and international transportation systems."

requirements.[118] In addition, it must be noted that US policy does not rule out charges levied against States[119] thus raising reasonable suspicions as to the US user charges policy that might be followed in the future. This is not consistent with European requirements. "A complementary, independent and interoperable system -Galileo- is essential to neutralize these concerns."[120]

From an economical perspective, Galileo appears vital for the future of Europe's high technology industries.[121] Currently the US industry enjoys a dominant role in the global GNSS market. "The European Union cannot afford not to become involved in what [...] will be one of the main sectors of industry in the twenty-first century."[122] "The overall effect of introducing Galileo [...] will significantly increase the market addressable by European product, applications and service provider companies, as well as dramatically increase the achievable market share of this larger market."[123] In addition, Galileo poses a number of significant challenges as to design and manufacturing that will help Europe to further develop its industrial and technical capabilities.[124]

3. The Programme:

The Galileo Programme comprises four distinct phases:

- The *definition* of the system, which was concluded in the year 2000 with a comprehensive document[125] setting out the results of this phase. During this phase the Commission mobilized a large part of the European space industry as well as a large

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[118] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 2.4. See also, European Commission, Press Release "Continuation of the GALILEO Project: the Commission Underlines the Need for Rapid Decisions" (22/11/2000) Available online at http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/00/1336|0|AGED&lg=EN (Date accessed: 08/08/2002).

[119] See Presidential Decision Directive *supra* note 64 at Policy Guideline 1:The US offer talks of "direct" user charges only, thus Europe might be obligated to pay governmental levies to the US in the future.

[120] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 2.4

[121] See EU, *Galileo: The European Programme for Global Navigation Services* (23/05/2002), Galileo Documents at 5. <Available online at http://europa.eu.int/comm/energy_transport/library/galileo_brochure_may2002.pdf> (Date accessed 27/05/2002). [Hereinafter *Galileo: The European Programme for Global navigation Services*].

[122] See EU, European Commission, Information Note of 31 December 2001, "Galileo, an Imperative for Europe" at 2. Obtained online at <http://www.galileo-pgm.org/indexcf.htm> (Date Accessed: 02/02/2002). [Hereinafter Information Note of 31 December 2001].

[123] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 2.5

[124] See *ibid.*

[125] See *COM (2000) 750 final* note 97.

number of potential service providers so as to generally define the lines of the Galileo Programme.[126]

- The *development and validation* phase covering the detailed definition and subsequent manufacture of the various system components: satellites, ground components, user receivers.[127] The Transport Council of 26 March 2002 finally launched the inception of this phase.[128]
- The constellation *deployment phase* (2006-2007) will basically consist on the full deployment of both the space segment and ground infrastructure so as to be able to offer an operational service as of 2008.[129]
- Galileo is scheduled to be *operational* from the year 2008. This phase entails the need to keep up with the maintenance of the constellation (replacement of satellites) and ground segment.[130]

4. The Partners:

Galileo is a joint initiative of the European Commission and the European Space Agency (ESA). Following Council Resolution of 19 July 1999,[131] the Commission was invited to start without delay and in cooperation with ESA the definition of the Galileo project. Within the field of management, the Commission has proposed important legislative measures namely the establishment of the Galileo Joint Undertaking[132] so as to ensure a single effective management body for the programme and at the same time enable a combination of public and private funding.[133] The Commission has furthermore afforded a significant financial contribution to the definition phase through the 5th Framework Programme for Research and Development.[134] The trans-European network's

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[126] See *ibid* at 3.
[127] See <http://europa.eu.int/comm/energy_transport/en/gal_how1_en.html> (Last updated: 16/04/2002).
[128] See *Conclusions of the Transport Council of 26 March 2002 supra* note 105.
[129] See *COM (2000) 750 final supra* note 97 at 3.
[130] See *ibid.*
[131] See *Council Resolution of 19 July 1999 supra* note 96.
[132] See *COM (2001) 336 final supra* note 102.
[133] See *ibid* at 4.
[134] The Fifth Framework Programme (FP5) has two distinct parts: the Fifth European Community Framework Programme covering Research, Technological Development and Demonstration activities; and the Fifth EURATOM Framework Programme covering research and training activities in the nuclear sector. The Galileo projects funded under FP5 can be consulted online at <http://dbs.cordis.lu/fep-

budget as well as the Sixth Framework Programme for Research and Development[135] will also contribute to the development phase.

The European Space Agency has long experience in the implementation of complex space missions. Pursuant to a Council Resolution of 1994,[136] ESA together with the Commission and EUROCONTROL, engaged in the development of the European contribution to the Global Navigation Satellite System at GNSS-1 level, that is EGNOS, and to the preparation of GNSS-2.[137] Currently EGNOS is being developed by European and Canadian industries under ESA management.[138] Galileo's development and validation phase is to be co-financed by ESA and the Commission. Pursuant to Article 3 of the Statutes of the Joint Undertaking,[139] the Joint Undertaking shall conclude an agreement with ESA by virtue of which the latter is to carry out the activities required during the development phase related to the space segment and the earth segment of Galileo.

Galileo's infrastructure needs to be constructed in the upcoming years. The development phase of Galileo is to be funded with EUR 1.1 billion from public funds to

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(*...continued*)
cgi/srchidadb?CALLER=PROJ_FP5&QM_EP_PGA_D=LIFE+QUALITY&QM_EP_PGA_D=EESD&QM_EP_PGA_D=GROWTH&QM_EP_PGA_D=FP5-EAECTP+C&QM_EP_PGA_D=HUMAN+POTENTIAL&QM_EP_PGA_D=INCO+2&QM_EP_PGA_D=INNOVATION-SME&QM_EP_PGA_D=IST&QM_EP_PGA_D=FRAMEWORK+5C&QZ_WEBSRCH=galileo&USR_SORT=EP_PGA_A+CHAR+ASC> (Date accessed: 09/06/2002).

[135] As stated on the *Commission's Modified Proposal COM (2001) 709 final of 22 November 2001 for a Decision of the European Parliament and of the Council Concerning the Sixth Multiannual Framework Programme of the European Community for Research, Technological Development and Demonstration Activities aimed at Contributing Towards the Creation of the European Research Area,* seven priority thematic areas have been selected for the period 2002-2006, *inter alia* that of aeronautics and space particularly addressing the implementation of the Galileo project. This document is available online at <http://ftp.cordis.lu/pub/documents_r5/natdir0000002/s_1732005_20011129_130120_6ERC011555en.pd> (Date accessed: 08/06/2002).

Commission's COM (2002) 43 final of 5 February 2002 Amended Proposal for Council Decisions Concerning the Specific Programme implementing the Sixth Framework Programme of the European community for Research, technological Development and Demonstration Activities, recalls the importance of building the necessary expertise and knowledge so as to be able to exploit Galileo. Research will focus on the development of multisectorial concepts, systems and tools, user equipment including receivers. This document is available online at <http://ftp.cordis.lu/pub/documents_r5/natdir0000022/s_1763005_20020205_084345_6FPC021586en.pdf> (Date accessed: 08/06/2002).

[136] See *Council Resolution of 19 December 1994 supra* note 77.

[137] See *Tripartite Agreement supra* note 79.

[138] See <http://europa.eu.int/comm/energy_transport/en/gal_who1_en.html> (Date accessed: 08/06/2002).

[139] See EU, *Statutes of the Galileo Joint Undertaking* annexed to the Council Regulation N. 876/2002 *supra* note 106. [Hereinafter *Statutes of the Galileo Joint Undertaking*].

be equally apportioned between the European Commission and ESA. An extra EUR 200 million are expected to be raised from the private sector.[140] Industry participation is essential for the development of Galileo. For this purpose and pursuant to Article 3 para 2 of the Statutes of the Galileo Joint Undertaking, "it shall negotiate, by way of a competitive tendering process with the private sector, an overall agreement for the financing of the deployment and operational phases."[141] Already in March 2001, the representatives of the main industries concerned signed a *Memorandum of Understanding* committing themselves to a contribution to the development phase.[142]

5. Applications and Services of the Galileo System:

Galileo is a multimode system whose applications are well beyond the determination of the user's position and time. The numerous applications range from all modes of transport (aeronautical, maritime, road, rail, and pedestrian) to timing, engineering, agriculture and fisheries, energy, environment, financing, banking and insurance, environmental management, search and rescue, crisis management, personal navigation and recreation. [143]

As to civil aviation, Galileo will revolutionize Air Traffic Management by allowing for the optimization of air routes and the reduction of the mandatory separation between aircraft thus permitting a much-needed increase of the air space capacity. By using GALILEO, airport infrastructures could also be adapted to growing air traffic while guaranteeing better traffic control and safety. [144]

In respect of aviation safety, Galileo will be more reliable than the present systems and it can be used in the various phases of flight (*i.e.* en-route guidance, airport approach, landing and for ground guidance). Furthermore, aviation safety can very meaningfully be

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[140] See European Commission, Press Release, "A Joint Undertaking for Galileo" (20/06/2001). Available online at <http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/01/863|0|AGED&lg=EN> (Date accessed: 08/06/2002).

[141] See *Statutes of the Galileo Joint Undertaking supra* note 139.

[142] See EU, European Commission, *Commission Staff Working Paper SEC (2001) 1960 of 5 December 2001, Progress Report on the GALILEO Programme* at 8 para 2.2. Available online at <http://europa.eu.int/comm/energy_transport/library/gal_sec_2001_1960_en.pdf> (Date accessed: 08/06/2002). [Hereinafter *SEC (2001) 1960*].

[143] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 13-17.

[144] See <http://europa.eu.int/comm/energy_transport/en/gal_what_en.html#1> (Date accessed: 05/07/2002).

enhanced by the joint use of GPS and Galileo. The joint integrity potential offered by two interoperable constellations, will provide a very high degree of reliability of the signal optimal for safety critical services.[145] The possible relations of Galileo in respect of GLONASS remain unsure given the present uncertainties as to whether the Russian Federation will have the financial strength to maintain its constellation fully operational.

Galileo will offer five different categories of services:

- The open service, defined for mass-market applications, will provide a positioning navigation and dating service free of charge. It will be available to any person in possession of a Galileo receiver with no authorization required. The principal applications of this service will be private road navigation, network dating, traffic information systems and mobile telephony. There will be no service guarantee or liability from the operator for this service.[146]
- The commercial service, aimed at market applications requiring higher performance, will provide added valued services subject to the payment of a fee to the Galileo operator. Typical value added services include high data-rate broadcasting, precise timing services, the provision of ionosphere delay models and local differential correction signals for extreme-precision position. In return for the fee the operator will offer a series of guarantees including the assumption of liability for malfunctions of the system and a compensation mechanism to reimburse damages. There will be a controlled access to this service based on protected access keys in the receivers.[147]
- The safety of live service (SOL), offering a world-wide high integrity level, will be used for most transport applications where human lives could be endangered in the case of a faulty performance of the navigation service without proper and timely notice of the failure (*i.e.* aviation and rail transport). Revenues will be generated by providing controlled access to the signal users such as air traffic controllers, air companies, rail companies, etc.[148]

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[145] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 20;
See also *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at 23 para 4.
[146] See *COM (2000) supra* note 97 at 12.
See also *Galileo: The European Programme for Global Navigation Services supra* note 121 at 20.
[147] See *COM (2000) 750 Final supra* note 97 at 12.
See also *Galileo: The European Programme for Global Navigation Services supra* note 121 at 20; *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at 24 para 1.1.
[148] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 20.

- The public regulated service (PRS) operational at all times even during periods of crisis, will have the accuracies and availability of the safety of life services. The service however will be limited to public controlled applications such as European and/or national security, (*i.e.* police, civil protection, law enforcement and other governmental activities) some critical energy and telecommunications applications and economic and industrial activities of strategic importance for Europe. Civil bodies will control access to this encrypted service pursuant to security policy rules applicable in Europe. The PRS will be separated from the other services so that in case of emergency they could be denied without affecting it.[149]
- A search and rescue service is being defined based on the humanitarian and public service principles of the international COSPAS-SARSAT, currently the only system of this kind covering the entire globe.[150] Galileo will bring significant improvements to the existing system including near real time reception of distress messages (the average waiting time is presently an hour) with acknowledgement to the user that the message has been received, precise location of alerts (with a margin of a few meters rather than the current five kilometres range) multiple satellite detection and enhanced availability of the space segment. [151]

See also *COM (2000) 750 Final supra* note 97 at 13.

[149] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 21.
See also *COM (2000) 750 Final supra* note 97 at 13; See also
<http://europa.eu.int/comm/energy_transport/en/gal_how_en.html#2> (Date accessed: 05/07/2002).

[150] COSPAS-SARSAT is a satellite system designed to provide distress alert and location data to assist search and rescue (SAR) operations, using spacecraft and ground facilities to detect and locate the signals of distress. There are now a number of countries and organizations participating in the operation of the System, Canada, France, Russia and the USA (the four Parties to the COSPAS-SARSAT International Programme Agreement) 20 Ground Segment Providers, 9 User States and 2 Participating Organizations. Further information is available at the COSPAS-SARSAT home page at <http://www.cospas-sarsat.org/> (Date accessed: 05/07/2002).

[151] See *COM (2000) 750 Final supra* note 97 at 11and 13.
See also *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at 25-26 para 1.4.

Chapter III: The Role of ICAO in the Planning and Implementation of GNSS:

I. Global Coordination:

"The implementation of CNS/ATM systems [...] could not be successful without the involvement of a global international institution providing the necessary expertise and performing planning and coordinating functions."[152] The Statement of ICAO Policy on CNS/ATM systems stipulates that ICAO "shall coordinate and monitor the implementation of the CNS/ATM systems on a global basis in accordance with ICAO's regional navigation plans and global coordinated CNS/ATM systems plan."[153] The 31st Session of the ICAO Assembly furthermore stressed that "ICAO is the only international organization in a position effectively to co-ordinate global CNS/ATM activities."[154] At the 33rd Session, held from September to October 2001, Assembly Resolution A33-15 reproduces the same statement.[155] The fact that both the Russian Federation and the United States have offered their respective systems to the rest of the world through ICAO, confirms their recognition of ICAO's global coordination role.[156]

ICAO's coordinating function is to be exercised at both global and regional levels. From a global perspective, due to the multiplicity of existing and envisaged systems, a need for coordination arises so as to ensure their compatibility and interoperability. At the

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[152] See Weber & Huang *supra* note 42 at 43.
[153] See ICAO, *Statement of ICAO Policy on CNS/ATM Systems Implementation and Operation* ICAO Doc. LC/29-WP/ 3-2 (28/03/1994) at para 3. [Hereinafter *ICAO Policy Statement on CNS/ATM Systems*].
[154] See ICAO, *Consolidated Statement of Continuing ICAO Policies and Practices Related to Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) Systems* (04/10/1995). Assembly Resolution A31-6, at Appendix A. Available online at < http://www.icao.int/icao/en/res/res_arch/a31_6.htm> (Date accessed: 10/06/2002).
[155] See ICAO, Assembly, *Consolidated Statement of Continuing ICAO Policies and Practices Related to Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) Systems* (05/10/2001). Assembly Resolution A33-15, Appendix A at first 'whereas clause' superseding Assembly Res. A31-6 *ibid.* Available online at <http://www.icao.int/icao/en/assembl/a33/resolutions_a33.pdf > (Date accessed: 11/06/2002). [Hereinafter Res. A33-15].
[156] See A. Kotaite "ICAO'S Role with Respect to the Institutional Arrangements and Legal Framework of Global Navigation Satellite System (GNSS) Planning and Implementation" (1996) XXI-II Ann. & Air Sp. L. at 198.

regional level, ICAO can assist the development of regional implementation plans.[157] Accordingly, the European Air Navigation Group (EANGPG) was re-established by the ICAO Council acting upon Recommendation 1/1 of the Special European Air Navigation Meeting that took place in September 1994. The objectives of the ICAO European Air Navigation Planning Group are *inter alia:*

> To promote and facilitate the harmonisation and co-ordination of the air navigation related Programme of other international organisations such as the Commission of the European Communities (CEC), the European Civil Aviation Conference (ECAC), EUROCONTROL, the Interstate Aviation Committee of the Commonwealth of Independent States (IAC/CIS) (within the framework of functions and authority voluntarily delegated by the States of the CIS), the Joint Aviation Authorities (JAA), *and their Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) systems implementation efforts*, (emphasis added) including the activities of States and State groupings in the Central, Eastern and Far Eastern Parts of the EUR Region.[158]

As part of its coordinating function, ICAO is also to harmonize with the International Telecommunication Union for frequencies allocation.[159]

II. Technical Cooperation for the Development and Implementation of GNSS:

"The term 'technical cooperation' is the politically correct synonym for ICAO's 'technical assistance Programme"[160] denoting the provision of training opportunities, expert services and experimental projects so as to facilitate the implementation of CNS/ATM systems particularly for developing countries.[161] The 1994 Policy Statement recognized ICAO's "central role in coordinating technical cooperation arrangements for

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[157] See J. Huang "Development of the Long-Term Legal Framework for the Global Navigation Satellite System", (1997) XXII-I Ann. & Air Sp. L. at 591.
[158] See ICAO, European Air Navigation Planning Group (EANPG) at <http://www.icao.int/icao/en/ro/eurnat/eanpg_eanpg.html> (Date accessed: 11/08/2002).
[159] See Kotaite *supra* note 156 at 198. See also Huang *supra* note 157 at 591.
[160] See Milde *supra* note 60 at 204.
[161] See Kotaite *supra* note 156.

CNS/ATM systems implementation."[162] The 33rd Session of the ICAO Assembly furthermore reiterated this principle.[163]

III. Regulation of GNSS:

1. Short-Term Legal Framework:

A. ICAO Initiatives: Policy Statements, Guidance Material and Recommendations:

The international law-making process very often starts with a first set of non-binding rules in diverse forms offering the necessary guidance in the absence of more strict rules and paving the way towards a legally binding framework.[164]

In 1994, ICAO issued its "Policy Statement on CNS/ATM Systems Implementation and Operation"[165] enouncing important principles such as universal accessibility, sovereignty, authority and responsibility of contracting States, the role of ICAO with regard to CNS/ATM, technical cooperation, institutional arrangements and implementation, global navigation satellite systems, airspace organization and utilization, continuity and quality of service and cost recovery.

As an interim measure, ICAO made arrangements through an exchange of letters with the United States in 1994 and with the Russian Federation in 1996[166] concerning the use of GPS and GLONASS by the international civil aviation community. The exchange of letters reiterated the main principles previously enounced by ICAO in the 1994 Policy Statement.[167]

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[162] See *ICAO Policy Statement on CNS/ATM Systems* note 153 at para 4.
[163] See Res. A33-15 *supra* note 155 Appendix B.
[164] See Kotaite *supra* note 156 at 198.
[165] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153.
[166] See Exchange of Letters *supra* note 62.
[167] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153.

The ICAO Legal Committee has adopted a Draft Model Agreement[168] between ICAO and the provider of the GNSS signal regarding the provision of signals together with a Draft Checklist of items that should be contained on contracts for GNSS signal provision.[169]

On 6 December 1995, the ICAO Council created a Panel of Legal and Technical Experts on the Establishment of a Legal Framework with Regard to GNSS (LTEP) which in 1998 concluded the text of the Draft Charter of the Rights and Obligations of States Relating to GNSS reaffirming[170] some essential principles useful for the establishment of a future GNSS legal framework.

From 11 to 15 May 1998, the ICAO Worldwide CNS/ATM Systems Implementation Conference was held in Rio de Janeiro with the objective of bringing together all partners in the world-wide implementation of CNS/ATM systems around two main issues, the financing mechanisms and the institutional frameworks required to move the projects forward.[171] The Conference declared its support for the adoption of the Draft Charter on the Rights and Obligations of States Relating to GNSS Services as an interim legal framework[172] and produced a series of important Recommendations.[173]

In 1998, the 32nd Session of the ICAO Assembly, pursuant to Resolution A32-19, formally adopted the Draft Charter.[174] It also adopted Resolution A32-20 by virtue of

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[168] See ICAO, *Draft Agreement Between the International Civil Aviation Organization (ICAO) and GNSS Signal Provider Regarding the Provision of Signals of GNSS Services*, ICAO Doc. LC/29-WP/3-9 (06/07/1994).

[169] The Draft Agreement has been qualified as an "exercise in futility in all respects: ICAO has no constitutional standing to enter into such agreement. As well the existing signal providers showed no interest in such agreement and based their offer to the international Community on a unilateral statement". Quoted from Milde *supra* note 60 at 209.

[170] See Weber & Huang, *supra* note 42 at 44: Some of these principles were derived from the 1994 *Policy Statement* and the exchange of letters. Another set of principles was derived form the Recommendations of the 29th Legal committee. Finally, other principles were derived from the Chicago Convention.

[171] See Press Release, "World Wide Conference Produces Strong Recommendations for Financing and Managing CNS/ATM Systems Implementation" (15 May 1998) Available online at <http://www.icao.int/allpirg/press.htm> (Date accessed: 11/06/2002).

[172] See *WW/IMP Declaration on Global Air Navigation Systems for the Twenty-first Century supra* note 15.

[173] See *Final Report of the World-Wide CNS/ATM Systems Implementation Conference* (15/05/1998). Available online at <http://www.icao.int/allpirg/finrep.html >(Date accessed: 11/06/2002) [Hereinafter WW/IMP Final Report].

[174] See ICAO, Assembly, 32nd Session, *Charter on the Rights and Obligations of States Relating to GNSS Services* (02/10/1998). Res. A32-19. [Hereinafter *GNSS Charter*] Available online at <http://www.icao.int/icao/en/res/a32_19.htm > (Date accessed: 11/06/2002).

which, a Secretariat Study Group on Legal aspects of CNS/ATM Systems was established to:

> a) ensure the expeditious follow-up of the recommendations of the worldwide CNS/ATM Systems Implementation Conference, as well as those formulated by the LTEP, especially those concerning institutional issues and questions of liability; and
> b) consider the elaboration of an appropriate long-term legal framework to govern the operation of GNSS systems, including consideration of an international convention for this purpose, and to present proposals for such a framework in time for their consideration by the next ordinary Session of the Assembly.[175]

The 33rd Session of the Assembly resolved to continue adopting at each ordinary session a consolidated statement of continuing ICAO Policies and Practices as to CNS/ATM[176] and that further work be carried out for the timely implementation of CNS/ATM systems.[177]

On the technical side the main ICAO effort is being developed by the Global Navigation Satellite System Panel (GNSSP) created in 1993 for the purpose of developing ICAO Standards and Recommended Practices (SARPS) and Guidance material[178] in accordance with Article 37 of the Chicago Convention.[179]

Finally, it is to be noted that Article 69 of the Chicago Convention could also be used for the promotion of GNSS as it gives the Council, under certain circumstances, the possibility to make recommendations to a specific State so as to improve international air navigation facilities.[180]

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[175] See ICAO, Assembly, 32nd Session, *Development and Elaboration of an Appropriate Long-Term Legal Framework to Govern the Implementation of GNSS,* (02/10/1998). Res. A32-20 at para 5. [Hereinafter Res. A32-20] Available online at <http://www.icao.int/icao/en/res/a32_20.htm> (Date accessed: 11/06/2002).
[176] See Res. A33-15 *supra* note 155 at para 2.
[177] See *ibid* Appendix B at para 5.
[178] See V. Iatsouk, "Development of ICAO Standards for the Global Navigation Satellite System is Moving Ahead" (1998) 53:5 ICAO J. at 7.
For further information on standardization see Chapter IV Section III.2.
[179] See *Convention on International Civil Aviation*, 7 December 1944, ICAO Doc. 7300/6 (entered into force 4 April 1944). [Hereinafter *Chicago Convention*].
[180] See Kotaite *supra* note 156.

B. The European Proposal with Respect to the Short-Term Legal Framework for GNSS: The Contractual Approach:

Since the 32nd Assembly, ICAO's Secretariat Study Group has been the only initiative at the global level as regards the institutional and legal issues presented by GNSS. In Europe, GNSS issues have also been studied by EUROCONTROL and by the European Community. The resulting outcome outlines the need for an overall institutional framework including in particular an appropriate liability regime.[181] However, in view of the fact that negotiating multilateral treaties is a time-consuming cumbersome process, a more flexible short-term approach solution has been developed, namely 'the contractual framework.'[182] "The purpose of the contractual framework is to link the safe use of GNSS services to the operation of the overall air navigation system and its components through contractual arrangements between the parties concerned."[183] Two requisites are however essential for a successful contractual framework, namely a set of mandatory elements to be contained in the contracts, and a GNSS institutional entity to act as a focal point between the multiple actors involved in the contractual chain.[184] At each stage in the chain, the contractual arrangements would give the necessary guarantees of service as set out in the ICAO Charter and SARPs while at the same time indicating the apportionment of liability of each actor.[185] The contractual approach, "could act as an intermediate solution until the contracting States have agreed and adopted an international legal instrument based on the common principles used for the contractual intermediate arrangements."[186]

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[181] See ICAO, Assembly, 33rd Session, "European Developments with Regard to the Development of a Contractual Framework Leading Towards a Long-Term Legal Framework to Govern the Implementation of GNSS", A33-WP/60 (02/08/2001) at 2 para 2.2. Available online at <http://www.icao.int/icao/en/assembl/a33/wp/wp060_en.djvu> (Date accessed: 11/06/2002).
[182] See *ibid* at 2 para 2.3.
[183] See *ibid* at 3 para 3.1.
[184] See *ibid* at 3 para 3.7.
[185] See *ibid* at 3 para 3.2.
[186] See ICAO, Assembly 33rd Session, "Establishment of a Legal Framework with Regard to CNS/ATM Systems Including GNSS" A33-WP/78 (03/08/2001) at 3 para 2.9. Available online at <http://www.icao.int/icao/en/assembl/a33/wp/wp078_en.djvu> (Date accessed: 11/06/2002). [Hereinafter A33-WP/78].

The Secretariat Study Group on Legal Aspects of CNS/ATM,[187] held five meetings between April 1999 and March 2001. The Council presented the main results of its work to the Legal Commission of ICAO at the 33rd Session of the ICAO Assembly.[188] A part of the Group believed that the important issue of liability should not be left up to national legislation and thus an international instrument should deal with the matter. Another sector of the Group affirmed the sufficiency of the existing liability regime under domestic legislation.[189] Eventually, the Group reached common grounds in the European proposal, namely "to explore the approach of a contractual framework,"[190] provided that some common elements would have to be included in the contractual arrangement.[191] The contractual framework as envisaged by the Group would be a non-mandatory framework covering the relationships among the different actors[192] and in compliance with the Charter on the Rights and Obligations of States Relating to GNSS Services.[193]

In respect to the suggested contractual approach, the United States, virtually the only current signal provider, expressed the view that although ICAO should further consider the contractual approach, it should nevertheless evaluate it carefully so as not to complicate the rights and responsibilities drawn by the Chicago Convention and furthermore to "leave to sovereign States the prerogative to determine their own interest and how to pursue them."[194]

As a non-definitive solution, the Legal Commission decided to recommend the Plenary of the Assembly to "decide that further work on the legal aspects of the CNS/ATM Systems must be carried out so as to finalize the concept of a contractual

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[187] See Res. A32-20 *supra* note 175.
[188] See ICAO, Assembly 33rd Session, "Progress Report on the Establishment of a Legal Framework with Regard to CNS/ATM Systems Including GNSS" A33-WP/34 (22/06/2001). Available online at <http://www.icao.int/icao/en/assembl/a33/wp/wp034_en.djvu> (Date accessed: 11/06/2002). [Hereinafter A33-WP/34].
[189] See *ibid* at 2 para 3.3.
[190] See *ibid*.
[191] See *ibid* at Appendix. The Study Group has drafted an outline of the contractual framework for GNSS Services.
[192] See *ibid* at 3 para 4.2.
[193] See *ibid* at 3 para 4.3.
[194] See ICAO, Assembly 33rd Session, "A Note on Legal aspects of CNS/ATM, Including Views on How to Evaluate a Proposed Contractual framework for GNSS." A33-WP/188 (26/09/2002) at 1 at 'Summary.' Available online at <http://www.icao.int/icao/en/assembl/a33/wp/wp188_en.djvu> (Date accessed: 11/06/2002). [Hereinafter A33-WP/188].

framework"[195] For this, it appeared that the Study Group would be the proper forum for the further study of the contractual approach.[196]

The Plenary of the Assembly, pursuant to Assembly Resolution A33-15 urged the Council "to continue considering without delay the economic, institutional, legal and strategic aspects related to the implementation of the ICAO CNS/ATM systems."[197]

2. Long-Term Legal Framework:

It was the mandate of the Secretariat Study Group on CNS/ATM Systems to continue the work undertaken by the LTEP and to further consider the elaboration of a long-term legal framework for the operation of GNSS in the form of an international Convention.[198] The Secretariat Study Group has recognized that "the long term-GNSS would still be evolving."[199] In general there is a broad consensus that the complex legal issues that arise out of GNSS require further study[200] and so, it was considered premature to decide at this Session to develop a multilateral instrument.[201] The Group noted in the 33rd Assembly Session that the European initiative to develop Galileo would bring new institutional issues, which would need to be revisited in the future.[202] As a result of its work, the Group proposed to further develop the contractual framework as an interim middle term solution.[203] While most delegations considered the contractual framework as a reasonable proposal for further work,[204] it was also stressed that the contractual approach would not provide for a final solution and that an international convention was still the ultimate goal to be pursued in the future.[205] The United States however reiterated the sufficiency of the

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[195] See ICAO, Assembly, 33rd Session, "Report of the Legal Commission for the General Section of its Report and on Agenda Items 7, 31, 32, 33, 34, 35 and 36" A33-WP/306 (04/10/2001) at 32-2 para 32:8 b). Available online at <http://www.icao.int/icao/en/assembl/a33/wp/wp306_en.djvu> (Date accessed: 11/06/2002). [Hereinafter A33-WP/306].
[196] See *ibid* at 32-2 para 32:7.
[197] See Res. A33-15 *supra* note 156 Appendix B at para 5.
[198] See Res. A32-20 *supra* note 175.
[199] See A33-WP/34 *supra* note 188 at 2 para 2.1.
[200] See A33-WP/306 *supra* note 195 at 32-2 para 32:7.
[201] See *ibid* at 32-1 para 32:5.
[202] See A33-WP/34 *supra* note 188 at 2 para 2.1.
[203] See *ibid* at 2 para 3.3.
[204] See A33-WP/306 *supra* note 195 at 32-1 para 32:5.
[205] See *ibid* at 32-2 para 32:7.

existing legal framework given the lack of evidence to show that the GNSS new technology gives rise for a new legal regime.[206]

3. Minimum Guarantees of the GNSS Long-Term Legal Framework:

Consensus as to an international instrument for the governance of GNSS is yet to emerge and GNSS service providers seem unwilling to internationally share control over their own systems. It is clear however that given the fact that most States would have to rely on foreign signals originated outside their territory, there is a need to ensure a series of minimum legal guarantees in terms of accessibility, continuity, integrity, accuracy and reliability of the system. "This can be done while fully protecting the providers' interests."[207] "The European view is that the establishment of new international rules possibly in the form of a Convention [...] is necessary."[208]

A. Universal Accessibility: The Principle of Non-Discrimination:

Universal access without discrimination is a must for GNSS to become a truly global system. The *Convention on International Civil Aviation* [209] states the principle that air navigation facilities open to public use shall be provided under "uniform conditions" to the aircraft of all other contracting States.[210] The 1994 Policy Statement affirmed the principle of universal access without discrimination.[211] The *Charter on the Rights and Obligations of States Relating to GNSS Services* further reiterates this principle.[212] The principle can also be found in the exchange of letters of ICAO with the United States and the Russian Federation in respect of GPS and GLONASS.[213]

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[206] See A33-WP/188 *supra* note 194 at 2 para 1.1.
[207] See Bond *supra* note 113 at 449.
[208] See WW/IMP *supra* note 7 "A European View on the Legal and Institutional Issues Relating to GNSS" WW/IMP-WP/12 (11/05/1998) at 4 para 4.4. Available online at <http://www.icao.int/allpirg/rio-wp/> (Date accessed: 12/06/2002). [Hereinafter WW/IMP-WP/12].
[209] See *Chicago Convention supra* note 179.
[210] See *ibid* at Article 15.
[211] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 1.
[212] See *GNSS Charter supra* note 174 at 2.
[213] See Exchange of Letters *supra* note 62.

However, the legal significance of the exchange of letters is controversial. The offers could be considered as a promise. "Promise is a unilateral declaration by which a State undertakes to behave in a certain manner" regardless of any reciprocal undertaking by other States.[214] Nevertheless, for a unilateral declaration to produce such effect, the States making the statement should have the clear intention to be bound by it.[215] In this respect, at least as regards the US Letter, the fact that it was expressly submitted "*in lieu of an agreement*" clearly evidences a lack of intention of the United States to conclude a formal agreement.

In any case, it has been noted that ICAO lacks the constitutional standing to enter into such agreement. Whereas the Chicago Convention establishes that the Council "may enter into such other agreements as may facilitate the work of the Organization,"[216] the context of the entire provision refers to agreements with other international bodies for the maintenance of common services and common arrangements concerning personnel. Therefore "it would appear impermissible to extend its applicability to the provision of GNSS."[217]

Furthermore, "in form, the letters are clearly not a 'treaty' and most important, if intended to be legally binding, proper United States procedures for entering executive agreements would have to be followed."[218]

In conclusion, it seems justified to affirm that the exchange of letters represents more a unilateral policy statement than a formal agreement. As a result, and giving the non-binding nature of the ICAO CNS/ATM instruments, the principle of *bona fides*[219]constitutes the only international guarantee as to compliance.[220]

The principle of non-discrimination however is well established at both international and national levels. Internationally there exists the precedent of the *Principles on Remote*

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[214] A. Cassese, *International Law* (Oxford: University Press, 2001) at 151.
[215] See *ibid.*
[216] See *Chicago Convention supra* note 179 at Article 65.
[217] See Milde *supra* note 60 at 201.
[218] See J.M. Epstein, "Global positioning System (GPS): Defining the Legal Issues of its Expanding Civil Use" (1995) 61 J. Air. L. & Com.at 275.
[219] The principle of good faith is one of the axioms of Public International Law. See *Charter of the United Nations*, 26 June 1945, 16 UST 1134 (entered into force 24 October 1945). Pursuant to Article 2(2) "all Members, in order to ensure to all of them the rights and benefits resulting from membership, shall fulfill *in good faith* the obligations assumed by them in accordance with the present Charter." Available online at <http://www.un.org/aboutun/charter/index.html> (Date accessed: 17/06/2002).
[220] See Milde *supra* note 60 at 201.

Sensing guaranteeing non-discriminatory access to data by the sensed State.[221] US national courts have also upheld the principle of non-discrimination.[222]

Despite the fact that the general principle of universal accessibility is well accepted there still remains the issue of how to provide a legal assurance of universal accessibility. A large number of States (namely Europe and developing countries) are of the view that only a convention could guarantee non-discriminatory access.

Galileo has raised issues as to the principle of universal access given the European intention to charge for highly accurate Galileo services. However, so long as the charging policy is applied under 'uniform conditions' Galileo cannot be said to violate the principle of non-discrimination.[223]

B. Continuity:

Continuity of a system is the capability of the system to perform its function without unscheduled interruptions during the intended operation.[224] "The principle of continuity of the GNSS both in the technical [...] and in the legal sense, [...] is of paramount importance."[225] The 1994 ICAO Policy Statement expressly addressed this principle.[226] The Charter further reiterates that every signal provider, shall ensure the continuity of the services"[227] In the exchange of letters, both the United States and the Russian Federation have respectively offered to provide the service on a continuous basis.[228]

However, the Chicago Convention specifically provides the "freedom of action" of States in the case of war or declared national emergency.[229] In this regard, it should be noted that it is the US Policy that "GPS and U.S. Government augmentations will

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[221] See UN, General Assembly, *Principles Relating to Remote Sensing of the Earth from Outer Space* UNGA Res. 41/65 (03/12/1986) at Principle XII. Available online at <http://www.oosa.unvienna.org/SpaceLaw/rs.html> (Date accessed: 17/06/2002).
[222] See Larsen "Future GNSS Legal Issues" *supra* note 61at 22.
[223] See *ibid* at 22.
[224] See Annex 10 *supra* note 48 I Attachment D, ATT D-2, para 3.4.1.
[225] See Milde *supra* note 60 at 207.
[226] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 8.
[227] See *GNSS Charter supra* note 174 at 4.
[228] See Exchange of Letters *supra* note 62. The United States offered "to make GPS-SPS available [...] on a continuous basis." The US has furthermore pledged to give six years notice of termination of the signals. The Russian Federation guaranteed that the system would "continue to operate for at least 15 years." See also Presidential Decision Directive *supra* note 64 at 1.
[229] See *Chicago Convention supra* note 179 at Article 90.

remain responsive to the National Command Authorities"[230] and that commercial use of GPS is subject to national security concerns.[231] The US military has specific contingency plans for denying GPS signals in specific areas of conflict. This however has never been done up to the present date, albeit the possibility exists.[232] Equally, the Decree of the President of the Russian Federation of 18 February 1999 [233] and the Decisions of the Government of the Russian Federation of 29 March 1999 on National Policy,[234] assigned GLONASS the status of dual-purpose system "employed for scientific, social economic goals *and in the interest of the defence and security of the Russian Federation* (emphasis added)."[235]

However, it has been argued that:

> In spite of the right of a State to adopt the course, which it considers best suited to the exigencies of its security and to the maintenance of its integrity, the deliberate and unannounced denial of service [...] could be a breach of the [...] Trail Smelter principle and of the doctrine of reliance. [...] The right of a State to protect itself from danger coexists with the right of the other State [...] not to be subjected to any harm by the other State in its action to prevent danger to its territory.
> Additionally, the freedom of the provider State is also limited by the fact that States will be relying on the offers made to permit the use of GPS [...]. This legal principle of reliance also referred to as the Good Samaritan principle is applied in its various forms in many legal systems throughout the world.
> The Good Samaritan doctrine can be applied to the promise to provide GNSS signals to the civil community. [...] By undertaking to offer the signals [...] the providers have placed themselves in the position of the parabolic Good Samaritan and have consequently assumed a duty of care [...] not to cause injury to any [...] user.[236]

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[230] See Presidential Decision Directive *supra* note 64 at Policy Guideline 3.
[231] See *ibid* at Policy Guideline 6.
[232] See US, DOT, Official US Position on Galileo, *U.S. Global Positioning System and European Galileo System* (07/03/2002) at para 4. Available online at <http://www.state.gov/r/pa/prs/ps/2002/8673.htm> (Date accessed: 17/06/2002).
[233] See Russian Federation, *Decree No. 38RP of the President of the Russian Federation* (18/02/1999) Available online at <http://www.rssi.ru/SFCSIC/english.html> (Date accessed 12/06/2002).
[234] See Russian Federation, *Declaration of the Government of the Russian Federation* (29/03/1999) Available online at <http://www.rssi.ru/SFCSIC/english.html > (Date accessed: 12/06/2002).
[235] See *Decree No. 38RP of the President of the Russian Federation supra* note 233 at para 1.
[236] See B.D.K Henaku, "Expanding Global Navigation Services: Selected Legal Issues" (1999) Proceedings of the Workshop on Space Law in the Twenty-First Century, UNISPACE III Technical Forum (New York: UN Publication, 2000) at 171- 173.

Moreover, in the LTEP one view was submitted that continuity of the service ought to be maintained even in case of war or emergency as civil aviation should not be endangered by reason of military concerns.[237] No legal authority however was cited to support such assertions.[238]

National security concerns are just too great. A middle ground could be found under a multilateral treaty where the signal providers stated the conditions under which the signal will be provided, particularly assuming the legal obligation to supply the services on a continuous basis subject however to specified exceptions (military exceptions presumably would be a minimum) and always under the commitment to give prior notice to the rest of the world in case of 'justified' interruption.[239]

Indeed, the United States, the only *de facto* GNSS signal provider, is fully aware of the need in the part of GPS users to be properly informed of any disruptions of the signal. In this regard, it is to be noted that the US Coast Guard and the FAA have been issuing notices to marines and to airmen regarding DOD's testing of the GPS signals. The notices have even been sent to international organizations and to other countries.[240] This however, has been done outside the umbrella of any binding legal framework, more as 'courtesy' in the part of the signal provider rather than as a legal obligation. It is desirable that if the continuity of the GNSS signal is being made subject to military contingencies, there at least be a firm commitment to give the corresponding prior notice of disruption.

Now, so long as the US remains as the only real GNSS signal provider, it is difficult to find any reasons why it would want to assume such (or any) responsibility in return for nothing. This may though turn different if GPS is deprived of its current GNSS monopoly by Galileo, a new exclusively *civil* system unconstrained by military imperatives and ready to assume legal responsibilities for disruption in the provision of a service not meeting all of its specifications. Then it might be that the US have to start

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[237] See ICAO, *Final Report of the First Meeting of the Panel of Legal Experts on the Establishment of a Legal Framework with Regard to GNSS.* ICAO Doc. LTEP/1 (23/12/1996) at 3-2 para 3:8. [Hereinafter LTEP/1].
[238] See Milde *supra* note 60 at 207.
[239] See Bond *supra* note 113 at 450.
[240] See Larsen "Future GNSS Legal Issues" *supra* note 61 at 20.

making some concrete commitments as to the integrity of the system to level the playing field in order to maintain its GPS 'clientele.'

C. *Integrity, Accuracy and Reliability of the System:*

Satellite navigation systems are expected to offer highly reliable, highly accurate and high integrity services if they are to become the primary means of navigation. The level of accuracy and integrity of the systems should be such as to serve all phases of flight with timely failure warnings and global coverage. Pursuant to the 1994 ICAO Policy Statement, effective arrangements so as "to minimize the operational impact of unavoidable system malfunctions or failure and achieve expeditious service recovery, shall be assured.[241] Likewise, the Charter provides that "every State providing GNSS services [...] shall ensure the [...] integrity, accuracy and reliability of such services."[242] Both the United States and the Russian Federation have committed to take all necessary measures to maintain the integrity and reliability of the GNSS services.[243]

The necessary accuracy however cannot be ensured by GPS and GLONASS alone, and thus augmentation needs to be provided by additional methods. The FAA is developing WAAS and LAAS.[244] In the part of the Russian Federation, due to budgetary constrains, key policy issues for the future include the commitment to Government-supported GLONASS augmentations.[245]

It is also crucial to ensure the integrity of the service by protecting the signal from interference. However the GNSS signal is extremely weak. While the vulnerability of GPS to interference can be reduced, it cannot be eliminated as of today.[246] As a consequence the Volpe Report[247] has recommended that "systems and procedures to

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[241] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 8.
[242] See *GNSS Charter supra* note 174 at para 4.
[243] See Exchange of Letters *supra* note 62: "The United States shall take all necessary measures to maintain the integrity and reliability of the service." In the part of the Russian Federation, "all necessary measures will be taken to ensure the reliability and integrity of the GLONASS (standard-accuracy) channel."
[244] For further information on augmentation systems see *supra* Chapter II Section II.
[245] See Kuropyatnikov *supra* note 70 at 9.
[246] See US, Volpe Report *infra* 247 at 57 para 7.
[247] On the 22nd May 1998, the White House issued Presidential Decision Directive PDD-63 instructing the DOT to undertake a study evaluating the vulnerability of GPS. The Report entitled *Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System* was prepared by

monitor, report, and locate unintentional interference should be implemented or utilized in any application for which loss of GPS is not tolerable."[248] GPS uses the Autonomous Integrity Monitoring of GPS Signals (RAIM). The problem is that it takes a period of time for the message to arrive to the receiver (more than 10/15 seconds) and thus it is not adequate for precision navigation. On the other hand, augmentation systems when fully operational[249] will be able to recognize a problem in less than 10 seconds.[250]

The Volpe Report furthermore recommended the eventual availability of three civil frequencies for mitigating the vulnerability of GPS signal disruption or loss.[251] Accordingly, the US Government has determined that availability of two additional signals is essential for many critical uses of GPS. For both military and civil users GPS services use the entire bandwidth L1. A second non-safety of life signal at the L2 frequency (1227.60 MHz) will be added in 2005. A third civil safety-of-life signal at 1176.45 MHz is scheduled to be added in 2007.[252]

Advantageously Galileo is being designed at a time when all these concerns are being pointed out and so it is intended to implement mitigation measures within the system itself.[253] The European system is thus projected to provide a series of guarantees of performance in terms of accuracy, availability, integrity and continuity of the service albeit *for certain services* and subject to the payment of a fee. No guarantees are envisaged for the basic Galileo service available to all users free of charge.[254]

(*...continued*)
the John A. Volpe National Transportation Systems Centre and came to be known as the Volpe Report. The report is available online at <http://www.navcen.uscg.gov/gps/geninfo/FinalReport-v4.6.pdf> (Date accessed: 12/06/2002). [Hereinafter Volpe Report].

[248] See Volpe Report *ibid* at 59 para 7.

[249] See 2001 FRP *supra* note 75 at 3-5 paras 3.1.3.3 and 3.1.3.4: WAAS has been available for non-safety applications since 2000. WAAS initial capability for safety-of-life applications is expected for 2003. Category I LAAS is currently in development with installation of the first (46) federal systems expected in 2003. Research and specification development are currently under way to support Category II and III LAAS. The first public use of Category II and III LAAS is scheduled for 2006.

[250] Information obtained at an interview with W. Frank Prize, Alternate Representative, Air Navigation Commissioner, United States Mission, International Civil Aviation Organization, Montreal (03/06/2002).

[251] See Volpe Report *supra* note 247 at 58 para 7.

[252] See 2001 FRP *supra* note 75 at 3-3 para 3.1.2.
See also P.B Larsen, "Legal Issues Relating to Civilian and Military Dual Uses of GNSS" (2000) Proceedings of the 43rd Colloquium on the Law of Outer Space (American Institute of Aeronautics and Astronautics) at 88.

[253] See also *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 2.2.

[254] See *COM (2000) 750 Final supra* note 97 at 12.

Galileo is also to bring improvements in respect of jamming through a public regulated service (PRS) using large bandwidths and signal encryption thus offering better protection against intentional interference. The service however is not generally available; it is a secured civil service to be offered to governmental and strategic civil users for civil, police and defence security.[255]

At this stage, the problem of how to ensure the quality of the service seems to rest more on the technical side than that of a legal nature. Whereas stronger guarantees of quality would be better achieved by a firm commitment on the part of the signal providers through a convention rather than pursuant to unilateral policy statements, it cannot be left aside that a definite cure for the problem of the signal vulnerability is yet to be found. Therefore, the only viable solution as of today lies with the recognition of the need of a redundant back-up system so as to guarantee the safety or air navigation in the event of loss of the GNSS signal.

[255] See Information Note of 31 December 2001 *supra* note 122 at Annex 2.

I. Compatibility of GNSS with the Chicago Convention:

The Chicago Convention represents the legal framework for international civil aviation, which is not easy to amend. "The procedure for the amendment of the Chicago Convention is the classic (and now somewhat antiquated) consensual method."[256]
The first paragraph of Article 94 of the Chicago Convention provides:

> a) Any proposed amendment to this Convention must be approved by a two-thirds vote of the Assembly and shall then come into force in respect of States, which have ratified such amendment when ratified by the number of contracting States specified by the Assembly. The number specified shall be no less than two-thirds of the total number of contracting States.[257]

Given that presently the number of contracting States is 188[258] any amendment would enter into force only after ratification by no less than 126 contracting States. Hence amendments take an unreasonable period of time to enter into force: the amendment introducing new Article 93 *bis* took nearly 14 years to come into force, the 1962 amendment of Article 48(a) came into force 13 years later, the amendment on the final clause of the Convention took 20 years, new Article 83 *bis* 17 years and Article 3 *bis* 14 years.[259]

It is therefore important that GNSS be compatible with the Chicago Convention. In this respect, the ICAO Legal Committee concluded that "there is no legal obstacle to the implementation and achievement of the CNS/ATM systems concept" and that "there is nothing inherent in the CNS/ATM systems concept which is inconsistent with the

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[256] See M. Milde, "The Chicago Convention- Are Major Amendments Necessary or Desirable 50 Years Later?" (1994) XIX-I Ann. & Air Sp. L. at 406.
[257] See *Chicago Convention supra* note 179 at Article 188.
[258] See <http://www.icao.int/cgi/goto.pl?icao/en/members.htm> (Last updated: 20/06/2002).
[259] See ICAO, List and Status of International Air Law Instruments at <http://www.icao.int/cgi/AirLaw.pl?alpha> (Date accessed: 14/06/2002).

Chicago Convention."[260] The Secretariat Study Group furthermore considered the implications of Article 28 of the Chicago Convention, which specifies that sovereign States are responsible for the provision of air traffic services in their territories. The Group came to the conclusion that no amendment of Article 28 is necessary in the context of GNSS.[261]

It is however easy to say that Article 28 of the Chicago Convention remains unchanged and that the implementation of GNSS leaves unaffected the responsibility of States under Article 28. But yet, a number of practical issues still need to be solved. In the context of GNSS where the provision of the service entails a foreign element, it is essential that a link be established between the provider of the satellite signal and the State having jurisdiction under Article 28 of the Chicago Convention.[262] This important matter will be the subject of further analysis in the next subsection in the context of the sovereignty concerns that the advent of GNSS has raised in the part of user States.

II. Sovereignty:

The Chicago Convention recognizes that every State has complete and exclusive sovereignty over its air space."[263] This inevitably translates into their right to regulate and decide how to provide air navigation services within their territory. Two main factors justify State claims for effective and direct political control over air navigation services, firstly, national security concerns and secondly, the intrinsic nature of air navigation facilities as a public service.[264] For a large number of countries GNSS poses a real challenge to the concept of sovereignty as traditionally understood given that the GNSS facilities, at least as far as the space segment is concerned, would be operated by a foreign State.

To ease this concerns, the ICAO Policy Statement reads:

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[260] See ICAO, *Report of the 28th Session of the Legal Committee of ICAO*. ICAO Doc. 9588-LC/188 [1994]. Excerpt at Guldimann & Kaiser *supra* note 33 at 126.
[261] See A33-WP/34 *supra* note 188 at 2 para 2.2.
[262] See *ibid.*
[263] See *Chicago Convention supra* note 179 at Article 1.
[264] F. Schubert, "The Shrinking Concept of Sovereignty" (2000) XXV Ann. & Air Sp. L. at 245-246.

> Implementation and operation of CNS/ATM systems [...] shall neither infringe nor impose restrictions upon States' sovereignty, authority or responsibility in the control of air navigation and the promulgation and enforcement of safety regulations. States' authorities shall be preserved in the co-ordination and control of communications and in the augmentation, as necessary, of satellite navigation services.[265]

The Charter[266] and the exchange of letters respectively reaffirm this principle.[267] However, "the importance of State sovereignty in the field of international air law cannot be overstated."[268] As it has been noted,

> The implementation of GNSS requires striking a balance between the need to respect State sovereignty and the need to promote the use of advanced air navigation and air traffic management technology. A necessary compromise may involve a measure of flexibility in the exercise of certain sovereign rights, in particular by entrusting tasks of signal provision and augmentation to foreign States and/or joint agencies or operating structures in exchange for additional benefits flowing from the public utility services of GNSS.[269]

No acceptable solution can be found for the future unless the concept of sovereignty is revisited. It is to be noted that air navigation services encompass both a regulatory and a service provision dimension, which have traditionally been performed by the same national entity. This said it must be realized that the service provision element is fundamentally different from that of a regulatory nature, which basically addresses the necessary conditions of mandatory compliance for access into national airspace by foreign aircraft.[270] The responsibility for the provision of air navigation services by a State under Article 28 of the Chicago Convention can be delegated: [271]

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[265] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 2.
[266] See *GNSS Charter supra* note 174 at para 2: "Every State preserves its authority and responsibility to control operations of aircraft and to enforce safety and other regulations within its sovereign airspace."
[267] See Exchange of Letters *supra* note 62. The US offer "is not intended in any way to limit the rights of any state to control the operations of aircraft and enforce safety regulations within its sovereign airspace" In its part, the Russian Federation does not intend "to limit the right of any state to control aircraft operations and monitor compliance with flight safety regulations in its airspace."
[268] See A. Kotaite, "Is There a Lessening of State Sovereignty or a Real Will to Co-operate Globally?" (1995) I Public International Law Casebook (Montreal: McGill University, 2001) at 111.
[269] See Huang *supra* note 157 at 590.
[270] See Schubert *supra* note 264 at 249.
[271] See A33-WP/78 *supra* note 186 at 2 para 2.2.

> A new pragmatic understanding of global national sovereignty [...] requires both functions to be clearly separated. While States would retain complete and exclusive sovereign powers to regulate ATM activities within their respective territories, [...] the provision of these services need no longer be contained by these political boundaries.[272]

The Rio Conference recommended that States "consider, [...] participation in sub regional, regional or global co-operative ventures to provide CNS/ATM systems components such as delegation of services (emphasis added)."[273]

In the context of GNSS where delegation entails a foreign element, Article 28 States' concerns could be fully addressed by means of regulatory safeguards. By making the service provider subject to responsibility for compliance with the regulatory framework, the State would be able to entirely protect its national sovereignty without needing to be involved in the actual provision of the service. International regulation (most desirably in the form of a Convention)[274] would establish the necessary link between the foreign GNSS signal provider and the State having jurisdiction under Article 28 of the Chicago Convention.

Should the crucial link between Article 28 States and GNSS signal providers be established in the form of international regulation, the next question would necessarily be that of how to achieve that current signal-in-space providers accept to comply with it. In the context of the present *status quo,* where the US holds a natural monopoly of the global GNSS market, it is unrealistic to believe that it would be willing to assume the responsibility of complying with a regulatory framework that only imposes on the US obligations to safeguard user States' sovereignty but that gives no rights in return. The US is presently in a situation where it can simply dictate all the conditions it likes without needing to take any responsibilities in return as there is not other alternative system that offer better guarantees. It does not need to assume any obligations to secure its dominant position in the lucrative GNSS market. Thus, so long as the present *status quo* remains, and assuming that the benefits flowing from the public utility services of GNSS outweigh national sovereignty concerns, the relations between the provider and user States will

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[272] See Schubert *supra* note 264 at 249.
[273] See *WW/IMP Final Report supra* note 173 Recommendation 2/5 b) at 26.
[274] See Schubert *supra* note 264 at 257.

rather be based in the goodwill of the only *de facto* GNSS signal provider regarding its offer to the international community of *its* Global Positioning System for civil use.

While the proposition of international regulation would not be successful in light of the present circumstances, it should *not* be so with the emergence of Galileo. It is the European intention to establish a contractual framework as a link among the different players in the various stages of the provision of GNSS services, *including primary signal providers and States having jurisdiction under Article 28 of the Chicago Convention.*[275] With one system offering such crucial guarantees the US could be forced to give similar assurances if it wants to remain competitive in a no longer monopolized market.

III. International Coordination of GNSS:

For a system such as GNSS that brings a foreign element into the provision of national air navigation services, global acceptability would be best achieved by means of international control of the system. An internationally owned (or at least operated) GNSS would give the necessary degree of confidence to Article 28 States as they would be able to influence the policy decisions, management and operation of the system. However, no matter how politically desirable the referred approach might be, the truth is that GNSS signal providers are never going to surrender their *self-procured* navigation systems to the operational control of the international community not to say to international ownership. Military concerns coupled with industrial policy goals in the part of the present signal providers to maximize gains from the lucrative GNSS market underlie this tendency.[276] This is even more so with the advent of Galileo, which is expected to raise significant private funding in order to partially finance the project.[277]

In the absence of an internationalized GNSS, the second most desirable scenario lies with the achievement of an optimal level of international cooperation in order to ensure worldwide interoperability and compatibility of existing and emerging GNSS systems.[278]

Following this more realistic approach the Rio Conference recommended:

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[275] See A33-WP/34 *supra* note 188 at 3 para 4.2.
[276] See Henaku *supra* note 236 at 170.
[277] See *ibid.*
[278] See *ibid.*

> That States and groups of States adopt a co-operative, multinational approach in order to ensure seamless and interoperable systems at the regional and global levels [...] and by doing so, avoid proliferation of systems elements in order to reduce costs, enhance safety and increase operational efficiency.[279]

The Charter establishes that "with a view to facilitating global planning and implementation of GNSS, States shall be guided by the principle of cooperation and mutual assistance whether on a bilateral or multilateral basis."[280] It is the goal of the United States to promote international cooperation in the use of GPS for peaceful purposes.[281] On 18 February 1999 the President of the Russian Federation took a decision on Russia's movement up to a new level of international cooperation by proposing GLONASS as a basis for the development of international satellite navigation systems.[282] European views are that "satellite positioning, navigation and timing can develop their full use only as a global system; international cooperation is necessary by means of which worldwide interoperable and compatible systems can be offered and costs reduced while at the same time guaranteeing quality of service."[283] Therefore, the Council instructed the Commission to "fully explore the possibilities for cooperation and/or further development with the United States of America and the Russian Federation" and to investigate "the interest of other third countries to cooperate in this area."[284]

"A dip in the archives reveals a seven-year history of the talks between the European Commission and the United States on cooperation in satellite navigation."[285] Work on a draft agreement laying down principles of cooperation remains a priority of both sides. To this end the US presented a draft agreement in late 2000. The European side responded to it in the form of a counter proposal in July 2001.[286]

Cooperation with the Russian Federation aims to achieve commonality of approach and possible sharing of frequencies and know-how. The negotiations slowed down in

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[279] See *WW/IMP Final Report supra* note 173 Recommendation 2/7 at 27.
[280] See *GNSS Charter supra* note 174 at para 7.
[281] See Presidential Decision Directive *supra* note 64.
[282] See *Decree No. 38RP of the President of the Russian Federation supra* note 233 at para 1.
[283] See *Council Resolution of 19 July 1999 supra* note 96 at 7th 'whereas' clause.
[284] See *ibid* at 2 para 9.
[285] See "International Negotiations" (2002) 20 at 3 Galileo Newsletter, Genesis Office. Available online at <http://www.genesis-office.org/indexgl.htm> (Date accessed: 08/05/2002).
[286] See *ibid.*

early 2001 due to differences related to financing. However, contacts were reinitiated in November 2001 now that the Russian State Council has decided to allocate substantial funding in the GLONASS maintenance for the next decade.[287]

High-level talks with China were held in June and September 2001 for potential cooperation on GNSS pursuant to which a joint working group was established.[288] Further discussions with the People's Republic of China are foreseen in the upcoming weeks.[289]

The Euro-Mediterranean GNSS Working group has been set with the Mediterranean partner countries. It met in Brussels on 17 May 2002 to discuss regional cooperation initiatives in satellite navigation.[290]

Working level/and or contractual contacts have been held with Canada, Norway, Israel, Czech republic Ukraine, Japan, Australia and African authorities.[291]

The United States and the Government of Japan have also implemented a mechanism for bilateral cooperation as regards the use of GPS.[292]

All the referred initiatives lack the necessary degree of harmonization to be able to achieve a seamless GNSS system. What we have presently described is merely a cluster of uncoordinated bilateral ad-hoc initiatives in the part of present and future primary and secondary signal providers. A multilateral cooperative effort gathering *at once* all present and future global and regional providers on the one hand and all potential users on the other is more desirable. In this line, it has been noted that most effective cooperation could easily be achieved if an appropriate international forum would be created specifically to address the issue of GNSS international coordination.[293] Given the

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[287] See *SEC (2001) 1960 supra* note 142 at 5 para 1.3.
[288] See *ibid.*
[289] See "International Negotiations" *supra* note 285.
[290] See *SEC (2001) 1960 supra* note 142 at 5 para 1.3.
See also "International Negotiations" *supra* note 285.
[291] See *ibid.*
[292] A Joint Statement regarding cooperation in the use of the GPS was issued on September 22, 1998 in New York City by the then heads of the two Governments pursuant to which the Government of the US and the Government of Japan decided to establish a mechanism for bilateral cooperation by means of a plenary meeting to be held annually to review and discuss matters of importance regarding the use of GPS. The first session of the plenary meeting was held on February 5, 2001 in Tokyo. Both of the Governments intend to continue working closely. The Joint Statement is available online at <http://www.igeb.gov/japan-statement.shtml> (Date accessed: 05/06/2002).
[293] See Henaku *supra* note 236 at 170.

multimode character of GNSS it has been advocated that UNCOPUOS would be the most suitable scenario for the referred purpose.[294]

1. Technical Coordination: Compatibility[295] and Interoperability:[296]

It is absolutely essential that all GNSS systems be interoperable and that user receivers function equally well in anyone of the satellite augmentation systems. From the perspective of civil aviation safety, interoperability will bring clear advantages in terms of availability, reliability, integrity and continuity of the service. The European Commission maintains that two systems backing up each other are essential to fight the vulnerability of the signal. With a single constellation the autonomous receiver integrity monitoring capability is marginal and thus insufficient for safety-of-life applications. With two interoperable constellations users would be allowed to rely on the 24 GPS satellites and the 30 Galileo satellites as a single GNSS constellation.[297] From an economic point of view, maximum interoperability would simplify avionics and thus reduce costs.[298]

However, the real issue at stake is how to maintain worldwide interoperability. GPS and GLONASS receivers are already interoperable so that the same user can use them consistently.[299] The European Union and the United States are also seeking and agreement on interoperability of GPS and Galileo.[300] It is really in the best interest of signal providers to achieve the interoperability of their systems so as to be able to economically exploit the enhanced levels of GNSS service performance that would be achieved with the joint use of two (or maybe three) interoperable constellations. Provision of a redundant system would raise the level of assurance that the signal is not going to be

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[294] See *ibid.*

[295] For the purposes of GNSS 'compatibility' is the ability of two or more satellite navigation systems to operate without interference to one another.

[296] GNSS 'interoperability' is the ability of the elements of two or more satellite navigation systems to operate together. See FANS/4 *supra* note 10 at 3.2-9 para 3.2.6.1.a).

[297] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110, Annex 3 at 27 para 2.1.

[298] See FANS/4 *supra* note 10 at 3.2-10 para 3.2.6.2.

[299] See P. B Larsen, "Should GNSS Standards that are Uniform for all Users be Established or are Unimodal Standards Satisfactory?" (1999) Proceedings of the 42nd Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 110.

[300] See "International Negotiations" *supra* note 285: Common ground on interoperability was found in a meeting held in Washington last October.

interrupted thus giving the public the necessary confidence to build businesses, and services based on the capabilities offered by GNSS.[301] This is the reason why present and future signal providers (*i.e.* US-EU) have readily embarked in negotiations aimed at ensuring the technical compatibility of their respective systems.[302] However, for the sake of uniformity and to avoid technical difficulties arising from the proliferation of systems, a multilateral approach rather than the present course of bilateral negotiations would be most adequate. Right now it seems more as if the present GNSS incumbent and the potential stronger competitor were trying to jointly impose their technical requirements to future newcomers.

2. Legal Coordination: Standardization:

The Chicago Convention conferred upon ICAO extensive powers in the regulation of technical aspects of air navigation. It is a mandatory function of the ICAO Council to adopt Standards and Recommended Practices (SARPs) for all matters concerned with the safety, regularity and efficiency of air navigation.[303] This quasi-legislative function constitutes a unique feature of ICAO among all other organizations of the UN family. The Standards and Recommended practices are *for convenience* designated as Annexes to the Chicago Convention[304] but they do not constitute an integral part to the Convention and do not have the same binding legal force.[305] States have committed to collaborate in securing "the highest practicable degree of uniformity"[306] and thus they cannot be forced to act if they find "impracticable to comply in all respects with any such international standard or procedure."[307] In such case States must immediately notify ICAO of the

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[301] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at 26-27 para 2.
[302] See US, R. Braibanti, J.Y.Kim & D. Wells, Presentation on U.S Commercial Issues Regarding Galileo, *GPS-Galileo Negotiations: Commercial Issues at Stake.* (25/04/2002) at slides 3 and 6. Available online at <http://www.ta.doc.gov/space/library/speeches/ > (Date accessed: 21/07/2002).[Hereinafter Presentation on U.S Commercial Issues Regarding Galileo].
In this regard it has been recently noted that "the U.S could see benefits if [Galileo] is designed to be truly interoperable with GPS" and that the U.S goals for cooperation are *inter alia* to "maximize benefits of a combined GPS-Galileo service."
[303] See *Chicago Convention supra* note 179 at Article 37.
[304] See *ibid* at Article 54 (l).
[305] M. Milde, "Enforcement of Aviation Safety Standards: Problems of Safety Audits" (2000) I Public International Air Law Casebook (Montreal: McGill University, 2001) at 318.
[306] See *Chicago Convention supra* note 179 Article 37.
[307] See *ibid* at Article 38.

differences between its practices and the standard.[308] In light of this it must be admitted that the ICAO standards represent only soft law, lacking any binding legal authority.[309] Nevertheless, there is a strong motivation for States' compliance with ICAO standards, given that certificates of airworthiness and licenses falling below the standards do not need to be recognized by the other contracting States.[310] This could eliminate the non-complying State from the picture of international air transport.[311] It has been noted however, that Article 33 of the Chicago Convention, referring specifically to certificates of airworthiness and certificates of competency and licenses[312] does not have any relevance as to GNSS.[313] Accordingly, the establishment of certain minimum GNSS Standards from which derogation would not be possible has been proposed in analogous approach to Annex 2 of the Chicago Convention.[314] Nevertheless, whilst the status of

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[308] See *ibid.*

[309] Of this opinion see for example Milde *supra* note 305 at 318-319. See also T. Buergenthal "ICAO Technical Legislation" (1969) I Public International Air Law Casebook (Montreal: McGill University, 2001) at 247; N. Jasentuliyana, "Celebrating Fifty Years of the Chicago Convention Twenty-Five Years after the Moon Landing: Lessons of Space Law." (1994) XIX-II Ann. & Air Sp. L. at 432-433.There are however dissenting opinions asserting that the SARPs are to a certain extent binding. See for example S. Liyanage, "Aviation Safety Oversight Assessment" (1996) XIX-II Ann. & Air Sp. L. at 239: "All States, irrespective of whether they have notified their [...] differences have a continuing obligation nevertheless to ensure that SARPs are respected to the maximum extent possible. Nothing in the Convention justifies a conclusion that notification relieves a State of its obligation, under the first paragraph of Article 37, to collaborate in securing the highest practicable degree of uniformity in all matters where such uniformity will facilitate and improve air navigation." In this connection R. Van Dam has maintained the view that States who depart from the ICAO standards must eventually improve and strive to reach the level of the international standard." See R. Van Dam, "Recent Developments in Aviation Safety Oversight" (1995) XX-I Ann. & Air Sp. L. at 315. Furthermore, Prof. Cheng is of the opinion that ICAO SARPs have binding nature in the absence of a notification to the Council of a difference. See B. Cheng, *The Law of International Air Transport* (London: The London Institute of World Affairs, 1962) at 70. Some binding force of the ICAO SARPs have also been found in the fact that States have a legal obligation to co-operate in good faith and to apply ICAO's regulations. "It would seem that this obligation is legal and not only 'purely moral,' in consequence of which, not only the failure to notify departures from standards, but also the non-fulfilment of the discretionary obligation [to implement ICAO's regulations] will constitute a breach of the Convention. The non-execution of such duties may entail action by the Council under Article 54(j) and (k). In case of a dispute the Assembly may even suspend the right to vote of those States that fail to comply with the decision of an arbitrator or judicial organ." See J. Erler, *The Regulatory Functions of ICAN and ICAO: A Comparative Study,* Master Thesis, Institute of Air and Space Law, McGill University, 1964 at 140. See also J. Ducrest, "A New Dynamic Legislative and Quasi-Legislative Functions of the International Civil Aviation Organization?" (1996) XXI-II Ann. & Air Sp. L. at 116-117. Finally some binding force of the SARPs has been ascertained by arguing that there is a time limit to file differences with the SARPs. See I. Detter, *Law Making by International Organizations* (Stockholm: P. A. Norstedt, 1965) at 251. However not authority has been cited in support of this assertion.

[310] See *Chicago Convention supra* note 179 at Article 33.

[311] See M. Milde *supra* note 305 at 319.

[312] See *Chicago Convention supra* note 179 at Articles 31 and 32.

[313] See Milde *supra* note 60 at 203.

[314] See LTEP/1 *supra* note 237 at 4-2 para 4:1.10.

Annex 2 has its express legal basis in the Chicago Convention,[315] no similar constitutional support exists for any other purposes including GNSS.[316]

Despite their non-binding force GNSS SARPs are necessary both from a legal and technical point of view. From a legal perspective, SARPs constitute international regulations that are necessary for ICAO's Member States to fulfill their duty in accordance with Article 37 of the Chicago Convention "to collaborate in securing the highest practical degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services *in all matters in which such uniformity will facilitate and improve air navigation* (emphasis added)."[317] The referred uniformity is *conditio sine qua non* to ensure an optimal international level of safety, regularity and efficiency of air navigation particularly in the context of a *global* navigation system like GNSS that is to be relied on worldwide.

From a technical point of view, the need for SARPs arises from the fact that the Required Navigation Performance Concept (RNP)[318] as applied to approach, landing and departure did not prove sufficient to meet all the necessary safety-related requirements for low minima operations which therefore need to be resolved via ICAO's standardization mandate.[319]

Pursuant to the ICAO Policy Statement of 1994, "in accordance with Article 37 of the [Chicago] Convention, ICAO shall continue to discharge the responsibility for the adoption and amendment of Standards, Recommended Practices and Procedures governing CNS/ATM systems."[320] Therefore, the quality of the system is to be in compliance with ICAO Standards of systems integrity.[321] The Charter reiterates that

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[315] See *Chicago Convention supra* note 179 at Article 12: Over the high seas, the rules on force shall be those established under this Convention.
[316] See M. Milde *supra* note 60 at 204.
[317] See Cheng *supra* note 309 at 63-64.
See also M. Sheffy, "The Air Navigation Commission of the International Civil Aviation Organization: A Study of its Functions and Powers and an Outline of its Main Fields of Activity" (1958) 25 J. Air. L. & Com. at 436; E. Pepin, "ICAO and Other Agencies Dealing with Air Regulation." (1952) 19 J. Air. L. & Com. at 152.
[318] See RNP Concept *supra* note 40.
[319] See Iatsouk *supra* note 178 at 2.
[320] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 3.
[321] See *ibid* at para 8.

"every State providing GNSS services [...] shall ensure that the services are in accordance with ICAO standards."[322]

In its offer relating to the use of GPS, the United States pledged "its full cooperation [...] in working with ICAO to establish appropriate standards and recommended practices (SARP) in accordance with Article 37 of the Convention on International Civil Aviation."[323] Similarly the Russian Federation "is prepared to cooperate in every way in preparing the required GNSS Standards and Recommended practices."[324]

In 1993, the GNSS Panel was created by the ICAO Air Navigation Commission to develop ICAO Standards and Recommended Practices and guidance material for the implementation of GNSS.[325] The Panel initially produced a set of Guidelines for the introduction of the Global Navigation Satellite System (GNSS).[326] The first pack of SARPs became applicable on 1 November 2001 pursuant to amendment 76 to the first Volume of Annex 10 to the Chicago Convention.[327] Although GNSS is expected to support all phases of flight and aerodrome surface operations, present SARPs provide for en-route, terminal and approach and landing operations down to Category I precision approach.[328] Standards for Category II/III operations are presently being developed by the GNSS Panel and in parallel by the Radio Technical Commission for Aeronautics (RTCA)[329] and the European Organisation for Civil Aviation Equipment (EUROCAE)[330] Working Groups. However it appears that GNSS precision approach operations will not be generally available before the year 2015.[331]

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[322] See *GNSS Charter supra* note 174 at para 4.
[323] See Exchange of Letters *supra* note 62.
[324] See *ibid.*
[325] See WW/IMP *supra* note 7 "GNSS System Status and Standardization in Progress" WW/IMP-WP/36 (11/05/1998) at 4 para 7.2.
[326] See ICAO, *Guidelines for the Introduction and Operational Use of the Global Navigation Satellite System*. ICAO Circ. 267-AN/159 (1996).
[327] Amendment 76 was adopted on 12 March 2001. It became effective on July 16 and applicable the 1st of October 2001. See Amendments to Annex 10 Volume I, Table A to the Chicago Convention *supra* note 48 at vii.
[328] See Annex 10 *supra* note 48 at 4 para 2.4.1 note 2.
[329] The Radio Technical Commission for Aeronautics is a company charged by the US Federal Government and transportation industry to develop navigation, control and communications standards.
[330] The European Organisation for Civil Aviation Equipment was formed at Lucerne in 1963 so as to provide for a regular forum in Europe where administrations, airlines and industry could meet to discuss technical problems. Further information is available online at <http://www.eurocae.org/cgi-bin/home.pl?Target=va/description/background.html&Num=1> (Date accessed: 18/06/2002).
[331] B. Jeans & J. Dyson, "GNSS Precision Approach Operations May not be Widespread before 2015" (2002) 57: 3 ICAO J. at 9.

As of today, ICAO's specifications relate solely to the signal-in-space format. No uniform legal regime has yet been developed by ICAO with regard to the technical qualities of the airborne equipment needed for using GNSS. This has derived in a situation where the FAA is in most cases *de facto* determining such regime. Given the fact that GPS is virtually the only system presently used for air navigation purposes, the standards embodied in US technical regulations are basically being followed by all the countries intending to allow the use of GPS within their sovereign air space. [332]

European intentions however, point towards deterring further consolidation of the US dominance via ensuring the European participation in the development of global standards.[333] Beyond the United States' assurance of full cooperation with ICAO lays the intention to "advocate the acceptance of GPS and U.S. Government augmentations as standards for international use."[334] So long as the US holds a natural monopoly of the GNSS market, it is however difficult to imagine how Europeans could have an input in the development of GNSS standards. Nevertheless, "the development of Galileo will allow Europe to fully participate in the development of international standards"[335] due to the fact that the United States is actually interested in maximizing the benefits of a combined GPS-Galileo service.[336] This means that suddenly the US is no longer alone in determining GNSS specifications, now it has an economic interest to pursue and thus the need to negotiate. If the United States wants to exploit the benefits of the enhanced availability to users of two interoperable constellations it will need to reach common grounds with Europe as to GNSS standardization. Thus, Europe can use this new US interest as a bargain power in the negotiation of global GNSS standards in order to secure European active participation in the standardization process.

Initial coordination with US GPS specifications could be achieved trough the European Joint Aviation Authorities (JAA) [337]/ Federal Aviation Administration (FAA)

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[332] See Kok *supra* note 52 at 53.
[333] See *COM (1999) 54 final supra* note 14 at 4.
[334] See Presidential Decision Directive *supra* note 64 at Policy Guideline 5.
[335] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at para 4.
[336] See Presentation on U.S Commercial Issues Regarding Galileo *supra* note 302 at slide 6.
[337] The Joint Aviation Authorities (JAA) is an associated body of the European Civil Aviation Conference (ECAC) representing the civil aviation regulatory authorities of a number of European States who have agreed to co-operate in developing and implementing common safety regulatory standards and procedures in Europe. Much emphasis is also placed on harmonizing the JAA regulations with those of the USA. Further information on the JAA may be obtained at <http://www.jaa.nl> (Date accessed: 23/07/2002).

harmonization work programme.[338] The JAA and the Federal Aviation Administration of the United States (FAA) have already committed to harmonize, Federal Aviation Regulations (FAR) and Joint Aviation Requirements (JARs)[339] regarding design and manufacture, operation and maintenance of civil aircraft and related products and parts; noise and emissions from aircraft and aircraft engine and flight crew licensing.[340]
A similar commitment could be envisaged in the field of GNSS so as to reach common grounds as regards the standards embodied in US and JAA technical regulations.

As a final remark it must be noted that GNSS is susceptible to multifaceted applications well beyond the aviation sector. It is thus desirable that the GNSS standards that are being developed in the different sectors be coordinated with respect to the legal issues that they all have in common.[341] In the US efforts are being made to coordinate GNSS standardization. While a different administration within the DOT is in charge of each GPS use, they are all under the supervision of the Secretary of Transportation tasked with the mandate to ensure the coordination and standardization of transportation.[342] The EU has recognised the need for coordinating the standards being developed for the various modes of GNSS users and has proposed to set up a GNSS Regulatory Co-ordinator taking responsibility for the development of standards for Galileo for all uses. "The standards developed could then be incorporated into regulation by the appropriate bodies (*e.g.* ICAO, IMO,[343] ISO[344])."[345]

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[338] See 19th Annual FAA/JAA International Conference (June 3-7 2002), Presentation given by B. Robeson, *Raising the Safety Bar Globally: Setting Priorities for Scarce Resources* (04/06/2002) at slide 3: The FAA/JAA harmonization work program has been going on for well over a decade. The reason for harmonization was to reduce certification costs while maintaining an acceptable level of safety. Available online at <http://www.jaa.nl/conference/AIA%2C%20Robeson%20Presentation.ppt> (Date accessed: 23/07/2002).

[339] Pursuant to *Council Regulation (EEC) No. 3922/91 of 16 December 1991, On the Harmonization of Technical Requirements and Administrative Procedures in the Field of Civil Aviation,* OJ L 373 p. 004-0008 the standards drawn up by the JAA as they are completed become law in the EC States. The Regulation is available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31991R3922&model=guichett> (Date accessed: 23/07/2002).

[340] See <http://www.jaa.nl/whatisthejaa/jaainfo.html> (Date accessed: 27/03/2002).

[341] See Larsen "GNSS International Aviation Issues" (1998) Proceedings of the 41st Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 188.
See also Huang and Weber *supra* note 42 at 46.

[342] See Larsen "Future GNSS Legal Issues" *supra* note 61 at 21.

[343] In 1948 an international conference held in Geneva adopted a Convention formally establishing the International Maritime Organization (IMO). The IMO Convention entered into Force in 1958 and the new organization held its first meeting the following year. The Organization is aimed at providing machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical

Although there is a need to coordinate the various standards under development for the diverse modes of GNSS users, account should be taken of the special situation of the aviation sector where safety requirements are more stringent.[346] This is due to the fact that in the case of aircraft accidents, the chance of survival is very limited. Furthermore, the external costs associated with accidents have a significant economic impact.[347] As result it has been advocated that the labour of coordination of GNSS standards, should be closely correlated with the current work of ICAO.[348]

IV. Institutional Issues: Regulatory and Operational Structures:

> From a *lege ferenda* perspective, the institutional issues are the point of departure for successful realization of any GNSS. It is essential for GNSS to succeed in operating in a safe, functionally and economically sound way as well as in capturing the confidence in the public at large to establish a transparent and coherent institutional structure.[349]

ICAO has advocated that the CNS/ATM systems should make optimum use of the existing organizational structure and should be operated in accordance with the existing institutional arrangements.[350] However, the institutional framework for GNSS has not yet been defined and remains of a purely hypothetical nature.

(*...continued*)
matters of all kinds affecting shipping engaged in international trade and to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships" (Article 1(a) of the IMO Convention). Further information on IMO is available at <http://www.imo.org> (Date accessed: 23/07/2002).

[344] The International Organization for Standardization (ISO) is a worldwide federation of national standard bodies from more than 140 countries established in 1947. ISO is a non-governmental organization aimed at promoting the development of standardization and related activities in the in order to facilitate the international exchange of goods and services and to developing international cooperation in various fields. Further information on ISO is available at <http://www.iso.org/iso/en/ISOOnline.openerpage> (Date accessed: 23/07/2002).

[345] See *COM (1999) 54 final supra* note 14 at 23.

[346] See Weber & Huang *supra* note 42 at 46.

[347] See EXTRA Project, *Safety and Security*, funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme (31/08/2001) at 8. Available online at <http://europa.eu.int/comm/transport/extra/safety_security.pdf> (Date accessed: 23/07/2002).

[348] See Weber & Huang *supra* note 42 at 46.

[349] F.G Von der Dunk, "The Bigger Picture: Public International Law and the Future of GNSS", (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 12.

[350] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 5.

The major theoretical legal issue involved refers to the need to separate the regulatory and operational structures as a minimum requisite for a clear GNSS institutional framework.[351] The operator of the space segment is tasked with the day-to-day management including the technical, financial and commercial management of the GNSS system.[352] The regulatory structure represents the passive side of the GNSS institutional framework by exerting legal controls over the operational structure and its performance in terms of safety, security and economics.[353]

Different options for future operational structures of GNSS have been considered in the past.[354] The most relevant issue at the moment is that GPS, presently the core element of GNSS remains under the exclusive ownership and operational control of the US.[355] Whereas ownership is not the most important element as regards institutional arrangements[356] the achievement of international control of GNSS by means of establishing a multilateral framework would be most desirable from the perspective of non-provider States. Control would allow GNSS user States to contribute to the determination of the policy of the system and to define the framework for its operations and management. Thus, the interests of all non-provider States would be well served by institutional arrangements that provided an acceptable level of international control over GNSS.[357] This option however inevitably requires the willingness of all provider States to enter into such framework, which is unlikely to be achieved.[358] Presently, there exists no mechanism whatsoever permitting the incorporation of non-US civil voices into GPS.[359] Albeit the US Government holds consultations with the European Tripartite Group and Japan, no prospects of a common system are foreseeable for the moment.[360] The United

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[351] See Von der Dunk *supra* note 349 at 12.
[352] See FANS (II)/4 *supra* note 36 at 6-7 para 6.3.3.4.
[353] See Von der Dunk *supra* note 349 at 12.
[354] See ICAO, "Different Types and Forms of the Long-Term Legal Framework for GNSS" ICAO Doc. LTEP/1-WP/5 (20/09/1996) at 8 para 8.
[355] M. Ferrazzani, "The European Initiatives and Programmes for Satellite Navigation", (1998) Proceedings of the 41st Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 165.
[356] See FANS/4 *supra* note 10 at 6-7 para 6.3.3.4 b).
[357] See *ibid* at para 6.3.3.5.
[358] On the issue of international control of GNSS see also *supra* Chapter IV Section III.
[359] See Ferrazzani *supra* note 355 at 165.
[360] See *ibid*.

States furthermore has made it clear that due to military concerns it shall not share the operation and control of GPS.[361]

In the regulatory side the main theoretical issue would be to determine which entity should exercise legal control over GNSS activities.[362] A number of national and international institutions are already engaged in regulating the numerous GNSS activities. At the international level, the United Nations is the only institution with a comprehensive role as to all GNSS functions. The UN Committee for the Peaceful Uses of Outer Space (UNCOPUOUS) has produced several international treaties of relevance for the operation of GNSS. ICAO is adopting Standards and Recommended Practices for GNSS aviation uses and also considering a long-term legal framework for GNSS. The International Maritime Organization (IMO) ICAO's maritime counterpart, is developing standards and procedures for GNSS maritime navigation. The International Telecommunication Union (ITU) is responsible for the coordination of the radio frequencies used to achieve communication between GNSS satellites and receivers. The EU, ESA and EUROCONTROL have developed their own regulations for the deployment of EGNOS and Galileo.[363]

At national level, the DOT has been entrusted with the responsibility for all GPS civilian matters. The different modal uses are divided into the FAA for aviation, the US Coast Guard for maritime navigation, the Federal Highway Administration for highways, the Federal Railroad Administration for trains and yet another separate administration for the use of hazardous materials.[364]

The regulation of GLONASS is based on a series of Governmental Decrees. Pursuant to the Decision of the Government of the Russian Federation of 29 March 1999 now the Russian Space agency is responsible for the application and development of GLONASS in the interests of civil users.[365]

It has been noted that the regulatory side of the GNSS institutional framework serves the purpose of exerting legal controls over the operational structure and its performance

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[361] See Presidential Decision Directive *supra* note 64, Policy Guideline 3: The GPS and U.S. Government augmentations will remain responsive to the National Command Authorities.
See also COM (1999) 54 final *supra* note 14 at 5.
[362] See Von der Dunk *supra* note 349 at 12.
[363] See Larsen "Expanding Global Navigation Services" *supra* note 61 at 157-159.
[364] See Larsen "Future GNSS Legal Issues" *supra* note 61 at 21.
[365] See *Declaration of the Government of the Russian Federation* (29/03/1999) *supra* note 234.

in terms of safety, security and economics. Given the plethora of existing GNSS regulatory entities, for the sake of clarity and uniformity and to ensure that GNSS work as a global system, it would be desirable to establish one single regulatory institution. This would secure a minimum level of institutional and operational coherence crucial in the context of a satellite navigation system with worldwide repercussions. This however, once again would require the positive will of *all* provider States, which again is unlikely to be attained. If present (and future) signal providers remain reluctant to surrender their systems under international control in the operational structure, they will not accept the supervision of a single regulatory entity (presumably an international organization) either.

It may be too early to reach a conclusion on what the future GNSS institutional framework will be like. However, what is clear by now is that signal providers, are not to relinquish their systems to an international operational framework no matter how politically desirable this proposition may result from the eyes of the rest of the world. Industrial policy goals are just too great in the context of a flourishing GNSS market that promises EUR 270 billion between 2005 and 2025 in user equipment sales, services and exports only in Europe.[366] It seems a lot more realistic to assume that the United States will continue operating its GPS system and that European States will combine their resources to operate Galileo and EGNOS.[367] Is this situation however, it would still be necessary to ensure that this cluster of different constellations can work as a global system.[368] Although it is unlikely that GNSS providers accepted a single regulatory entity overseeing all existing systems it is nevertheless in their best interest to ensure that their constellations can function as a global system if they want to economically exploit the enhanced capabilities of multiple interoperable constellations (and they certainly do). Thus, at least regulatory coordination of the present and future systems at the international level can be envisaged for the near future of GNSS. This would be the minimum common denominator; in the longer term it would be best achieved by means of a convention.

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[366] See Henaku *supra* note 236 at 175.
[367] F. P Schubert, "An International Convention on GNSS Liability: When Does Desirable Become Necessary?" (1999) XXIV Ann. & Air Sp. L. at 250.
[368] See *ibid.*

V. Certification:

Certification can be defined as the formal process by virtue of which the certifying entity gives written assurance that the product or service is in compliance with specified requirements.[369] Particularly as regards GNSS, certification is to ensure a set of minimum guarantees, namely the continuity, universal accessibility, availability, accuracy, integrity and reliability of the system.

In the legal side two main issues arise with respect to certification, firstly that of which entity is going to assume general certification authority if GNSS is to be construed as a global seamless system and secondly, the fact that GNSS provides services for a variety of transport and non-transport sectors and moreover that in each field a sector-specific procedure for certification has already been established prior to the advent of GNSS.

As to the first issue, it has been suggested that ICAO could be required to certify the GNSS space segment against its own GNSS Standards and Recommended Practices.[370] However these suggestions are deprived of any constitutional basis in the Chicago Convention, "ICAO does not posses any jurisdiction to certify or license the providers of the space segment of the GNSS."[371] Moreover, such initiative is bound to be unacceptable for all non-aviation sectors equally reliant on GNSS at least if a general certification scheme of the space segment is envisaged for all modes of users. In any case, the idea of a single certifying authority as a whole has been found entirely unrealistic from the perspective of current signal providers.[372]

Under the current certification regime, at least in the aviation sector, certification lies entirely within the responsibility of sovereign States. Generally, States certify aircraft registered under their jurisdiction together with avionics used on board as well as ground based instruments within their territory.[373] Regarding GNSS in particular, presently no

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[369] See Von der Dunk *supra* note 349 at 13.
[370] See LTEP/1 *supra* note 237 at 3-3 para 3:20.
See also WW/IMP *supra* note 7 "Legal Implications of CNS/ATM" ICAO WW/IMP-WP/74 (11/05/1998) at 4 para 2.2.2.6. Available online at <http://www.icao.int/allpirg/wp74.pdf> (Date accessed: 23/07/2002). [Hereinafter WW/IMP-WP74].
[371] See Milde *supra* note 60 at 203.
[372] See WW/IMP-WP/74 *supra* note 370 at 4 para 2.2.2.6.
[373] See Von der Dunk *supra* note 349 at 13.

international entity appears likely to gather the necessary authority for global certification in the near future. A more realistic approach would be that each State certified whatever GNSS components under its jurisdiction against available SARPs. Hence, signal providers would certify the space segment whilst the rest of the States using GNSS would be responsible for certifying avionics and ground facilities within their jurisdiction.[374]

Yet even if certification would be left in the hands of national authorities, a certain degree of international regulation would still be necessary to achieve mutual recognition of nationally certified GNSS components by other States. In the field of aviation this has traditionally been achieved by virtue of Article 33 of the Chicago Convention as regards certificates of airworthiness and certificates of competency and licences issued by other contracting States and also pursuant to ICAO's SARPs establishing the standards against which aviation components must be certified.[375] However, in the context of GNSS two difficulties remain, firstly the fact that States can opt out of the ICAO SARPs and secondly that ICAO has presently only developed SARPs referred to the signal-in-space segment. ICAO's standardization labour should be completed so as to develop a uniform legal regime with regard to the technical qualities of the airborne equipment needed for using GNSS. As regards the non-mandatory character of SARPs the ideal in the context of a global system is that States not be allowed to opt out of the minimum requirements considered essential for the safety of use. It has been noted however that there is presently no constitutional basis to establish a set of GNSS SARPs from which derogation would not be possible. The necessary constitutional basis could be achieved in two ways, by either amending the Chicago Convention so as two allow for a set of GNSS binding SARPs analogous to Annex 2 or by setting the minimum requirements for GNSS certification in a GNSS-specific international convention. Quite some time would pass before any of these solutions could be achieved, however, in the long run, this approach would secure the necessary minimum guarantees for a safe use of the Global Navigation Satellite System.

If the approach of a new GNSS-specific convention is followed, the next dilemma posed by certification would be, whether to adopt a sector-specific or a multilateral approach. Whether uniform certification as to the space segment fundamental to all users

[374] See *ibid* at 13.
[375] See Von der Dunk *supra* note 349 at 13.

and uses of GNSS is desirable, a multimode approach should in any case take into account the high safety demands of the aviation sector. This however, could translate in the system becoming generally too expensive from the start to the detriment of economic efficiency. Hence it might be overall most adequate to adopt the sector-specific certification approach allowing for a better adjustment of each sector's requirements.[376]

VI. Liability:

1. The Existing Liability Regimes Applicable to the Signal-in-Space Providers:

Presently no consensus has yet been achieved with respect to the desirability of an international legal instrument governing GNSS liability. Thus, given the complex chain of interaction among the different actors involved in the provision of GNSS services, in the case of a GNSS related accident claimants are forced to seek compensation through the existing channels available against each possible defendant. In such a case, potential claimants range from the aircraft operator to the air passengers and third parties. Possible defendants include the US Government for the GPS system, the Russian Federation for the GLONASS constellation and the EU and ESA for a Galileo malfunction, the regional augmentation system operator, the ATC service provider as well as the State who is providing the air navigation services on the basis of Article 28 of the Chicago Convention.[377]

GNSS liability is subject to several legal regimes. Two international instruments are applicable to GNSS in general, namely the Outer Space Treaty[378] and the Liability

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[376] See Von der Dunk *supra* note 349 at 14.

[377] See Schubert *supra* note 367 at 255-258: The non-provider State will be held liable if it fails to fulfil its responsibilities as a constituent part in the overall GNSS system. Pursuant to Article 28 of the Chicago Convention, States are responsible for their ANS infrastructure. Foreign GNSS signals will be included in the State's ANS infrastructure through its formal approval of the use of GNSS signals over its sovereign territory. Non-provider States furthermore must ensure that the signal meets established international standards in terms of reliability, accuracy and availability. Failure to exercise such responsibilities will give rise to liability in the part of non-provider States.

[378] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967). Available online at <http://www.oosa.unvienna.org/SpaceLaw/outersptxt.html> (Date accessed: 26/06/2002). [Hereinafter *Outer Space Treaty*].

Convention.[379] A variety of specific provisions govern the liability of the different signal-in-space providers. The present overview will focus on the liability of the GPS and Galileo systems.

A. The Outer Space Treaty:

The issue of international responsibility and liability[380] of States for damage caused by space activities is addressed in Articles VI[381] and VII[382] of the Outer Space Treaty. The entities that can be held internationally responsible are the States that are parties to the Treaty. International organizations are also regarded as subjects of space law given the fact that, both the international organization and Member States who are party to the Treaty are responsible for ensuring compliance with the provisions of the Outer Space Treaty.[383] Regrettably, when it comes to liability, Article VII refers solely to States. However, given the fact that such organizations are subject to international responsibility, it is only logical to assume that they shall likewise bear the liability that is likely to come

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[379] *Convention on the International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187 (entered into force 1 September 1972). Available online at <http://www.oosa.unvienna.org/Reports/liabilityE.pdf > (Date accessed: 26/06/2002). [Hereinafter *Liability Convention*].

[380] Following Professor B. Cheng, 'responsibility' means essentially answerability for one's acts or omissions in terms of their compliance with his or her legal duties. 'Liability' refers to the obligation to bear the consequences of breaching a legal duty particularly that of compensating for the damage caused normally in terms of monetary payment. See B. Cheng, "Article VI of the1967 Space Treaty Revisited: 'International Responsibility', 'National Activities', and 'The Appropriate State'" (1998) J. of Sp. L. at 9.

The difference between the two terms however remains controversial, it cannot be forgotten that in some languages there is one single word two express both 'responsibility' and 'liability' (i.e. Spanish, French). In view of the present author both terms are interchangeable, there cannot be responsibility without liability. They constitute the two sides of the same coin: the State must compensate for the damage resulting from its non-compliance with its legal duties. For the same opinion see Kayser *infra* note 384 note at 31-32.

[381] Article VI: States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space including the moon and other celestial bodies shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne by the international organization and by the States parties to the Treaty participating in such organization.

[382] Article VII: Each State 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 party from whose territory or facility the 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 space or in outer space, including the moon and other celestial bodies.

[383] See Article VI *supra* note 381.

with it.[384] Non-governmental entities are placed under the responsibility of the 'appropriate State.'[385]

The Outer Space Treaty refers to international liability of a State towards another State for damage caused to it or to its natural or juridical persons.[386] Thus liability relations of a State party with respect to its own nationals are not covered. This is the natural consequence of the fact that the Outer Space Treaty is an instrument of international law regulating the relations among sovereign States themselves but not internal relations within States.[387]

The Outer Space Treaty refers to damage in general. The compensable damage does not depend on the type of space activities from which it may arise but rather encompasses all types of damage that may be associated to a space object. This covers damage immediately caused by collision with the space object such as property damage or bodily injury. Furthermore, nothing in the Outer Space Treaty prevents the compensation of damage caused indirectly by the space object such as for example a faulty or erroneous GNSS signal resulting in a plane crash.[388]

Regardless the fact that all present and future GNSS signal provider States have ratified the Outer Space Treaty,[389] difficulties arise as to the real relevance of the Outer Space Treaty in respect of GNSS given that the Treaty does not really allow for its practical implementation. Firstly, it does not define at all the type of liability; nowhere does it refer to fault-based, strict, absolute or whatsoever form of liability. Neither does it determine the legal procedure for claiming compensation for damage caused by space objects. This is due to the fact that the Outer Space Treaty is merely a codification of a

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[384] V. Kayser, *Launching Space Objects: Issues of Liability and Future Prospects* (Dordrecht/Boston/London: Kluwer Academic Publishers, 2001) at 37.

[385] V. Kayser, "Commercial Exploitation of Space: Developing Domestic Regulation" (1992) XVII-I Ann. & Air Sp. L. at 189: Whereas the meaning of 'appropriate state' is nowhere defined and the question is still being discussed by authors two main criteria can be applied for its determination, namely the nationality of the company and where the company operated the launch.

[386] See Article VII *supra* note 382.

[387] See Kayser *supra* note 384 at 51.

[388] See *ibid* at 44.

[389] See UN Office for Outer Space Affairs, Status of International Agreements Relating to Activities in Outer Space at <http://www.oosa.unvienna.org/Reports/treaty_status_2001E.pdf> (Last updated: 01/01/2001).

previous UN Declaration[390] aimed at establishing a series of general principles that would serve as the basis for the progressive construction of a more specific legal framework to govern space activities. For a specific implementation of the Outer Space Treaty as to GNSS it would be necessary to rely on the general principles of international law.[391]

B. The Liability Convention:

The Liability Convention has further developed the liability regime applicable in case of damage resulting from space activities. By virtue of Articles II[392] and III[393] international liability in case of damage caused by a space object resides upon the 'launching State.'[394] International organizations can be assimilated to Member States subject to two conditions, namely that the organization has declared its acceptance to the rights and obligations defined in the Convention and that a majority of States Members of the organization are also parties to the Liability Convention and to the Outer Space Treaty.[395] These conditions met, international organizations shall be subject to joint and several liability for any damage caused. In the case that the organization has not paid due compensation for any damage caused within a period of six months, the claimant State may invoke the liability of the Member States that are parties to the Convention.[396] Both the US and all EU and ESA Members States are parties to the Liability Convention.[397] The European Space Agency has also declared its acceptance of the Convention.[398] The

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[390] See UN, *UNGA Res. 1962 (XVIII) of 13 December 1963 on Principles Governing the Activities of States in the Exploration and Use of Outer Space*. Available online at <http://www.oosa.unvienna.org/SpaceLaw/gares/html/gares_18_1962.html> (Date accessed: 26/06/2002).
[391] See Kayser *supra* note 384 at 54.
[392] Article II: 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.
[393] Article III: 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 onboard, such a space object by a space object of another contracting 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.
[394] Article I (c) of the *Liability Convention* defines the term 'launching State' as: (i) a State which launches or procures the launching of a space object; (ii) a State from whose territory or facility a space object is launched.
[395] See *Liability Convention supra* note 379 at Article XXII.
[396] See *ibid* at Article V.
[397] See Status of International Agreements Relating to Activities in Outer Space *supra* note 389.
[398] The Declaration of Acceptance by ESA is annexed to G. Lafferranderie, "Responsabilité Juridique Internationale et Activités de Lancement d'objets Spatiaux au CGS" (1994) 80 ESA Bulletin at Annex 2. Available online at <http://esapub.esrin.esa.it/bulletin/bullet80/laff80.htm> (Date accessed: 26/06/2002).

Liability Convention does not provide for any specific rules as to non-governmental entities.

The Liability Convention encompasses two types of liability. If the damage is caused on the surface of the Earth or to aircraft in flight, the liability of the launching State shall be absolute.[399] In the event of damage caused elsewhere, the launching State shall be held liable only if the damage was due to his fault or the fault of persons under its responsibility.[400]

The applicability of the Liability Convention as to navigation satellite systems remains controversial. The disputed issue is whether damage resulting from a plane crash caused by a GNSS faulty signal, could be subsumed under Article II of the Liability Convention.[401] It has been advocated that the Liability Convention "establishes strict liability only for physical impact damage caused by a space object on the surface of the Earth or to aircraft in flight" and that it does not encompass any damage that my result from an erroneous GNSS signal.[402] The United States position also interprets the Convention to the effect that it does not apply to damage caused by GPS.[403] Likewise, European doctrine seems to agree that neither the text nor the spirit of the Convention indicates that it covers damage resulting from a GNSS failure.[404]

Pursuant to Article II of the Convention, the launching State is only obliged to pay compensation for any damage *caused* by its space object. The term damage means "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 international intergovernmental organizations."[405] It is undisputed that the Convention applies in the case of damage caused by physical collision with the space object. However beyond the damage derived

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[399] See *Liability Convention supra* note 379 at Article II.
[400] See *ibid* at Article III.
[401] See Henaku *supra* note 236 at 175.
[402] See Milde *supra* note 60 at 212.
See also I. Lagarrigue, "Are Existing Navigation Satellite Liability Provisions Adequate to Govern a Navigation Satellite Malfunction?" (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 32.
[403] K.K Spradling, "The International Liability Ramifications of the US NAVSTAR Global Positioning System" (1990) Proceedings of the 33rd Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 97.
[404] R. Van Dam, "GNSS and Aviation: EUROCONTROL's Perspective." (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 48.
See also F. P Schubert *supra* note 367 at 252.
[405] See *Liability Convention supra* note 379 at Article I (a).

from physical impact with the space object, there is other damage likely to arise. As applied to the GNSS scenario the most common occurrence would be a plane crash resulting from a faulty GNSS signal.

It is not clear what the Liability Convention has meant by the expression 'caused by'. In the opinion of Professor Christol "clearly the term 'cause' should only require a causal connection between the accident and the damage."[406] There remains however the issue of which test is to be used in determining causation. "The correct test to be adopted in establishing the causal connection should be the proximity test"[407] so as to find out whether the aircraft accident had been the normal consequence of a faulty GNSS service regardless of physical collision. Nothing in the operative part of the Liability Convention, neither the *travaux préparatoires* support the use of the direct impact test.[408] At the 94th Meeting of the Legal Subcommittee of UNCOPUOS, the US delegate made a proposal expressly limiting the scope of the Convention to damage caused by collision.[409] In response, the Canadian and French delegates argued that the possibility of physical impact was too narrow and that it was not the only source of damage to be taken into consideration.[410] As a result, the US proposal originally drafted as "if the collision of space objects causes damage" was rephrased as "if space objects cause damage."[411] Consequently, so long as the damage finds its cause in the specific space object, the Liability Convention should be applied.

The direct hit doctrine limits the applicability of the Liability Convention to the type of damage that was predictable back in the 70s.[412] However,

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[406] C.Q Christol, "International Liability for Damage Caused by Space Objects" (1980) 74 American J. of Int. L. at 362. Available online at <http://heinonline.org/HeinOnline/start.pl?handle=hein.journals/ajil74> (Date accessed: 27/06/2002).
Larsen has also accepted that damages derived from satellite navigation systems fall under the *Liability Convention*. See Larsen, "Legal Liability for Global Navigation Satellite Systems" (1993) Proceedings of the 36th Colloquium on the Law of Outer Space, (American Institute of Aeronautics and Astronautics) at 73.
[407] See Henaku *supra* note 236 at 175.
[408] See *ibid.*
[409] P. Van Fenema, *Convention on International Liability for Damage Caused by Space Objects*, Doctoral Thesis, Institute of Air and Space Law, McGill University, 1973 at 60 citing the *UNCOPUOS Summary Record of the 94th Meeting of the Legal Subcommittee*, UN Doc. A/AC. 105/C.2/SR.94 (June 1968).
[410] See *ibid* at 60.
[411] See *ibid* at 60 citing the *UNCOPOUS Summary Record of the 95th Meeting of the Legal Subcommittee*, UN Doc. A/AC. 105/C.2/SR.95 (June 1968).
[412] See Henaku *supra* note 236 at 176.

> damage could also be caused by technologies which, while not yet developed can be expected to be developed in the future. Technology will not stand still [...] The Liability Convention, being a general Treaty for Liability for damage caused by space objects, will also have to regulate such unknown factors, providing the regime which will guarantee the rights of the 'victims' of such technologies. [413]

To argue otherwise "strongly offends the dynamism of law and the extreme sense of technological innovation involved in space exploration."[414]

Other aspects of the Liability Convention rather than the damage issue are more likely to limit its usefulness in respect of a GNSS malfunction. Under the Convention the right to present claims is reserved solely to States. Only the State that suffers the damage or whose natural or juridical persons suffer the damage "*may* (emphasis added) present to a launching State a claim for compensation for such damage."[415] It follows that it is under the discretion of the State to seek compensation and that it has no obligation whatsoever to do so. Further, the claim is to be presented from State to State via diplomatic channels[416] typically a lengthy and politicised process, often taking into account other interests beyond the merits of the claim itself. Furthermore, there are no legal assurances that the claimant will be entitled to compensation given the fact that the outcome of the Convention's claiming procedure[417] is deprived of any binding force unless the parties have expressly agreed on the mandatory nature of the decision. Only a limited number of States have currently so declared.[418]

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[413] B.A Hurwitz, *State Liability for Outer Space Activities in Accordance with the 1972 Convention on International Liability for Damage Caused by Space Objects* (Dordrecht/Boston/London: Martinus Nijhof Publishers, 1992) at 18.

[414] See Henaku *supra* note 236 at 176.

[415] See *Liability Convention supra* note 379 at Article VIII.

[416] See *ibid* at Article IX.

[417] The *Liability Convention* has the merit of establishing a procedure for the settlement of disputes. By virtue of Article XVI, in the case that no resolution of the claim has been arrived at trough diplomatic negotiations within one year from the date in which the claim was notified to the launching state at the request of either party a Claims Commission shall be established. It must be noted however that in light of Article XIX para 2, unless the parties have actually agreed on the binding nature of the decision, the Commission will merely render a recommendatory award. Regardless the good intentions lying behind the establishment of this procedure the truth is that absent a mandatory outcome, the mechanism is deprived of any practicality when it comes to the resolution of international disputes. It has never been used in practice. See Kayser *supra* note 384 at 57.

[418] Austria, Canada, Denmark, Greece, Ireland, The Netherlands, Norway, New Zealand, and Sweden. See *ibid.*

These provisions clearly evidence that the Liability Convention is solely based on public international law principles of State responsibility whereby the individual (either natural or juridical persons) has no *locus standi*. The Convention creates relationships exclusively among sovereign States thus significantly failing to achieve a unification of private law that could assist the claimants in the case of a GNSS related accident.[419] Consequently potential victims of a GNSS related accident should seek recourse under the Liability Convention as a last resort.

C. *US Liability: The Federal Tort Claims Act:*

> While GPS gives the world the capability to perform previously unthinkable tasks, it has also opened the United States to unparalleled liability.[420]

In truth, GPS has exposed the United States to liability arising from users all over the world.[421] Since GPS is a global system it is certain that a satellite malfunction would affect non-US citizens relying on GPS information outside the United States. Consequently a foreign subject could sue the US Government, in its quality of the GPS's manager[422] for negligent operation of the system in US Federal District Courts.[423]

Any person suffering damage pursuant to a GPS inaccuracy may recover from his/her loss through four different streams.[424] Firstly, the person through his/her State could seek

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[419] See Milde *supra* note 60 at 212.

[420] B.E Ehrhart, "A Technological Dream Turned Legal Nightmare: Potential Liability of the United States Under the Federal Tort Claims Act for Operating the Global Positioning System" (2000) II Public International Law Casebook (Montreal: McGill University, 2001) at 230.

[421] See *ibid* at 228.

[422] See *ibid* at 230: The US involvement with the management of the GPS consists of three segments: (1) the Operational Control Segment consisting of the Master Control Station (MCS) at Colorado (2) Monitor Stations and (3) ground antennas controlled by the MCS.

[423] See *Piper Aircraft v. Reyno*, 454 U.S 235 (1981). The court made clear than non-US citizens that are injured outside the US can sue a US defendant in a U.S Federal Court. In the case that the United States had a greater interest in the case, the trial may then be held in the United States. This has based Ehrhart's opinion that in the hypothesis that a foreign citizen based on damage resulting from a GPS malfunction sued the US Government under the Federal Tort Claims Act, it would provide the US sufficient interest so as to hold the trial before a US Federal District Court. See Ehrhart *supra* note 420 at 240. The case is available online at the West Law Database at <http://web2.westlaw.com/find/default.wl?1=454&T1=E&2=%A0U.S.%A0&T2=S&3=235&T3=E&NumControlFields=3&TemplateFind=Y&RecreatePath=%2Ffind%2Fdefault.wl&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&x=0&y=0> (Date accessed: 28/06/2002).

[424] See Ehrhart *supra* note 420 at 228.

compensation under the Liability Convention of 1972.[425] Secondly the person may sue under the Foreign Claims Act (FCA).[426] The FCA however only allows the plaintiff to file an administrative claim against a government agency and the claim is in principle to be settled in an amount not exceeding $100,000.[427] Thirdly the victim may sue under the Suits in Admiralty Act (SAA).[428] However, the admiralty and maritime jurisdiction of the United States is limited to "cases of damage or injury, to person or property, caused by a vessel on navigable water."[429] While most of the Earth's surface is covered by water, many of the GPS related activities are land-based.[430] It seems thus that most of the GPS related liability would arise under the Federal Tort Claims Act (FTCA).[431] Pursuant to the sovereign immunity doctrine the United States cannot be sued in domestic or foreign courts without its consent.[432] Under the FTCA, the United States Government has waived its sovereign immunity for any

> claim for money damages against the United States 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 agency while acting within the scope of his office or employment, under circumstances where the United States, if a

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[425] The United States ratified the *Liability Convention* on May 18th 1973. See 24 U.S.T 2389. Available online at West Law Database at <http://web2.westlaw.com/find/default.wl?findcite=24+UST+2389&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&findgo.x=9&findgo.y=4> (Date accessed: 27/06/2002).
For further discussion of the *Liability Convention* see *supra* Chapter IV Section VI Subsection 1.B.

[426] See 10 U.S.C. § 2734 (1994). Available online at the West Law database at <http://web2.westlaw.com/find/default.wl?findcite=10+USC+2734&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&findgo.x=7&findgo.y=9> (Date accessed: 27/06/2002).

[427] See *ibid* at para (a).
See also Ehrhart *supra* note 420 at 228.

[428] See 46 App. U.S.C. Ch. 20 § 741-752. Available online at <http://www.access.gpo.gov/uscode/title46a/46a_15_.html > (Date accessed: 27/06/2002).

[429] See 46 App. U.S.C. Ch. 19A § 740. Available online at <http://www.access.gpo.gov/uscode/title46a/46a_14_.html> (Date accessed: 27/06/2002).
See also Ehrhart *supra* note 420 at 228.

[430] See Ehrhart *supra* note 420 at 240.

[431] See 28 U.S.C. Ch. 171 §§ 2671-2680 (1994) Available online at <http://www.access.gpo.gov/uscode/title28/partvi_chapter171_.html> (Date accessed: 27/06/2002).

[432] See *United States v. Mitchell* 463 U.S 206 (1983) at 212: "It is axiomatic that the United States may not be sued without its consent and that the existence of consent is a prerequisite for jurisdiction." The case is available online at the West Law Database at <http://web2.westlaw.com/find/default.wl?cite=463+US+206&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw> (Date accessed: 27/06/2002).
See also *United States v. Sherwood,* 312 U.S. 584 (1941) at 584: "The United States as sovereign is immune from suit except as it consents to be sued." at <http://web2.westlaw.com/find/default.wl?cite=312+US+584&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=8&GO.y=8> (Date accessed: 27/06/2002).

> private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred [433]

However, this waiver of immunity is subject to numerous exceptions.[434] *Inter alia*, the provisions of the FTCA shall not apply to "any claim arising in a foreign country."[435] Prior to 1993, US case law [436] had consistently held that the site of the negligent act rather than the location where the damage occurred determines the applicability of the 'foreign country exception.'[437] Thus, a non-US citizen relying on GPS who suffered damage pursuant to a faulty data upload at the Master Control Station in Colorado could sue the US Government under the FTCA even if the injury he suffers actually occurs in another country.[438]

In 1993 however the United States Supreme Court ruled in the *Smith Case*[439] that Antarctica falls within the 'foreign country' exception based on the fact that "the first dictionary definition of 'country' is simply 'a region or tract of land.'"[440] This decision sets hurdles to the applicability of the FTCA to cases arising out of GPS negligent

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[433] 28 U.S.C. § 2672 *supra* note 431.
[434] See 28 U.S.C § 2680 *supra* note 431 listing all exceptions.
[435] See *ibid* at para (k).
[436] For a comprehensive overview of the case law prior to 1993 (*Smith* case *infra* note 434) see L.S.B. Bornemann, "The Unlikelihood that the FTCA Waives Sovereign Inmunity for Torts Committed by United States Employees in Outer Space: A Call for Preemptive Legislation" (1999) 63 J. Air. L. & Com. at 519.
[437] See *Richards v. US,* 369 US 1(1962) at 1: "The Federal Tort Claims Act requires federal courts, [...] to look in the first instance to law of the place where the acts of negligence took place, and does not, through use of the words "act or omission," refer to the place where the negligence had its operative effect." Available at the Westlaw database at <http://web2.westlaw.com/find/default.wl?cite=369+US+1&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=11&GO.y=13> (Date accessed: 27/06/2002).
See also *Tenore v. Nu Car Carriers, Inc.,* 341 A.2d 613 (1975) at 613: "Under Federal Tort Claims Act, damages are determined by the law of the state *where the tortious act was committed* (emphasis added)." At <http://web2.westlaw.com/find/default.wl?cite=341+a.2d+613&TF=10&TC=5&RS=WLW2.77&VR=2.0&SV=Split&FN=_top&MT=Westlaw> (Date accessed: 27/06/2002).
See also *Sami v. US 617 F. 2nd 755* (1979) at 761: "The entire scheme of the FTCA focuses on the place where the negligent or wrongful act or omission of the government employee occurred." at <http://web2.westlaw.com/find/default.wl?1=617&T1=E&2=%A0F.2d%A0&T2=S&3=755&T3=E&NumControlFields=3&TemplateFind=Y&RecreatePath=%2Ffind%2Fdefault.wl&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&x=5&y=12> (Date accessed: 27/06/2002).
See also Ehrhart *supra* note 420 at 230-231.
[438] See Spradling *supra* note 403 at 96.
[439] See *Smith v. US* 507 U.S 197 (1993). Available at the Westlaw database at <http://web2.westlaw.com/find/default.wl?cite=507+US+197&clickit=y&ErrHost=EG%2DWLWEB%2DB79&FN=%5Ftop&MT=Westlaw&RS=WLW2%2E76&ssl=y&strRecreate=yes&sv=Split&VR=2%2E0> (Date accessed: 27/06/2002).
For a detailed analysis of the *Smith* case see Bornemann *supra* note 436 at 533 et seq.
[440] See *Smith v. US supra* note 439 at 201citing Webster's New International Dictionary 609 (2nd ed. 1945).

operation. "If a place need only be a 'region or tract of land' outside the United States to be a foreign country, outer space certainly falls within the definition of foreign country."[441] However, in practice, the Smith ruling does not limit the applicability of the FTCA as to the GPS constellation. For the exception to apply the court would need to establish that the negligent act from which the damage resulted actually occurred in outer space.[442] The negligent operation of the GPS system however is most likely to derive from a human action happening on Earth and within the sovereign territory of the US, the most common scenario being a faulty data upload at the MCS in Colorado.[443]

However, more difficult obstacles arise as to the applicability of the FTCA to damage resulting from the negligent operation of GPS. The most prominent exception from the US Government waiver of sovereignty is the so-called 'discretionary function' exception.[444] Accordingly the FTCA will not be applicable in the case of any claims

> based upon an act or omission of an employee of the Government, exercising due care, in the execution of a statute or regulation, whether or not such statute or regulation be valid, or based upon the exercise or performance or the failure to exercise or perform a discretionary function or duty on the part of a federal agency or an employee of the Government whether or not the discretion involved be abused.[445]

This exception has been defined over the years by a series of decisions beginning in 1953 when the US Supreme Court, based on the fact that it had been the congressional intent not to hold the government liable for acts affecting "governmental functions," held that the US could not be liable for those governmental acts undertaken under discretion.[446] Later on however, the Supreme Court narrowed down the scope of the

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[441] See Bornemann *supra* note 436 at 535.
[442] See Ehrhart *supra* note 420 at 231.
[443] In 1992 the Air Force erroneously updated the position of one of the GPS satellites causing a horizontal position error exceeding 300 meters. The negligent GPS act would presumably resemble the 1992 error by the MCS. See Ehrhart *supra* note 420 at 228 and 237.
[444] See 28 U.S.C § 2680 *supra* note 431 at para (a).
[445] See *ibid.*
[446] See *Dahelite v. US* 346 US 15 (1953) at 33: "Not only agencies of government are covered but all employees exercising discretion." Available at the West Law Database at <http://web2.westlaw.com/find/default.wl?1=346&T1=E&2=%A0U.S.%A0&T2=S&3=15&T3=E&NumControlFields=3&TemplateFind=Y&RecreatePath=%2Ffind%2Fdefault.wl&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&x=0&y=0> (Date accessed: 29/06/2002).
See also Ehrhart *supra* note 420 at 232; Elder *supra* note 16 at 901; Epstein *supra* note 218 at 264.

discretionary function exception by focussing on the difference between planning and operational governmental acts.[447] The US Government had claimed immunity based on the allegation that the 'discretionary function' exception led to the protection of all 'uniquely governmental functions.'[448] The Court however concluded that "while the area of liability is circumscribed by certain provisions of the Federal Tort Claims Act,[449] [...] all Government activity is inescapably 'uniquely governmental' in that it is performed by the Government"[450] and that accepting the Government interpretation would equate to granting the Government a "blanket exception from liability."[451] In 1984 the US Supreme Court went on by stating that the Congress intent had been to protect the discretionary Governmental acts taken by virtue of its role as a regulator.[452] Four years later, the Supreme Court qualified the referred decision by concluding that "the exception applies to "the discretionary acts of regulators rather than to all regulatory acts."[453] The Court furthermore created a twofold test to determine whether the exception would protect a given governmental decision.[454] Firstly, it would be required for the exception to apply

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[447] See *Indian Towing Co. v.* 350 U.S 61(1955) at 76 holding the Government liable under the Federal Tort Claims Act "for negligence in the conduct of any governmental activity on the operational level." Available online at the Westlaw Database at <http://web2.westlaw.com/find/default.wl?cite=350+U.S+61++&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=5&GO.y=17> (Date accessed: 29/06/2002).
See also *Ingham v. Eastern Airlines* 373 F. 2d 227 (2d Cir.) (1967) at 239: "Nevertheless, the government's reading [...] is much too broad, for it would exempt from tort liability any operational malfunction by the government." at <http://web2.westlaw.com/find/default.wl?cite=373+F.2d+227&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=6&GO.y=12> (Date accessed: 29/06/2002).
See also Ehrhart *supra* note 420 at 232; Epstein *supra* note 218 at 265.

[448] See *Indian Towing Co. v. US* 350 U.S 61 *ibid* at 64.

[449] See 28 U.S.C.§ 2680 *supra* note 431.

[450] See *Indian Towing Co. v. US* 350 U.S 61 *supra* note 447 at 67.

[451] See *ibid* at 66.
See also Ehrhart *supra* note 420 at 232.

[452] See *US v. Varig Airlines* 467 US 797 (1984) at 813: "Whatever else the discretionary function exception may include, it plainly was intended to encompass the discretionary acts of the Government acting in its role as a regulator." Available online at the West law Database at <http://web2.westlaw.com/find/default.wl?cite=467+US+797&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=8&GO.y=13> (Date accessed: 29/06/2002).
Also the dissenters at *Dahelite* read the discretionary function exception as protecting "that type of discretion which government agencies exercise in regulating private individuals." See *Dahelite v. US supra* note 446 at 58.
See also Ehrhart *supra* note 420 at 232.

[453] See *Berkovitz v. US* 486 US 531(1988) at 539. Available online at the Westlaw Database at <http://web2.westlaw.com/find/default.wl?cite=486+US+531+&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=13&GO.y=13> (Date accessed: 29/06/2002).

[454] See *ibid* at 536.

that the act involved the possibility of choice by the Government employee.[455] "Thus, the discretionary function exception will not apply when a federal statute, regulation, or policy specifically prescribes a course of action for an employee to follow."[456] If the first part of the test had been satisfied, it would be then necessary for the Court to decide whether the employee's judgement was "of the kind that the discretionary function exception was designed to shield."[457] The court concluded that "the exception, properly construed, [...] protects only governmental actions and decisions based on considerations of public policy."[458]

In 1991, the Supreme Court moved away from the planning/operational distinction[459] by stating that "there is nothing in the description of a discretionary act that refers exclusively to policymaking or planning functions" and that nothing supports the position that there is a dichotomy between discretionary functions and operational activities.[460] The decisive criterion as to the applicability of the exception is rather based "on the nature of the actions taken and on whether they are susceptible to policy analysis." [461] The Court further qualified the two-prong test by creating a rebuttable presumption by virtue of which, the discretionary function exception applies if there has already been a finding of discretion, provided however that the first part of the test (that is the discretion) had been satisfied through "established governmental policy expressed or implied by statute, regulation or agency guidelines."[462] In other words, if established governmental policy allows a government agent to exercise discretion, then it is presumed that the conduct of the agent was based on policy considerations when exercising such discretion and thus that the discretionary function exception applies. Thus for the claim to survive it would be

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[455] See *ibid.*
[456] See *ibid.*
[457] See *ibid* at 537. "The basis for the discretionary function exception was Congress' desire to "prevent judicial second-guessing' of legislative and administrative decisions grounded in social, economic, and political policy through the medium of an action in tort."
[458] See *ibid* at 537.
See also Ehrhart *supra* note 420 at 232-233.
[459] See *Indian Towing Co. v. US supra* note 447 at 76.
[460] See *US v. Gaubert* 499 US 315 (1991) at 316. Available online at the Westlaw database at <http://web2.westlaw.com/find/default.wl?cite=499+US+315&TF=10&TC=5&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&GO.x=10&GO.y=19> (Date accessed:29/06/2002).
[461] See *ibid* at 325.
See also Ehrhart *supra* note 420 at 233.
[462] See *US v. Gaubert supra* note 460 at 324.
See also Ehrhart *supra* note 420 at 233.

necessary for the plaintiff to allege facts in support of a finding that the challenged actions were not grounded in policy.[463]

Despite the somewhat tortuous evolution of the discretionary function exception case law, the twofold test envisaged by the Court[464] has indeed become the criterion that courts apply when determining the scope of the exception.[465] It must be noted however that several US Courts of appeal have actually ignored the mandate of the Supreme Court to abstain from granting immunity to 'unique governmental functions'[466] and held that

> the discretionary function exception restores the government's immunity in situations where its employees are carrying out governmental or 'regulatory' duties. Accordingly, if the government can prove that the actions taken by its employees consisted of the *unique functions and responsibilities of the government* (emphasis added), then the government cannot be held liable under the FTCA even if a private individual would be held liable.[467]

The 'discretionary function' exception constitutes the most difficult-to-overcome hurdle that the FTCA poses to sue the US Government for a negligent GPS malfunction. So long as previous case law focussed on the planning/operational distinction, it was possible to argue that although the decision to supply the GPS could be considered discretional, once the decision was taken, the provision of the service is operational in nature and thus falling short from the scope of the exception.[468]

Now, the analysis necessarily begins by applying the two-tier test. Under the first part, it would be necessary to determine whether the employee who made the decision did actually have room for judgement. The problem however is that the guidelines used by the Air Force Space Command to update the GPS constellation remain classified even

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[463] See *US v. Gaubert supra* note 460 at 324.
[464] See *Berkovitz v. US supra* note 453 at 536.
[465] See Ehrhart *supra* note 420 at 235.
[466] See *Indian Towing Co. v. US supra* note 447 at 67.
[467] See *Faber v. US* 56 F. 3d 1122 (9th Cir. 1995) at 1124. Available at the Westlaw Database at <http://web2.westlaw.com/find/default.wl?1=56&T1=E&2=%A0F.3d%A0&T2=S&3=1124&T3=E&NumControlFields=3&TemplateFind=Y&RecreatePath=%2Ffind%2Fdefault.wl&RS=WLW2.76&VR=2.0&SV=Split&FN=_top&MT=Westlaw&x=0&y=0> (Date accessed: 30/06/2002).
See also Ehrhart *supra* note 420 at 235.
[468] See *Indian Towing Co. v. US supra* note 447 at 69.
See also *Ingham v. Eastern Airlines supra* note 447 at 238.

pursuant to a Freedom of Information Act request[469] and so it is impossible from the outset to determine the level of discretion left to the employee. Assuming that the regulation grants the employee discretion, and thus that the first part of the test is met, then there applies the presumption that the act is covered by 'discretionary function' exception.[470] Three questions need to be answered when trying to rebut the presumption, namely whether the decision involves broad policy considerations, who made the decision and whether GPS is a 'unique governmental function.'[471]

As to the first question it is to be noted that a GPS operator is in principle limited to following the prescribed procedure for updating the GPS constellation and thus it does not appear that he/she could be in a position to make any decisions involving broad policy considerations.[472]

As to the second factor, the US Supreme Court has held that "it is the nature of the conduct rather than the status of the actor that governs whether the exception applies."[473] Despite the Supreme Court dicta, the status of the decision maker is likely to be taken into consideration by the Courts.[474] However, the person in charge of uploading the GPS satellites would presumably be a lower-level officer.[475]

Even though the analysis of the two first factors does not seem to determine the applicability of the exception in the case of a negligent operation of the GPS system, the Government could still be protected pursuant to the 'unique government' doctrine that has recently evolved.[476] Given the dual character of the GPS system, and the stringent

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[469] See Ehrhart *supra* note 420 at 253.
[470] See *US v. Gaubert supra* note 460 at 324.
[471] See Ehrhart *supra* note 420 at 237.
[472] See *ibid* at 237.
[473] See *US v. Gaubert supra* note 460 at 316.
[474] See *Fisher Bros. Sales, Inc. v. US* 46 F3d 279 (1995) at 285. The Court took into account the decision maker status so as to determine the applicability of the 'discretionary function' exception to the case: "The Commissioner's decisions were clearly "matter [s] of choice" for a person *occupying his position* (emphasis added). The case is available online at the Westlaw Database at <http://web2.westlaw.com/find/default.wl?cite=46+F3d+279+&clickit=y&ErrHost=EG%2DWLWEB%2DB32&FN=%5Ftop&GO%2Ex=9&GO%2Ey=11&MT=Westlaw&RS=WLW2%2E76&ssl=y&strRecreate=no&sv=Split&VR=2%2E0> (Date accessed: 30/06/2002).
See also Ehrhart *supra* note 420 at 237.
[475] See Ehrhart *supra* note 420 at 253: GPS satellites must be uploaded via computer commands. Ehrhart believes that an Air Force general "would not be the person sitting at the terminal updating the satellites."
[476] See *Faber v. US supra* note 467.
See also Ehrhart *supra* note 420 at 238: Although the Supreme Court has never expressly supported the 'unique government functions' doctrine, Circuit Courts have progressively inserted this exception in the twofold *Berkovitz* test thus creating the appearance of reliance on Supreme Court precedents. Hence a

security concerns that prompted its deployment, "the military's need for secrecy in its GPS operation could create enough of a 'unique government function.'" [477] Determining the US Government liable for GPS operation would inevitably translate into the need to disclose how GPS works thus making it even more vulnerable to jamming. Given the national defence interests at stake, it is likely that a federal court held that the need to protect the GPS secrecy from the rest of the world involves broad policy considerations and thus falls under the discretionary function exception.[478]

As a final remark it must be born in mind that given the variability of the US courts' decisions when facing discretionary function exception issues there is only room for speculation as to predicting the outcome of a GPS lawsuit for negligent operation of the system. In light of the circumstances, only future specific GPS case law can bring more solid conclusions.

D. EC Liability: The Treaty Establishing the European Community:

Given the Commission's primary role in respect to Galileo, a possible satellite malfunction resulting in damage will inevitable give raise to the liability of the European Community. The overall regime of the liability of the European Community (EC) is governed by Article 288 (ex Article 215) of the EC Treaty.[479]

The analysis of Galileo liability issues necessarily comprises both the European Community's contractual and extra-contractual (tort) liability regimes. It has been noted that Galileo will offer different categories of services.[480] For those services offered under a guaranteed liability regime a series of contractual arrangements have been envisaged so as to apportion the corresponding responsibility among the different actors involved.

(*...continued*)
federal court examining a GPS lawsuit is likely to apply this new doctrine given that at least in facade it is based in the decisions of the US highest Court.

[477] Ehrhart *supra* note 420 at 238.

[478] See *ibid.*

[479] See *EC Treaty supra* note 91. Article 288 reads:

The contractual liability of the Community shall be governed by the law applicable to the contract in question.

In the case of non-contractual liability, 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.

[480] For a study of the services offered by the Galileo system see *supra* Chapter II Section III Subsection 5.

Pursuant to this scheme in the case of a service malfunction, contractual liability in the part of the Community could arise. It is the first paragraph of Article 288 EC Treaty that regulates the contractual liability of the EC when acting in its corporate capacity.

The liability of the Community in contracts does not give rise to major issues given the clarity of the wording of the first paragraph of Article 288. It must be read in conjunction with Article 238 (ex Article 181 EC Treaty) pursuant to which the European Court of justice (ECJ) is granted the exclusive jurisdiction to judge on contracts concluded by or on behalf of the Community. This said, it must be noted however that since 1989, the Court of First Instance[481] currently has jurisdiction to rule at first instance on claims arising out of contracts entered to by the Community subject to appeal before the ECJ whose decision is final.[482]

The judgement is to be based on the law applicable to the contract, since a general EC contractual legal regime does not exist.[483] To prevent choice of law conflicts, it is assumed as a general rule that the Community will determine the law applicable to each contract that it enters to.[484] It is most likely that the law applicable will be that of the Member State were the institution concerned is situated.[485] If a choice of law provision

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[481] Since it was set up in 1952, more than 8,600 cases have been brought before the European Court of Justice. In order to handle such workload, the Court of Justice requested the Council to set up a new judicial body. Pursuant to Council Decision 88/591 ECSC, EEC, EURATOM of 24/10/1989 Establishing a Court of First Instance of the European Communities as corrected by the Corrigendum published in the OJ No. L 241of 17/08/1989 as amended by Council Decision 93/350/ECSC, EEC, EURATOM of 8 June 1993 and as corrected by Corrigendum published in the OJ No. L 234, 17/09/1993 the Council Established the Court of first Instance aimed at improving "the judicial protection of individual interests and to maintain the quality and effectiveness of judicial review in the Community legal order by enabling the Court of Justice to concentrate its activities on its fundamental task, of ensuring uniform interpretation of Community law." See EU, Council of the European Union, *Council Decision of 8 June 1993 Amending Council Decision 88/591/ECSC, EEC, Euratom Establishing a Court of First Instance of the European Communities* [1993] OJ L 144 p. 0021 – 0022 at first 'whereas clause'. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31993D0350&model=guichett> (Date accessed: 2/07/2002).

[482] See EU, Council of the European Union, *Council Decision 88/591 ECSC, EEC, EURATOM of 24 October1989 Establishing a Court of First Instance of the European Communities as amended by Article I of Council Decision 93/350/ECSC, EEC, EURATOM of 8 June 1993 and as corrected by Corrigendum published in the OJ No. L 234, 17/09/1993 Establishing a Court of First Instance of the European Communities* at Article 3.1(c).

[483] A. A. Levasseur & R.F. Scott, *The Law of the European Union: A New Constitutional Order* (Durham: Carolina Academic Press, 2001) at 835.

[484] See *ibid.*

[485] C. Vicenzi & J. Fairhurst, *Law of the European Community* (Harlow, England: Longman, 2002) at 177.

were not included, then it is assumed that the law applicable to the contract will be that of the Member State most closely connected to the contract.[486]

The Galileo open service, albeit deprived of a guaranteed regime of liability at the contractual level, will nevertheless expose the Community to liability in tort for damage resulting from the negligent operation of the system. The Community's tort liability, described as non-contractual liability in terms of civil law countries, is governed by the second paragraph of Article 288 EC Treaty, which is to be read in conjunction with Article 235 (ex Article 178) EC Treaty. According to the latter it is the exclusive jurisdiction of the ECJ to rule in disputes relating to compensation for damage arising out of the Community's non-contractual liability. However since 1989, the Court of First Instance currently has jurisdiction to rule at first instance on claims for damages brought by natural or legal persons against the Community subject to appeal before the ECJ whose decision is final.[487]

The establishment of the Community's liability under Article 288(2) is generally determined by two sets of conditions namely those of a procedural nature and those of a substantial character. In respect to *locus standi* requirements, there are no limitations as to the circle of persons entitled to bring a claim for damages arising under Article 288(2).

> Any person who claims to have been injured [...] must have the possibility of bringing an action, if he is able to establish liability, that is, the existence of damage caused by an illegal act or by illegal conduct in the part of the Community.[488]

Legal persons are also entitled to claim under Article 288(2) so long as they lodge the claim as separate entities and are not trying to enforce a collective right to compensation

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[486] C. Stefanon & H. Xanthaki, *A Legal and Political Interpretation of Article 215(2) [new Article 288(2)] of the Treaty of Rome: The Individual Strikes Back* (Aldershot: Ashgate Dartmouth, 2000) at 40.

[487] See EU, Council of the European Union, *Council Decision 88/591 ECSC, EEC, EURATOM of 24 October 1989 Establishing a Court of First Instance of the European Communities as amended by Article I of Council Decision 93/350/ECSC, EEC, EURATOM of 8 June 1993 and as corrected by Corrigendum published in the OJ No. L 234, 17/09/1993 Establishing a Court of First Instance of the European Communities supra* note 482 at Article 3.1 (c).

[488] See *CMC and Others v. Commission*. Case 118/83 [1985] ECR 02325 at para 31. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61983J0118&model=guichett#SM> (Date accessed: 02/07/2002).

of the natural persons who are their members.[489] Member States may also initiate proceedings under Article 288(2).[490] The right to seek compensation under Article 288(2) is even transferable to a third party provided that the transfer was not a result of abuse.[491]

Contrary to previous case law, the action for damages does no longer require the previous exhaustion of national remedies:

> to make the reparation of loss or damage conditional upon the requirement that there must have been a prior finding by the Court of an infringement of Community law attributable to the Member State concerned would be contrary to the principle of the effectiveness of Community law.[492]

It must be noted that the action envisaged under Article 288(2) is that of an independent nature:

> The action for damages provided for by Article 178 and the second paragraph of Article 215 [now Articles 235 and 288(2) respectively] was established by the Treaty as an independent form of action with a particular purpose to fulfil within the system of actions and subject to conditions for its use, conceived with a view to its specific purpose.[493]

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[489] See *GAARM - Groupement des Associations Agricoles pour l'Organisation de la Production et de la Commercialisation des Pommes de Terre et Légumes de la Région Malouine and others v. Commission.* Case 289/83 [1984] ECR 04295 at paras. 3-4. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61983J0289&model=guichett> (Date accessed : 02/07/2002).

[490] Stefanon & H. Xanthaki *supra* note 486 at 75. Whereas the Court has not yet addressed the issue, it seems difficult to find a justification to exclude member States under Article 288(2) given their privileged position under the most restrictive action under Article 230 (ex Article 173) EC Treaty for judicial review of the legality of acts adopted by the Institutions of the Community.

[491] See *DEKA Getreideprodukte GmbH & Co. KG, i.L. (anciennement Firma Contifex Getreideprodukte GmbH & Co. KG) v. European Economic Community.* Case 250/78 [1983] ECR 00421 at para 11. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61978J0250&model=guichett> (Date accessed: 03/07/2002).

[492] See *Brasserie du Pécheur Sa. v. Germany: The Queen v Secretary of State for Transport, ex parte: Factortame Ltd and others.* Joined Cases C-46/93 and C-48/93 [1996] ECR I-01029 at para 95. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61993J0046&model=guichett> (Date accessed: 02/07/2002).

[493] See *Alfons Lütticke GmbH v. Commission of the European Communities.* Case 4-69 [1971] ECR 00325 at para 6. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61969J0004&model=guichett> (Date accessed: 03/07/2002).
See also *Aktien-Zuckerfabrik Schöppenstedt v. Council of the European Communities.* Case 5-71 [1971] ECR 00975 at para 3. Available online at

Claimants seeking compensation for damage under Article 288(2) EC Treaty, are given a period of five years "from the occurrence of the event" to submit the claim.[494] The Court has held that it is the manifestation of the damage rather than the occurrence of the damaging event the determination factor for the commencement of the period.[495] "The period of limitation shall be interrupted if proceedings are instituted before the Court or if prior to such proceedings an application is made by the aggrieved party to the relevant institution of the Community." [496] All applications under Article 288(2) must include "the subject-matter of the dispute, [...] and a brief statement of the pleas in law on which the application is based."[497]

From a substantive point of view, the establishment of non-contractual liability of the part of the Community depends

> on the satisfaction of a number of requirements relating to the unlawfulness of the conduct, [...] the reality of the damage and the existence of a causal connection between that conduct and the damage in question.[498]

The wording of Article 288 (2) EC Treaty refers to the unlawful action in the part of a EU institution or of its servants. From the perspective of Galileo, it is most likely that the institutions giving rise to EC liability will be the Commission and the Council. In respect to actions of legal servants, "the Community is only liable for those acts of its servants which by virtue of an internal and direct relationship are the necessary extension of the

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(*...continued*)
<http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61971J0005&model=guichett> (Date accessed: 03/07/2002).

[494] See *Protocol on the Statute of the Court of Justice*, 17 April 1957, (as last amended by Article 6 III (3)(c) of the Treaty of Amsterdam) at Article 43. Available online at <http://curia.eu.int/en/txts/acting/statut.htm> (Date accessed: 03/07/2002). [Hereinafter Protocol on the Statute of the Court of Justice].

[495] See *Birra Wührer SpA and others v. Council and Commission of the European Communities*,. Joined Cases 256, 257, 265, 267/80, 5 and 51/81 and 282/82 [1984] ECR 03693 at para 15. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61980J0256(01)&model=guichett> (Date accessed: 03/07/2002).

[496] See *Protocol on the Statute of the Court of Justice supra* note 494 at Article 43.

[497] See *ibid* at Article 19.

[498] See *SA Oleifici Mediterranei v. European Economic Community*. Case 26/81 ECR 03057 [1982] at para 16. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61981J0026&model=guichett> (Date accessed: 03/07/2002).

tasks entrusted to the institutions."[499] The term "act" includes both positive actions and omissions.[500] The act must be unlawful. In EU law, unlawful acts comprise three different categories, illegal actions, delictual actions and breaches of contract.[501] Delictual acts encompass the negligent acts by Community servants in the performance of their duties,[502] failure by the institution to properly supervise an inferior body,[503] and insufficient organization of the service.[504]

Whereas Galileo will be operated by a private company, it is however obvious that the company will be controlled and supervised by public authorities.[505] Although the Galileo institutional framework has not yet been clearly defined, there can be no doubt that the EC will be actively involved in the supervision of the Galileo operating company. During the definition phase it has been the Programme Management Board (PMB)[506] representing the EC together with ESA and other major public investors, that has overseen the day-to-day management of the overall Galileo Programme. During the subsequent phases, the PMB will be replaced with a new structure charged with the overall management of the system, besides its operation, exclusively entrusted to the Galileo Vehicle Company. It is clear that major public investors (*i.e.* EC) will keep being part of the new supervisory structure and so, the Community will be exposed to liability in the case of damage resulting from its failure to properly supervise the Galileo Operating Company or from the insufficient organization of the Galileo services.

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[499] See *Sayag v. Leduc*. Case 9/69 [1969] ECR 00329 at para 7. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61969J0009&model=guichett> (Date accessed: 03/07/2002).

[500] See *SA Oleifici Mediterranei v. European Economic Community supra* note 498 at para 10.

[501] See Stefanon & Xanthaki *supra* note 486 at 84.

[502] J. Steiner & L. Woods, *Textbook on EC Law* (6th Ed) (London: Blackstone Press Limited, 1998) at 498.

[503] See *Société nouvelle des usines de Pontlieue - Aciéries du Temple (S.N.U.P.A.T.) v. High Authority of the European Coal and Steel Community*. Joined cases 32/58 and 33/58 [1959] ECR 00127 at para 1. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61958J0032&model=guichett> (Date accessed: 06/07/2002).

[504] See *Société métallurgique de Knutange v. High Authority of the European Coal and Steel Community*. Joined cases 15-59 and 29-59 [1960] ECR 0001 at para 9. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61959J0015&model=guichett> (Date accessed: 06/07/2002).
See also Stefanon & Xanthaki *supra* note 486 at 85.

[505] See "US Diplomatic Efforts Against Galileo" (2001) 17 at 3, Galileo Newsletter, Genesis Office. Available online at <http://www.genesis-office.org/indexgl.htm> (Date accessed: 06/07/2002).

[506] For further study of the Galileo institutional scheme see *infra* Chapter V Section I.

Damage is the second requisite for the establishment of liability under Article 288(2). Only actual damage specifically suffered is recoverable.[507] Compensation has generally been awarded for financial loss, including the corresponding interest due to the effluxion of time and moral damages.[508] The question arises as to the award of compensation for physical injuries. Whereas up to now it had been difficult to imagine the occurrence of physical injuries resulting from the conduct of the Community, the Galileo system will naturally change the picture as the negligent transmission of a satellite faulty signal, in the civil aviation scenario would most likely derive into a plane crash resulting in the certain loss of human lives. The European Court of Justice (ECR) however has expressly acknowledged the obligation for the Community to compensate in the case of physical injuries:

> The victim of an accident must be compensated, irrespective of any financial loss, for any personal damage which may cover *physical* (emphasis added) or mental suffering. [509]

The third element of liability is that of causation. There must be a "direct causal link between the alleged wrongful acts and the alleged damage"[510] the "burden of proof of which rests on the applicants."[511] Thus in the context of a Galileo related accident it would be for the injured parties to prove the causal link.

The causal connection may be interrupted. The applicants themselves may break the chain of causation. In general the "the injured party must show reasonable diligence in

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[507] See *Société Roquette Frères v. Commission*. Case 26/74 [1976] ECR 00677 at para 23. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61974J0026&model=guichett> (Date accessed: 03/07/2002).

[508] See *M. Helen Marshall v. Southampton and South-West Hampshire Area Health Authority*. Case C-271/91[1993] ECR I-04367 at para 4. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61991J0271&model=guichett> (Date accessed: 04/07/2002).
See also Stefanon & Xanthaki *supra* note 486 at 96 and 106.

[509] See *Grifoni v. EURATOM*. Case C-308/87 [1994] ECR I-00341 at para 37. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61987J0308(01)&model=guichett#MO> (Date accessed: 03/07/2002).

[510] *Blackspur DIY Ltd, Steven Kellar, J.M.A. Glancy and Ronald Cohen v. Council of the European Union and Commission of the European Communities*. Case T-168/94 [1995] ECR II-02627 at para 11. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61994A0168&model=guichett> (Date accessed: 04/07/2002).

[511] See *ibid* at para 40.

limiting the extent of his loss or risk having to bear the damage himself."[512] If they fail to do so, they interfere with the chain of causation.

In the case of a Galileo malfunction the question arises as to whether the chain of causation may be broken when a body supervised or controlled by the Community has carried out the act from which the damage has resulted. In this respect the Court has clarified that in the referred circumstances the chain of causation will not be interrupted[513] so long as the act was not undertaken by an autonomous and independent authority of a member State.[514]

As to the extent of compensation the Court has clearly advocated the principle of full compensation for the entire loss sustained:

> Where financial compensation is the measure adopted in order to achieve the objective indicated above, it must be adequate, in that it must enable the loss and damage actually sustained as a result of the discriminatory dismissal to be made good in full.[515]

From a procedural perspective, the action under Article 288 (2) has been constructed in a sufficient flexible manner to facilitate individuals the effective use of the remedy

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[512] Opinion of Mr. Advocate General Léger delivered on 20 June 1995 [1996] ECR I-02553 at para 192 citing the interlocutory judgment of 19 May 1992 *Mulder and Others v. Council and Commission* [1992] ECR I-3061 at para 33. The opinion is available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61994C0005&model=guichett> (Date accessed: 03/07/1993).
See also *The Queen v. Ministry of Agriculture, Fisheries and Food, ex parte: Hedley Lomas (Ireland) Ltd.* Case C-5/94 [1995] ECR I-02553 at para 192. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61994C0005&model=guichett> (Date accessed: 03/07/2002).
See also *J.M. Mulder, W.H. Brinkhoff, J.M.M. Muskens, T. Twijnstra and Otto Heinemann v. Council of the European Union and Commission of the European Communities*. Joined Cases C-104/89 and C-37/90 [2000] ECR I-00203 at para 168. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61989J0104(01)&model=guichett> (Date accessed: 04/07/2002).
[513] See *Acciaieria Ferriera di Roma (FERAM) and others v. High Authority of the ECSC.* Joined Cases 9 and 25/64 [1965] ECR 00311. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61964J0009&model=guichett> (Date accessed: 04/07/2002).
[514] *Société pour l'Exportation des Sucres SA v. Commission of the European Communities*. Case 132/77 [1978] ECR 01061 at para 13. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=61977J0132&model=guichett> (Date accessed; 04/07/2002).
[515] See *M. Helen Marshall v Southampton and South-West Hampshire Area Health Authority supra* note 508 at para 26.
See also *Brasserie du Pécheur Sa. v. Germany supra* note 492 at para 82.

offered to them. Unlike the situation in the area of judicial review, there are no personal restrictions as to the circle of persons entitled to claim compensation under Article 288 (2).[516] This, together with a generous limitation period of five years and the declared independent nature of the action from any other compensation channels under EC or national law, will prove highly advantageous in the future to afford individuals an effective remedy in the case where the latter have suffered Galileo related damage due to the Community's action/inaction. From a substantive point of view however, a major obstacle arises as to the real effectiveness of the recourse, namely the obligation in the part of the claimants to prove the causal link between the wrongful act and the damage. Given the complex interaction of circumstances that may contribute to the occurrence of a plane crash, it will be a Herculean task for the plaintiffs to establish that the erroneous signal alone was determinant of the accident. It will be for the European Court to adopt a flexible approach towards this duty of the claimants if it wants to preserve the value of the action envisaged under Article 288 (2) EC Treaty.

E. ESA Liability: The ESA Convention:

"The European Space Agency is Europe's gateway to space."[517] Its mission is to bring forward the development of European space capabilities and to ensure that investment in space continues to bring benefits to Europe.[518] ESA has long experience in the implementation of complex space missions. The activities of the Agency include a series of mandatory programmes in which all Member States must participate.[519] In addition, members choose their level of participation in different optional programmes (*i.e.* navigation).[520] Galileo is a joint project of the European Commission and the European

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[516] See *EC Treaty supra* note 91 Article 230 (ex Article 173). The right to institute proceedings against the legality of Community acts is restricted in the case of natural persons to decisions specifically addressed to them and to those other acts of direct and individual concern to them.
[517] See ESA, "ESA Facts and Figures" at <http://www.esa.int/export/esaCP/GGG4SXG3AEC_index_0.html> (Date accessed 06/07/2002).
[518] See *ibid.*
[519] *Convention for the Establishment of a European Space Agency*, 30 October 1980, Ref. CSE CS (73) 19, rev. 7 (entered into force 30 October 1980). Available online at <http://www.esa.int/convention/> (Date accessed: 06/07/2002).
[Hereinafter *ESA Convention*].
[520] See *ibid* at Article V.1.b.

Space Agency (ESA).[521] In respect to Galileo, the Agency's responsibility covers the definition, development, and in-orbit validation of the space segment and related ground infrastructure.[522]

ESA's liability is governed by the provisions of its constituent instrument. The Agency enjoys a series of privileges and immunities.[523] In particular, ESA is immune from jurisdiction and from execution unless the Council has expressly waived its immunity for a specific case.[524] However,

> the Council has the duty to waive this immunity in all cases where reliance upon it would impede the course of justice and it can be waived without prejudicing the interests of the Agency.[525]

Up to the present date the ESA Council has not waived its immunity with respect to Galileo.[526] However immunity from jurisdiction and execution does not mean absence of liability. It cannot be forgotten that ESA has declared its acceptance to the Liability Convention of 1972 and so it could be held liable by the Claims Commission envisaged under such instrument. Nonetheless, for the resolution of the Claims Commission to be mandatory, previous agreement of the parties to the dispute as to the binding nature of the decision would be required. [527]

F. Non-Provider States Liability: Article 28 of the Chicago Convention:

States have traditionally decided how to provide air navigation facilities within their sovereign territories in a way to retain as much political control as possible. This has habitually been achieved through Civil Aviation Departments, Agencies or Authorities

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[521] For a further study of the Galileo partners see *supra* Chapter II Section III Subsection 4.
[522] See ESA, "Who's Involved in Galileo?" at <http://www.esa.int/export/esaSA/GGG28850NDC_navigation_0.html> (Date accessed: 06/07/2002).
[523] See *ESA Convention supra* note 519 Annex I.
[524] See *ibid* at Annex I Article IV.1.
[525] See *ibid* at Article IV.1.a.
[526] See Lagarrigue *supra* note 402 at 32.
[527] See *supra* note 417 and accompanying text.

owned, controlled and operated by ATC entities either directly by a Department or through Autonomous Civil Aviation Authorities.[528]

The implementation of GNSS, however, poses a fundamental problem. For the majority of States, the GNSS infrastructure, at least as far as the signal-in-space segment is concerned, will be controlled and operated by foreign countries. The question arises as to the liability that non-provider States will bear in the case of damage resulting from a GNSS accident in their territory. The responsibilities of user States are to be derived from Article 28 of the Chicago Convention pursuant to which States undertake to provide in their territory, airports and navigation facilities in accordance with ICAO's Standards and Recommended Practices. Thus non-provider States are responsible for ANS over their territory.[529]

It has been noted that air navigation services encompass both a regulatory and a service provision dimension, which have traditionally been performed by the same national entity but that the responsibility for the actual provision of air navigation services by a State under Article 28 of the Chicago Convention can be delegated.[530] Even in the case of such delegation, the State remains responsible for ensuring the quality of the services provided in their territory.[531] It may be thus safely concluded that the responsibilities of non-provider States under Article 28 of the Chicago Convention are essentially regulatory in nature.

In light of the above, as regards GNSS, non-provider States are responsible for the establishment of an adequate regulatory framework so as to decide firstly whether to authorize the use of GNSS navigation facilities over their sovereign air space and if so to ensure on a continuous basis that the GNSS signal provided by a foreign State is in compliance with ICAO Standards and Recommended Practices in terms of the minimum guarantees of accuracy, reliability and integrity of the signal.[532]

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[528] See WW/IMP *supra* note 7, Presentation given by the honourable K.O Rattray, Solicitor General of Jamaica, *Legal and Institutional Challenges for GNSS-The Need for Fundamental Obligatory Norms* (14/05/1998) at 3-4. Available online at <http://www.icao.int/allpirg/rio-speeches/ag5/> (Date accessed: 07/07/2002).

[529] See Schubert *supra* note 367 at 255.

[530] See *supra* Chapter VI Section II.

[531] See Schubert *supra* note 367 at 255 citing the *Report on Financial and Related Organizational and Managerial Aspects of Global Navigation Satellite System (GNSS) Provision and Operation*. ICAO Doc. 9660 (May 1996), § 2.6.1.

[532] See *ibid* at 255-256.

This translates into the fact that in the case of a GNSS related accident, non-provider States should be held liable only due to their own failure to adequately perform their regulatory and supervisory duties but not for the negligent operation of the GNSS system by the signal provider. To hold otherwise would mean the obligation in the part of non-provider States to compensate damage resulting from the fault of others and regardless their own fault.[533]

Article 28 States' liability for failure to comply with the referred duties would then be subjected to domestic[534] laws on State liability. Most States have waived their sovereign immunity and thus can be sued for damage resulting from acts or omissions of their civil servants. As many States have adopted a fault-based liability regime the claimant will have to prove negligence in the part of the State. State liability is usually unlimited and thus the victims will be fully compensated for the damage suffered. However, as States are unwilling to be subjected to a foreign jurisdiction, claimants will have to seek compensation before the State's own courts.[535]

G. Direct Users' Liability in Case of a Plane Crash:

In the case of a GNSS- related accident, the claimant could hold the air carrier liable provided that he/she could prove that the aircrew knowingly deployed faulty GNSS signals or that the use of GNSS signals was not authorized unless the air carrier could demonstrate in its part that there had been no means to avoid the accident.[536]

In the case of a commercial plane crash and provided that the aircraft concerned was engaged in international transportation, an action for damages could be brought under the Warsaw Convention and its subsequent Protocols or under the Montreal Convention of 1999 when it enters into force. At EU level, the action may be brought under Council Regulation 2027/97 on Air Carrier Liability.[537] Damage may also be caused to third

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[533] See *ibid* at 255-257.
[534] See *ibid* at 258: "Despite the conclusion of numerous studies conducted under the auspices of ICAO over nearly forty years, there is no international regime that governs the liability of States for ANS."
[535] See Schubert *supra* note 367 at 258.
[536] See *ibid* at 260.
[537] See EU, Council of the European Union, *Council Regulation No 2027/97 of 9 October 1997 on Air Carrier Liability in the Event of Accidents* [1997] OJ L 285 p. 0001 - 0003. Available online at <http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=319

parties on the surface of the Earth, which would then be entitled to seek compensation from the aircraft operator under the Rome Convention of 1952.[538]

i. The Warsaw System:

The 1929 Warsaw Convention[539] constitutes the most widely accepted unification of private law. Ratified and adhered to by most countries[540] its rules have been applied all over the world providing the basis for a near universal system, which has endured for so many years. The Convention was the product of a time when the air industry was still at its infancy. In its time, it constituted a phenomenal contribution to the unification of law, providing for uniform solutions to major conflicts of law and jurisdiction. In some aspects the Convention achieved a better balance of interests between passengers and carriers than compared to other modes of transport.[541]

In the case of a GNSS-related accident, victims may find easiest to seek compensation through recourse under the Warsaw Convention. This is mainly due to the fact that the Convention embodies a presumption of fault in the part of the carrier with reversal of the burden of proof. Hence, the carrier may only be exonerated from the obligation to compensate the damage caused if "he proves that he and his agents have taken all necessary measures to avoid the damage or that it was impossible for him or them to take such measures."[542] This burden will not be easy to discharge. In the context of a GNSS-related accident, the carrier may argue that he provided for a back-up system in prevision

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(*...continued*)
97R2027&model=guichett> (Date accessed: 07/07/2002).[Hereinafter *Council Regulation on Air Carrier Liability*].

[538] See *Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface*, 7 October 1952, ICAO Doc. 7364 (entered into force 4 February 1958). Available online at <http://www.iasl.mcgill.ca/airlaw/private/other/rome1952.pdf> (Date accessed: 08/07/2002) [Hereinafter *Rome Convention*].

[539] *See Convention for the Unification of Certain Rules Relating to International Carriage by Air, 12 October 1929*, Schedule to the United Kingdom Carriage by Air Act, 1932; 22 & 23 Geo.5, ch. 36 (entered into force 13 February 1933). Available online at <http://www.iasl.mcgill.ca/airlaw/private/warsaw/warsaw1929.pdf> (Date accessed: 07/07/2002).[Hereinafter *Warsaw Convention*].

[540] 150 parties have ratified the Convention. See <http://www.icao.int/icao/en/leb/wc-hp.htm> (Date accessed: 07/07/2002).

[541] M. Milde, "Liability in International Carriage by Air: The New Montreal Convention" (1999) I Private International Law Casebook (Montreal: McGill University, 2001) at 278.

[542] See *Warsaw Convention supra* note 539 at Article 20 para 1.

for a signal disruption. However, the carrier is to prove *complete* absence of negligence as regards all aspects of the flight and not only with respect to a GNSS malfunction. Given the complex interaction of causes that may lead to a plane crash, it is very difficult that the carrier be able to demonstrate absolute non-existence of *any* negligence in his part.

The Convention furthermore offers claimants the possibility of considerable 'forum shopping' as the action may be brought, "at the option of the plaintiff" in four different jurisdictions.[543] This is important as the claimant's choice of forum will determine all procedural matters and to a certain extent also the level of compensation obtained.[544]

However, as *a quid pro quo* from easing the burden of proof in the part of the claimant, the Convention imposed monetary limits of liability to the benefit of the carrier.[545] The referred provision, contrary to the fundamental principle that the victim is entitled to full and adequate compensation for the damage suffered, has constituted a source of major dissatisfaction leading to a series of initiatives in the form of subsequent amendments (or attempted amendments) and unilateral initiatives to improve the Convention.[546] From Protocol to Protocol the Warsaw Convention eventually evolved into a victim oriented two-tier regime of strict liability up to a specific limit of proven damage and presumed fault of the carrier beyond that sum.[547]

The new Convention also benefits the victims in that it increases the chances of 'forum shopping' in the case of damage resulting from the death or injury of a passenger by adding the so-called fifth jurisdiction, that is, the fora of the claimant's place of principal and permanent residence.[548] It can thus be expected that claimants will seek every possible means to file the claim before a US jurisdiction, generally more inclined to

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[543] See *ibid* at Article 28.
[544] See Milde *supra* note 541 at 288.
[545] See *Warsaw Convention supra* note 539 at Article 22.
[546] The *Warsaw Convention* has been subsequently amended by the *Hague Protocol* of 28 September 1955; the *Guadalajara Convention* of 18 September 1955; the *Montreal Agreement* of 1966 (this is not an instrument of international law amending the Convention but a private agreement of the airlines with the US); the *Guatemala City Protocol* of 8 March 1971 (never entered into force); the *Additional Protocols of Montreal* 1, 2, 3, of 25 September 1975.
[547] See *Convention for the Unification of Certain Rules for International Carriage by Air*, 28 May 1999, DCW Doc. No. 57 (not yet in force) at Article 21. Available online at <http://www.iata.org/legal/_files/Montreal1999.doc >(Date accessed: 07/07/2002). [Hereinafter *Montreal Convention*].
[548] See *ibid* at Article 33.2.

award generous compensation for a much wider level of non-economical damages than anywhere else in the world.[549]

Consequently, once entered into force, the Montreal Convention will most likely turn into the most popular channel available to air passengers to seek compensation in the event of a GNSS related accident. Up to the specified limit, claimants need only to prove the extent of the damage suffered without reference to any GNSS malfunction. Beyond the referred limit, liability is based on fault with reversed burden of proof so that the carrier will be exonerated solely if he is able to demonstrate that the damage was not due to the negligence or other wrongful act or omission of the carrier or its servants or agents. Neither shall the carrier be held liable if he proves that a third party was *solely* responsible for the damage.[550] The latter constitutes a novel defence of the new Convention, which could lead to the carrier's exoneration upon proof that the only cause of the accident was the intentional jamming of the GNSS navigation system.

In general however, the burden of proof in the part of the carrier, will not be easy to discharge: "the complicated chain of facts and their mutual causal nexus in aircraft accidents frequently leaves doubts as to the complete absence of any negligence, wrongful act or omission"[551] this even more so with the advent of air navigation by satellite.

ii. The EU Council Regulation on Air Carrier Liability:

Prompted by the necessity to improve the level of protection of passengers involved in air accidents[552] due to the limit set on liability by the Warsaw Convention in conflict with today's economic and social standards,[553] the European Union adopted the Regulation on Air Carrier Liability[554] applicable to its Member States as of 17 October 1998.

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[549] See Milde *supra* note 541 at 289.
[550] See *ibid.*
[551] See Milde *supra* note 541 at 287.
[552] See *Council Regulation on Air Carrier Liability supra* note 537 at first 'whereas' clause.
[553] See *ibid* at third 'whereas' clause.
[554] See *ibid.*

The Regulation lays down the obligations of Community air carriers in relation to liability to passengers in the event of accidents for damage sustained on board an aircraft or in the course of any of the operations of embarking or disembarking.[555] For the purpose of the Regulation, "'Community air carrier' shall mean an air carrier with a valid operating licence granted by a Member State."[556]

The main aspects of the EC Regulation can be summarized as follows: there is an express waiver of any financial limits in the event of death, wounding or any other bodily injury of a passenger[557] coupled with strict liability for such claims up to a specified limit.[558] Beyond that sum the carrier may only exclude his liability by proving that he and his agents have taken all the necessary measures to avoid the damage or that it was impossible for him or them to take such measures.[559]

For the same reasons mentioned in respect of the Montreal Convention of 1999, the EC Council Regulation will most likely constitute the most utilized recourse by injured passengers in the event of a GNSS-related accident on board a Community carrier. Up to the specified limit claimants need only to prove the extent of the damage suffered and beyond that limit, it is for the carrier to rebut the presumption of its own negligence, certainly not an easy burden to discharge.[560]

iii. The Rome Convention:

In the occurrence of an aviation accident, (not necessarily GNSS-related) damage may also be caused to third parties on the surface of the Earth, which would then be entitled to sue the aircraft operator under the Rome Convention of 1952.[561]

The Rome Convention is favourable to victims in that it lays down a regime of strict liability. Hence, in the case of damage on the surface resulting from a GNSS-related accident, claimants would be entitled to compensation upon demonstration of the extent

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[555] See *ibid* at Article 1.
[556] See *ibid* at Article 2.1(b).
[557] See *ibid* at Article 3.1(a).
[558] See *ibid* at Article 3(2).
[559] See *ibid.*
[560] See *supra* note 551 and accompanying text.
[561] See *Rome Convention supra* note 538.

of the damage suffered and that it was directly caused by an aircraft in flight or by any person or thing falling therefrom[562] and regardless proof of a GNSS malfunction.

However, in the overall, and not necessarily being circumscribed to a GNSS scenario, the remedy established under the Rome Convention does not offer adequate protection to victims. Firstly, the Convention will only apply if ratified by both the State of registry of the aircraft concerned and the State in which territory the accident occurs.[563] Hence the applicability of the Convention is significantly reduced to a small number of signatories.[564] Secondly, in a similar approach than taken under the Warsaw Convention, the extent of compensation to which victims are entitled is limited by fixed amounts of money.[565] At the time when the Warsaw Convention was drafted it may have been justified to limit the extent of liability in the part of the air carrier as a protectionist measure of a nascent industry. It can moreover be argued that pursuant to the contract of carriage air passengers knowingly agree on the conditions of transport including the limits of liability and are furthermore given the opportunity to avail themselves of additional private insurance. However, to limit the extent of liability under the Rome Convention to the detriment of innocent parties in no way involved in international air transportation is nowhere justifiable.

2. Assessment of the Present System: The Desirability of a Liability Convention for GNSS:

Assessing the need of a new GNSS specific instrument may be approached from two distinct perspectives, namely that of what it should idealistically be, and that other more pragmatic view of what it is realistically possible to achieve.

From a *lege ferenda* point of view, elaborating a GNSS liability Convention is highly desirable. Navigation by satellite entails a complex interaction of relationships among the multiple actors involved in the provision of GNSS services. Moreover, a GNSS-related accident will most likely implicate the involvement of more than one State such as the

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[562] See *ibid* at Article 1.1.
[563] See *ibid* at Article 23.1.
[564] The *Rome Convention* has 44 parties. See <http://www.icao.int/icao/en/leb/rome1952.htm> (Date accessed: 08/07/2002)
[565] See *Rome Convention supra* note 538 at Article 11.

signal provider State, the regional augmentation system operator, and the user State with the corresponding choice of law conflicts and difficulties of allocating the corresponding liabilities. This, coupled with the fragmented legal regime currently in place will inevitably result in the multiplication of claims against the different actors involved in the provision of GNSS services.

To get a rough impression of the complexity of the situation one could imagine the potential course of action in the most common possible scenario, namely the case of a GNSS-related accident resulting in a plane crash.

Had for example a non-US citizen reliant on GPS suffered damage pursuant to the negligent operation of the GPS system, he/she could seek compensation under the Liability Convention. However, the liability Convention based on principles of public international law creates a relationship merely among sovereign States thus significantly failing to directly benefit the claimants. Although it is possible for non-US citizens to file suit against the US government under the Federal Tort Claims Act, serious difficulties arise for potential claimants to overcome the hurdle of the 'discretionary function exception' in the case of a GPS malfunction.

At EU level, one may argue that the provisions of the Treaty of Amsterdam are adequate to indemnify future claimants from damage derived from a Galileo malfunction. However, to secure the effectiveness of the remedy offered under Article 288(2) EC Treaty, it is imperative that the European Court of Justice adopt a flexible approach towards the duty of the claimants to prove a direct causal link between the damage suffered and the Galileo malfunction.

On condition that the plane had been engaged in international transportation the passenger could easily recover compensation from the air carrier under the victim oriented regime of the new Montreal Convention. However, the Convention is not yet in force.

Initially it was proposed to bring the Montreal Convention into force upon the fifteenth instrument of ratification.[566] Even lower numbers were considered.[567] However, dissenting views emerged and it was finally agreed that the new Convention "shall come into force on the sixtieth day following the date of deposit of the thirtieth instrument of

[566] See Milde *supra* note 541 at 289.
[567] See *ibid* at 290.

ratification, acceptance, approval or accession."[568] Done the 28 of May 1999, as of today, the excellences of the Convention have gathered just 19 contracting States.[569] How long will it take for the Montreal Convention to enter into force? "Conventional wisdom and general precedents would suggest that it should be rated a good success if the new Convention entered into force [...] during the first five years of the 21st Century."[570] But perhaps it will take longer.

With the new Montreal Convention out of the picture the damage suffered by passengers in the course of international air transportation is to be governed by a series of different texts depending on which instruments have been ratified by the concerned States in each case, certainly not the most uniform of all legal regimes. Only in the case of damage suffered on board a Community carrier would the victims benefit from the victim-oriented EU Council Regulation.

To further complicate the picture, it must be noted the air carrier may not only appear in the position of a potential defendant. He/she may also seek compensation for the damage suffered in the accident by suing several parties along the chain of actors involved in the provision of GNSS navigation services, namely the signal-in-space provider, the user State, the ATC provider or even the GNSS equipment manufacturer.[571]

Neither air passengers nor third parties on the surface are availed of an effective remedy. The Rome Convention is only applicable among a small number of countries and it unjustifiably limits the extent of compensation to which victims may be entitled

When one thinks of the ultimate purpose of establishing a liability regime, the first explanation that comes into mind is that of affording the victims adequate and effective compensation for the damage suffered. 'Adequate' and 'effective' must necessarily embody the notion of reasonable expeditiousness of the remedy. The present regime is fragmented, complex and obligates each claimant to engage in several actions against various defendants in different States. A victim-oriented approach more in conformity with today's social standards is *desirable.*[572]

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[568] See *Montreal Convention supra* note 547 at Article 53.6
[569] See <http://www.icao.int/icao/en/leb/mtl99.htm> (Date accessed: 09/07/2002).
[570] See Milde *supra* note 541 at 290.
[571] See Schubert *supra* note 367 at 261.
[572] See *ibid* at 266.

Now, the notion of desirability does not necessarily coincide with that of realism, realism in respect of what it is achievable in light of the present state of affairs. In truth, GNSS is not so different from other existing navigation aids. Even present short-range systems such as VOR operate across national boundaries. Long-range navigational aids such as LORAN-C and OMEGA have been in use for years. They were also developed by the military and later on brought into civil use. They have moreover been traditionally controlled by one country while relied on by the rest of the world.[573]

It is also correct to argue that from a strict legal point of view, the existing regime does indeed cover the liability of all players involved in the GNSS system.[574] Even more so, ICAO' Secretariat Study Group has qualified the existing regime as "reasonably adequate to determine or apportion liability arising from accidents involving failure or malfunction of GNSS systems"[575] although procedural rules, in particular as regards jurisdiction, "are not fully adequate to bring all parties before the same court."[576]

Consensus regarding the desirability of a new instrument has not yet emerged and it is doubtful that it will ever be achieved. No realistic assessment may be performed without due regard to the position of current signal providers. Russia will not assume any responsibility for damage caused by an erroneous GLONASS signal.[577] The United States has consistently advocated the sufficiency of the existing legal framework:

> A serviceable legal framework [...] already exists, one which is flexible, adaptable and amenable to being elaborated to meet new technical challenges.[578]

Despite European exigencies of a GNSS-specific new instrument, how can the crusade for a new Convention ever be successful without including all GNSS signal providers? Maybe we should start thinking of how to make the best use of the existing

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[573] See WW/IMP *supra* note 7, Presentation given by M.B. Jennison, Assistant Chief Counsel, International Affairs, Federal Aviation Administration, *A Legal Framework for CNS/ATM* (14/05/1998) at 1-2. Available online at <http://www.icao.int/allpirg/rio-speeches/ag5/> (Date accessed: 09/07/2002).
[574] See Schubert *supra* note 367 at 265.
[575] See A33-WP/34 *supra* note 188 at 2 para 3.2.
[576] See *ibid.*
[577] Information obtained from Victor P. Kuriamov, Representative of the Russian Federation at the Council of ICAO (15/05/2002).
[578] See WW/IMP-WP/74 *supra* note 370 at 4 para 2.2.2.2.
See also Jennison *supra* note 573 at 1: "GNSS not only has a legal framework, it has a legal framework that is adequate to the task."

legal regime at least for the near future, until we see how Galileo actually evolves and affects the liability regime of GNSS and if it really becomes the promised strong competitor *versus* the Global Positioning System that forces the US to give the legal guarantees demanded by GNSS users.

Chapter V: Specific Legal Issues of Galileo:

I. Institutional Issues:

"The real challenge for Galileo is institutional."[579] The European Commission and ESA are developing the overall Galileo initiative as a common project. Both organizations however are based on distinct areas of competence and have autonomous financial resources. Despite their differences it is essential that both entities work genuinely together.[580]

In 1998, the Council of the EU agreed "to strengthen further the synergy and increase the complementarity between the Commission and ESA."[581] In 1999 following Resolutions by the EU Council[582] and by the ESA Ministerial Council,[583] the ESA executive and the Commission jointly elaborated a European Space Strategy recognizing the specific features of the Galileo project and determining that the pursuit of common objectives in this and other initiatives would require the establishment of a clear operational framework to allow ESA to act as the implementing Agency for the space and ground segments.[584] For this purpose, the Commission and the ESA executive decided to set up a Joint Task Force.[585] On 16 November 2000, the Council of ESA at an extraordinary meeting and the Council of the EU met separately in Brussels and adopted two complementary resolutions.[586] These Resolutions endorsed the proposed European

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[579] See M. Ferrazzani "European Institutional Scenario", (2000) 3:1, Newsletter of Committee Z (Outer Space) of the International Bar Association on Business Law at 4.
[580] See *ibid.*
[581] See EU, Council of the European Union, *Council Resolution of 22 June 1998 on the Reinforcement of the Synergy between the European Space Agency and the European Community* [1998] OJ C 224 p. 0001–0002 at para 1. Available online at <http://europa.eu.int/eur-lex/pri/en/oj/dat/1998/c_224/c_22419980717en00010002.pdf> (Date accessed: 20/06/2002).
[582] See EU, Council of the European Union, *Council Resolution of 2 December 1999 on the Development of a Coherent European Space Strategy* [1999] OJ C 375 p. 0001at para 4. Available online at <http://europa.eu.int/eur-lex/pri/en/oj/dat/1999/c_375/c_37519991224en00010001.pdf >(Date accessed: 20/06/2002).
[583] See Resolutions of the ESA Council of 11 and 12 May 1999.
[584] See *Joint ESA/EC Document on a European Strategy for Space* at 17 para 5.1. Available online at <http://ravel.esrin.esa.it/docs/wisemen_report.pdf> (Date accessed: 20/06/2002).
[585] *Ibid.*
[586] See EU, Council of the European Union, *Council Resolution of 16 November 2000 on a European Space Strategy* [2000] OJ C 371 p. 0002 – 0003 at para 10. Available online at

Space Strategy, reiterated the importance of Galileo as an example of the new approach to space and approved the initiative to establish a Joint EC/ESA Task force. The task Force composed of Members of the Commission and of the ESA executive was finally set up in March 2001 and mandated to make joint proposals for the continuing joint development of the European Space Strategy and its implementation and to monitor progress on the two priority projects relevant to EU policy, namely Galileo and Global Monitoring for Environment and Security (GMES).[587] The first Report on the European space activities for the EU and ESA Councils was to be finished by the end of 2001.[588] With regard to Galileo, the task force concluded that the complexity of the Programme requires a simple and robust management scheme to be set up.[589]

The institutional framework set during the definition phase was composed of the Galileo Steering Committee, the Programme Management Board and the Galileo Programme Office. The Galileo Steering Committee in charge of supervising the definition phase is composed of representatives of the EU and of ESA, Norway, Iceland and Switzerland, the last four as observers. It has the status of a management committee. It represents the political strategic and policy levels of the Galileo Programme management. It is anticipated that during the subsequent phases, the GSC will still be in place. The Programme Management Board (PMB) representing the EC, ESA and other major public investors, was mandated to oversee the overall Galileo definition phase. The Galileo Programme Office (GPO), composed of permanent experts under the supervision of the GPO manager was charged with the preparation of the PMB decisions and actions.[590]

In June 2002 the Commission proposed the establishment of a Joint Undertaking charged with the overall responsibility for Galileo during the development and validation phase. The Joint Undertaking was finally established pursuant to a Council Resolution in

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(*...continued*)
<http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=32000Y1223(01)&model=guichett> (Date accessed: 20/06/2002).
See also ESA Council Resolution of 16 November 2000.

[587] See <http://www.europa.eu.int/comm/space/taskforce_en.html> (Date accessed: 20/ 06/2002).

[588] See European Commission, Press Release, "EC-ESA Joint Task Force on European Strategy for Space Meets for the First Time in Brussels" (02/03/2001) Available online at <http://europa.eu.int/comm/research/press/2001/pr0203-space-en.html> (Date accessed: 20/06/2002).

[589] See *European Commission and the European Space Agency Joint Task Force Report*, annexed to COM (2001) 718 final *supra* note 107 at 14.

[590] See Andries *supra* note 6 at 60-61.

March 2002.[591] The Joint Undertaking has legal personality and enjoys the most extensive legal capacity accorded to legal persons under the laws of all Member States.[592] The bodies of the Joint Undertaking are the Administrative Board, the Executive Committee and the Director.[593] The Administrative Board, composed of the Members of the Joint Undertaking, is to take the necessary decisions for the implementation of the programme and exercise supervisory functions.[594] The Executive Committee composed of a representative of the Commission, a representative of the European Space Agency and a representative of industries designated by the Administrative Board is mandated to assist the Administrative Board in the preparation of its decisions.[595] The Director shall be the Chief Executive responsible for the management of the Joint Undertaking and shall be its legal representative.[596] The Joint Undertaking shall conclude an agreement with ESA by virtue of which the latter is to carry out the activities required during the development and validation phase related to the space segment and the earth segment of Galileo.[597] The Joint Undertaking has been established for a period of four years, which shall be extended in any case until the obligations under the agreement with ESA have been met.[598] A longer-term management arrangement will be needed in the future.[599]

Early work undertaken by EUROCONTROL identified the need for the establishment at the regional level of a European entity mandated to organize and coordinate the installation and operation of the satellite navigation infrastructure in Europe.[600] The safe use of Galileo would be linked to the operation of the overall system by a series of contractual arrangements at each stage of the chain. The concept of the contractual framework however would only be effective in an institutional environment where the GNSS entity would play a central role as an interface between the States, service providers and users on the one hand and system operators on the other. This entity would

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[591] See *Council Regulation Setting up the Galileo Joint Undertaking supra* note 106.
[592] See *Statutes of the Galileo Joint Undertaking supra* note 139.
[593] See *ibid* at Article 7.
[594] See *ibid* at Article 8.
[595] See *ibid* at Article 9.
[596] See *ibid* at Article10.
[597] See *ibid* at Article 3.
[598] See *ibid* at Article 20.
[599] See *European Commission and the European Space Agency Joint Task Force Report supra* note 589 at 14.
[600] See WW/IMP-WP/12 *supra* note 208 at 2 para 2.2.

act as the focal point by concluding the necessary contracts with the relevant actors thus ensuring the operation of Galileo on the whole.[601]

Similarly, following a rather more general approach, the Commission is considering the establishment of a GNSS Agency to play the role of a GNSS European regulator to harmonize requirements as far as possible, and to regulate and certify the system. The main requirement in the establishment of the Galileo Agency would be to provide it with legal personality so that it could define the future GNSS policy, raise funding, conclude international agreements and be subject to operational liabilities.[602]

The overall institutional scenario has been proposed by the GEMINUS[603] study as follows: A private company known as the Galileo Vehicle Company incorporated under a system of national law will perform the operation of the Galileo system.[604] The Galileo Agency likely to be established by a Council decision will be a public organization with legal personality so as to be able to negotiate and conclude agreements at State level particularly with non-Member States that will allow operational Galileo services in their sovereign air space.[605] It will have executive, quasi-legislative and quasi-judiciary functions over the operational constitution of Galileo.[606] This has the advantage of a two-tier liability system where the liability of the Vehicle Company is limited while simultaneously providing for unlimited liability to any victims under the responsibility of the Galileo Agency.[607] The referred arrangement allows on the one hand the Galileo Vehicle Company to operate Galileo as a business while on the other hand enables for a victim oriented compensation scheme based on unlimited liability.

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[601] See *ibid* at para 2.4.
[602] M. Ferrazzani *supra* note 355 at 166.
[603] The European Commission signed four major contracts with the European satellite industry. GEMINUS is a very important contract worth EUR 5 million. The study is based on an institutional and commercial operating analysis so as to ensure Galileo's success. See Andries *supra* note 6 at 49.
[604] See Galileo European Multimodal Integrated Navigation User Service (GEMINUS) Study (17/08/2000), *Report on the Institutional Environment*, Annex C to GEMINUS Final Report at 9 para 2. Available online at <http://www.genesis-office.org/indexgl.htm> (Date accessed: 20/06/2002).
[605] See *ibid* at 4 para 1.
[606] See *ibid* at 36 para 6.3.5.
[607] See *ibid* at 48 para 8.3.

II. Financing of Galileo: Public-Private Partnership:

The financial viability of Galileo is indisputable:

> Galileo is not more expensive than 150 KM of semi-urban motorway or the cost of just one track of the main tunnel for the future high-speed rail link between Lyon and Turin.[608]
> It is roughly two-thirds the cost of the high-speed rail link between Liege, Cologne and Frankfurt, or the 160 KM Betuwe rail infrastructure project for container transport in the Netherlands.[609]

Galileo is to be financed by means of a combination of public and private funding. All partners involved in the Programme (even users in the future) are to contribute to the funding of the system. For the development phase the EU's contribution of EUR 550 million has already been released [610] and the European Space Agency already has an equivalent amount at its disposal.[611] For the deployment phase, the estimated costs are EUR 2.1 billion of which 1.5 billion are expected to be contributed by the private sector.[612] The Commission and the European Space Agency will also make provision for partial funding. During the operational phase, public funding will gradually decrease until 2015; this will be an advance from the Community budget and not a subsidy.[613]

In 1999 the European Commission proposed that a Public-Private Partnership (PPP) be developed for the Galileo Programme to deliver complementary finance and value for money.[614] It must be noted that the Treaty of Amsterdam amended ex Article 129 c (now

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[608] See *Information Note of 31 December 2001 supra* note 122 at para 5.
[609] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 10.
[610] EUR 100 million were immediately released after Council Resolution of 5 April 2001 on Galileo. See *Council Resolution of 5 April 2001 on Galileo supra* note 101 at Article 1. The remaining EUR 450 million were released at the Transport Council of Ministers on March 26, 2002. See *Conclusions of the Transport Council of 26 March 2002 supra* note 105.
[611] ESA has used its institutional machinery for asking the Member States to subscribe EUR 550 million for the validation phase. The EU and ESA have covered all the needs for the development and validation phase. See *COM (2000) 750 final supra* note 97 at 25.
[612] See *ibid* at 26.
[613] See <http://europa.eu.int/comm/energy_transport/en/gal_more2_en.html#8> (Date accessed: 10/07/2002)
See also *COM (2000) 750 final supra* note 97 at 26.
[614] See *COM (1999) 54 final supra* note 14 at vi.
See also *COM (2000) 750 final supra* note 97 at 27.

Article 155 of the EC Treaty) so as to facilitate the private sector's access to Community funding. This new approach made the establishment of PPP's easier.[615]

The Council of the EU welcomed the Commission's proposal and called on the Community and Member States to ensure largely private interest in developing and financing of Galileo and "to take all adequate measures to prepare a public-private partnership as soon as possible."[616] "Private participation through a public-private partnership is a fundamental element for the success of the Galileo Programme."[617] The aim is to engage the private sector in the implementation of the Programme as soon as possible.

Generally speaking, the main reasons for the public sector to develop PPP strategies are mainly to attract new funding[618] and to achieve risk sharing while at the same time capturing the private sector's know-how, efficiency, enhanced creativity and value generating capacity.[619]

The allocation, management and control of risks lay at the heart of any PPP: "The success of PPP depends crucially on the effective appraisal and later on management of risk."[620] There are many sources of risk likely to have financial consequences *i.e.* technical, organizational, political, regulatory, market, financial, legal and administrative risks, all of which need to be properly identified, assessed and allocated for the effective execution of the PPP.[621]

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[615] See EU, European Commission, *Explanatory Memorandum to COM (98) 172 Proposal for a Council Regulation Amending Regulation EC No. 2236/95* (09/06/1998) at 6 para 3.2. Available online at <http://europa.eu.int/comm/agenda2000/ten/ten_en.pdf> (Date accessed: 11/10/2002).

[616] See *Council Resolution of 19 July 1999 supra* note 96 at 2.

[617] See *Council Resolution of 5 April 2001 on Galileo supra* note 101 at para 3.

[618] See Private Operations and Financing of TEN's (Profit), *Public Private Partnerships; Introduction, Handbook, Recommendations and Conclusions* (09/04/2001) at I.1 para I.1.1. Available online at <http://europa.eu.int/comm/transport/extra/final_reports/strategic/profit.pdf> (Date accessed: 11/07/2002). The Profit project has been funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme at I.5: Private sector finance consists of debt and equity finance. Sources of private sectors include lenders and investors such as banks, manufacturing companies, and operators.

[619] See *ibid* .

[620] See *ibid* at I.5 para I.1.4.

[621] See Value Added Services for Transport Project (Vast), *Final Report for Publication* (15/04/2000) at 72 para 7.1. Available online at <http://europa.eu.int/comm/transport/extra/final_reports/strategic/VAST.pdf > (Date accessed: 11/10/2002). The Vast Project is funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme.

Two different alternatives may be envisaged as to the PPP scenario for the Galileo system, namely that of a Joint Venture and a Concession Company.[622] Whereas the former would satisfactorily meet all of the public sector interests, it does not adequately serve the purpose of attracting private investment. The idea would be for both, public and private partners, to invest in one single entity. During the development phase, the Joint Venture would be the recently established Joint Undertaking with ESA and the EC holding a controlling interest. Private partners (most likely industrial partners, service providers, and in future the public) would become minority shareholders by investing in private equity.[623] At the end of the development phase the Joint Venture would transfer to the Galileo Vehicle Company to be financed by public equity and grant and private equity and debt. Revenues from the market are expected at this stage.[624]

This said, it must be noted that the private sector is very reluctant to contribute to the development phase, as no financial return is likely to be obtained in this level. Discomfort also arises in the deployment and operation phases from the prospects of very long-term perspectives of financial return, the high risk involved and the possible conflict of interests in the part of the public sector by virtue of its role of both equity investor and sponsor of Galileo.[625]

The most suitable scenario would be for a Concession Company to be established for the deployment and operation of Galileo trough a competitive bidding process launched by the Joint Undertaking. At the end of the development phase the Joint Undertaking would be replaced by another public entity to counterbalance the remainder of the concession.[626] The Operating Company would finance its activity from private equity and debt. There would be a separate public function to govern safety standards and pricing for certain services.[627] The referred model best achieves the separation of the public and

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[622] PricewaterhouseCoopers , *Final Report of the Inception Study to Support the Development of a Business Plan for the GALILEO Programme: Executive summary* (20/11/2001) at 9 para 7. Available online at <http://europa.eu.int/comm/energy_transport/library/gal_exec_summ_final_report_v1_7.pdf> (Date accessed: 11/10/2002). [Hereinafter *PricewaterhouseCoopers Executive Summary*].
[623] See *ibid.*
[624] See *ibid* at 10 para 7.1.
[625] See *ibid* at 11 para 7.1.
[626] See *ibid.*
[627] See *ibid* at 12 para 7.1.

private sectors while at the same time both meets the requirements of the public sector and eases the concerns of the industry.[628]

III. User Charges :

ICAO's Policy Statement of 1994 expressly addressed the issue of cost recovery in the following terms:

> In order to achieve a reasonable cost allocation between all users, any recovery of costs incurred in the provision of CNS/ATM services shall be in accordance with Article 15 of the Convention and shall be based on the principles set forth in the Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services (Doc. 9082) including the principle that it shall neither inhibit nor discourage the use of the satellite-based safety services.[629]

The World-Wide CNS/ATM Systems Implementation Conference further recommended:

> That the costs of implementing and operating CNS/ATM systems components be recovered trough the medium of user charges.[630]

Article 15 of the Chicago Convention embodies both the principle of non-discrimination between ICAO's Member States as regards charges and that no charge should be levied solely for the right of overflight. More comprehensive guidance is offered by ICAO's *Policies on Charges for Airports and Air Navigation Services* (formerly ICAO's *Statements by the Council to Contracting States on Charges for Airports and Route Air Navigation Facilities*).[631] As regards the cost basis for air navigation services charges, the Council considers that "as a general principle, where air navigation services are provided for international use, the providers may require the users

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[628] See *ibid* at 11 para 7.1.
[629] See *ICAO Policy Statement on CNS/ATM Systems supra* note 153 at para 8.
[630] See *WW/IMP Final Report supra* note 173 at Recommendation 3/10.
[631] See ICAO, *ICAO's Policies on Charges for Airports and Air Navigation Services*. ICAO Doc. 9082 (Sixth edition, 2001). Available online at <http://www.icao.org/icaonet/dcs/9082_6ed.pdf> (Date accessed: 12/07/2002).

to pay their share of the related costs,"[632] that "the providers of air navigation services for international use may require all users to pay their share of the cost [...] regardless of whether or not the utilization takes place over the territory of the provider State,"[633] that "the cost to be shared is the full cost of providing the air navigation services,"[634] that "the costs to be taken into account should be those assessed in relation to the facilities and services, *including satellite services* (emphasis added),"[635] that "the costs of air navigation services provided during the approach and aerodrome phase of aircraft operations should be identified separately,"[636] and that in any case, "international civil aviation should not be asked to meet costs that are not properly allocable to it."[637]

In order to "ensuring a fair cost allocation amongst all users of GNSS, and to avoiding that the civil aviation would have to meet costs which are not properly allocable to it,"[638] EUROCONTROL presented a study of different possible methods for the allocation of GNSS costs to civil aviation and other users to the last Conference on the Economics of Airports and Air Navigation Services.[639] In the overall, the 'requirements-driven method' was concluded as the most adequate cost-allocation procedure.[640] It consists of a "multi-step cost allocation process which incorporates the number of users, the user's requirements by phase of operation or application and the incremental costs to provide varying levels of service across such diverse requirements."[641] For the purpose of allocating the core system costs by service level, the incremental costs of supplying this

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[632] See *ibid* at 15 para 36.
[633] See *ibid* at 19 para 47.
[634] See *ibid* at 15 para 38 i).
[635] See *ibid* at 15 para 38 ii).
[636] See *ibid* at 15 para 38 iii).
[637] See *ibid* at 15 para 36.
[638] See "The Allocation of GNSS (Global Navigation Satellite Systems) Costs" ANSConf-WP/65 (12/05/2000) at 2 para 2.1. Available online at <http://www.icao.int/icao/en/atb/ansconf2000/docs/wp65e.pdf> (Date accessed 12/07/2002).[Hereinafter ANSConf-WP/65].
[639] See *Conference on the Economics of Airports and Air Navigation Services* (Montreal, 19-28 June 2000). [Hereinafter ANS Conf] The theme of the Conference was Air Transport Infrastructure for the 21st Century. ANS Conferences have consistently reviewed the general economic situation of airports and route facilities and made recommendations which have resulted in the preparation by the ICAO Council of policy guidance relating to airport and route facility charges, the latest version of which is contained in the sixth edition of the *Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services*, (Doc 9082/5). See *supra* note 631.
Further information on the ANSConf 2000 can be obtained online at <http://www.icao.int/icao/en/atb/ansconf2000/index.html> (Date accessed: 12/07/2002).
[640] See ANSConf-WP/65 *supra* note 638 at 3 para 2.2.
[641] See *ibid* at 3 para 3.1.

service needs first to be established. A determination of the number of users by service level must follow. The resulting figures can be used to allocate the core GNSS costs to different GNSS categories of users.[642]

The same method may furthermore be used to allocate costs between phases of flight[643] and States.[644] Following the approach taken by EUROCONTROL, the cost would first be allocated in accordance to the phases of flight and secondly between States. En-route GNSS costs would be allocated to the States or to the providers of en-route ATS. Approach/aerodrome GNSS costs would be allocated to the service providers (States or ATS providers and or airports depending on the circumstances).[645]

Serious cost recovery issues arise for Europe in respect of the Galileo system. Firstly, the most adequate method of cost recovery is yet to be defined. Since Galileo is being conceived as a public-private partnership, it appears essential that it generate the sufficient level of profit to both return the level of investment put in it and to provide a source of revenues for the Galileo Vehicle Company.[646] In the public side, the EU or its Member States could raise revenues by imposing a tax on the sale of all Galileo and GPS terminals in Europe as a way of funding the public sector's financial investment in Galileo.[647]

The Galileo Vehicle Company could raise revenues from:

a. Royalties on chipset sales to be paid by equipment providers who incorporate a Galileo chip in their products to allow users to accede Galileo's open service.[648]
b. Income from service providers who want to use the specialized encrypted signals to offer other services.[649]

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[642] See *ibid* at 3 para 3.2.
[643] In accordance with ICAO's recommendation to separate the costs of air navigation services provided during the approach and aerodrome phase of aircraft operations. See *supra* note 636.
[644] See ANSConf-WP/65 *supra* note 638 at 4 para 5.1.
[645] See *ibid* at 4 para 5.3.
[646] P. Nisner, "Future GNSS Service Needs to Resolve Issues of Cost Recovery and Standardization" (2002) 57:3 ICAO J. at 14.
[647] See *PricewaterhouseCoopers Executive Summary supra* note 622 at 4 para 3.
[648] See *ibid* at 3 para 3.
[649] See *ibid*.

Assuming that the Galileo Operating Company owned the intellectual property rights in the chipsets, with a system of royalties, each user would pay an equal charge for the purchase of a Galileo receiver containing a copyrighted chipset for decoding the Galileo signal.[650] However, the establishment of a system of royalties remains controversial. It has been argued that a system of royalties on equipment purchase, although revenue attractive, entails serious legal and practical difficulties as regards administration of the system outside the EU.[651] Moreover, users would be highly reluctant to a system of royalties that increases purchase prizes given GPS's competitive position in the market already capable of achieving economies of scale in production.[652]

The use of encrypted signals equally raises serious concerns in the part of the international aviation community. The main advantage of encryption (in the area of anti-spoofing protection of the signal)[653] while useful for confirming guarantees is however outweighed by the cons, namely the possibility of endangering aviation safety by losing a 'key' and therefore a necessary signal and the resulting restrictive interoperability given the difficulties of standardizing encrypted signals. Moreover, it could even be illegal for US commercial aircraft to use non-US encryption if they are on US reserve fleet and thus they could be prevented from flying to Europe if European encryption is used.[654]

Evidently the method of cost recovery for the Galileo system deserves further study. It is imperative that the European Commission eventually defines a solution that is acceptable to all, existing GNSS signal providers, public and private Galileo investors and the total users of Galileo.

The second challenge for Europe will be to define a commercial case for Galileo given the fact that both GPS and GLONASS are offered to the international civil aviation community free of direct charge. The European business strategy is based on two assumptions. Firstly, it is said that 77% of Galileo use will be to complement GPS.[655] In the field of safety-of-life applications it is unlikely that a single GNSS service will ever

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[650] See *ibid* at 4 para 3.
[651] See Galileo European Multimodal Integrated Navigation User Service (GEMINUS) Study (17/08/2000), *Ad-hoc Working Paper Assessing Commercial Opportunities for the Galileo Operator*, Annex F to GEMINUS Final Report at 18 para 3.1.2. Available online at <http://www.genesis-office.org/indexgl.htm> (Date accessed: 20/06/2002). [Hereinafter Annex F to the GEMINUS Report].
[652] See *ibid* at 19 para 3.1.4.
[653] See *ibid* at 20 para 3.1.6.6.
[654] See *ibid* at para 3.1.6.4.
[655] See *ibid* at 23 para 3.2.1.1.

meet the necessary high levels of accuracy, availability, continuity and integrity of the signal. Provision of a redundant system will provide the necessary assurances for safety critical GNSS services (*i.e.* aviation).[656] From the point of view of mass-market non-safety applications the performance improvements brought forward by the possibility of relying in a total of 54 interoperable satellites (24 GPS and 30 Galileo satellites) would give the public the necessary confidence to build businesses, capabilities and services based on GNSS.[657] "This [...] assumes that even the price sensitive automotive manufacturers will want to provide joint GPS-Galileo navigation systems, because of the improvements in availability to users [...]."[658]

The second European assumption is that users will be willing to pay for the superior services offered by Galileo. The EU aims at developing a system of its own that offers superior accuracy and reliability than GPS, and the very high level of continuity required for satisfying contractual responsibility.[659] Galileo will offer two basic levels of service, the open service free of charge and a series of guaranteed superior services for fee-paying users. Even the basic service provided free of charge is expected to offer better quality and reliability than the present equivalent GPS service.[660]

Now, the viability of the referred approach depends first and foremost on the timely implementation of the Galileo system in order to meet the window of opportunity in the market.[661] One must not forget that when the more sophisticated GPS third generation commence service, GPS III augmented by WAAS/MSAS/EGNOS will be likely to offer comparable services to Galileo in terms of accuracy, integrity and other performance factors and will be offered free of direct charge. The goal is that Galileo initiate commercial operations by the year 2008 when the market is expected to be going through a phase of rapid growth and the new generation of GPS III satellites will still have a period of one or two years before becoming operational. "Galileo will only become established if it is in the market in time to gain acceptance in the launch of new

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[656] See *The European Dependence on US-GPS and the Galileo Initiative supra* note 110 at 27 para 2.2.
[657] See *ibid* at 26-27 para 2.
[658] See Annex F to the GEMINUS Report *supra* note 651 at 23 para 3.2.1.1.
[659] See *Galileo: The European Programme for Global Navigation Services supra* note 121 at 8.
[660] See *ibid* at 9.
[661] See *PricewaterhouseCoopers Executive Summary* see *supra* note 622 at 9 para 7.

equipment and services which will accompany this change."[662] If this were achieved, it would translate into a market penetration rate progression of 13 % in the year 2010 to 52% in 2020 and a total annual revenue stream of EUR 380-515 million by the year 2020.[663]

It is therefore essential that all time-sensitive mandatory technical and operational steps such as in orbit validation of the Galileo system, development of the ground and space segments and frequency allocation issues be properly scheduled so as to allow that Galileo be present in the market by the year 2008.

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[662] See *PricewaterhouseCoopers Executive Summary* see *supra* note 622 at 4.
[663] See *ibid* at 5 comparing the most recent PricewaterhouseCoopers study to previous forecasts in the GEMINUS and GALA Projects.

Conclusions:

In view of the steady traffic growth of international civil aviation and having recognized the shortcomings and deficiencies of the present infrastructure and procedures in support of the air transport industry, ICAO envisaged a revolutionary concept based on a combination of satellite technology and computers which came to be known as CNS/ATM. GNSS, the core of ICAO's CNS/ATM systems, is able to support future air navigation needs while at the same bringing significant improvements in terms of safety and air space management.

Presently two independent GNSS systems are operational, the United States' GPS and the Russian Federation's GLONASS. They have both agreed to make their respective systems available for international navigation and positioning free of direct charge. However, due to budgetary constrains, the future of the Russian satellite navigation system remains uncertain and so the US GPS has been able to establish a *de facto* monopoly. For the purpose of securing both the European political independence from the United States and a fair share of the lucrative global satellite market and related jobs, the Europeans have launched their own contribution to the Global Navigation Satellite System in the form of Galileo, a global system under civilian control autonomous from GPS and GLONASS.

Now, the advent of GNSS remains overshadowed by a number of legal and institutional issues that causes difficulties to the implementation of this revolutionary technology that increases safety, efficiency, productivity and knowledge. The main problem arises from the absence of any foreseeable long-term organizational structure for the Global Navigation Satellite System.[664] It is clear by now that the idea of GNSS as one single global integrated satellite system placed under international control is never to materialize. National security imperatives, coupled with the goal in the part of provider States to maximize industrial benefits from their self-procured satellite navigation systems, make it more realistic to assume that the future of GNSS will not be in the form of a single system but rather as a cluster of different global and regional applications

[664] See Schubert *supra* note 367 at 249.

where each signal-in-space provider will remain in control of its respective system.[665] Consequently, the most realistic approach seems to be for system providers and interested GNSS users to achieve a level of international cooperation optimal to resolve the technical and legal issues prompted by the advent of GNSS.[666]

For most countries GNSS raises a number of legitimate concerns given the fact that the GNSS infrastructure, at least as far as the space segment is concerned, will be operated and controlled by foreign States. These concerns are further aggravated by the fact that the present GNSS services offered for civil use originated from systems that were initially designed for military use. Given the high level of financial investment that the implementation of GNSS will require in the part of user States it is only logical that they insist in a series of legal guarantees to govern the provision of the services and to regulate liability. It is essential that there be universal accessibility to the GNSS for all States and their airlines without any kind of discrimination. Furthermore, technical performance criteria in terms of the continuity, accuracy, integrity and reliability of the GNSS signal ought to be guaranteed.

At the core of the intense debate surrounding the implementation of GNSS lies the issue of liability. It is fundamental that an effective liability regime be in place to effectively allocate the corresponding responsibilities along the complex chain of actors involved in the provision of GNSS services and to compensate any damage resulting from the failure, disruption or provision of a GNSS service not meeting the required minimum requisites of performance. The existing liability regime is fragmented, complex and forces each individual claimant to engage in several actions against the various defendants in different States. A victim-oriented approach more in accordance with today's social and economic standards is desirable.

The European position is that the establishment of a new uniform legal framework in the form of a GNSS-specific international convention addressing these concerns is essential to achieve universal acceptability of the Global Navigation Satellite System. Yet this view has not gathered the support of present GNSS signal providers *i.e.* the US that has consistently argued that the existing domestic and international provisions already

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[665] See *ibid* at 249-250.
[666] See Henaku *supra* note 236 at 170.

offer satisfactory solutions for any problems that may arise from the reliance on satellite-based navigation and positioning.

The debate between promoters and detractors of a GNSS-specific framework is likely to continue in the following years. However, it is hardly likely that the United States would ever agree to surrender its Global Positioning System under the provisions of a new international convention in the context of the present *status quo*. Firstly defence imperatives and secondly (but not less in importance) the goal of reaping the benefits from a monopolized market underlies the United States' reluctance to enter such framework. It needs not to be reiterated that a GNSS-specific convention would be deprived of any practical value without all signal providers having become parties to it.

In light of the above referred it is submitted that the only hope for a GNSS convention to ever come into being right now depends on the European success in putting together a new satellite system capable of competing with the already established American GPS. The main objections as to the implementation of GNSS so far have originated from the lack of legal guarantees in the part of present signal providers and from the dual use character of existing GNSS applications. In this situation it seems only logical to agree with the European assumption that GNSS users will be willing to pay for a civil GNSS system giving a series of service performance guarantees, including a guarantor ready to assume responsibility in the case of a satellite malfunction and a compensation mechanism to reimburse damages. Even the advent of the more sophisticated GPS III, similar to Galileo in terms of technical performance, will not ease the difficulties of holding the US Government liable for damage arising out of a GPS malfunction under the existing legal framework. Thus, Galileo has the potential of becoming a strong competitor *versus* the incumbent GPS. In these circumstances it could be imagined that the US would probably change its current policy and agree to ratify a GNSS Convention in provision of the minimum guarantees required by GNSS users as a strategy to remain competitive in a no longer monopolized market.

This said, it cannot be overlooked that a large number of uncertainties remain as to the success of the European business-case for Galileo. Much of the European strategy depends on the timely implementation of Galileo in order to meet market "window of

opportunity deadlines."[667] The target is that Galileo be operational by the year 2008. However, it cannot be assured that Galileo will be ready to enter the market by the referred date. Neither can it be guaranteed that the commercial case for Galileo be viable: the European assumption is that users will be willing to pay for the superior services offered by Galileo. However, it is impossible to be sure of such prediction. At this stage in development of the market, even the envisaged Galileo high revenue stream remains uncertain. It is simply too early to be sure of the commercial opportunities of Galileo. Only time can solve present uncertainties and bring forward more concrete answers.

[667] See Annex F to the GEMINUS Report *supra* note 651 at 6.

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- International Organization for Standardization (ISO): <http://www.iso.org>
- International Air Transport Association (IATA): <http://www.iata.org>
- International Satellite System for Search and Rescue (COSPAS-SARSAT): <http://www.cospas-sarsat.org>
- European Space Agency (ESA): <http://www.esa.int>
- European Organization for the Safety of Air Navigation (EUROCONTROL): <http://www.eurocontrol.be>
- European Organization for Civil Aviation Equipment (EUROCAE): <http://www.eurocae.org>
- European Joint Aviation Authorities: < http://www.jaa.nl>

- Galileo Genesis Office: <http://www.genesis-office.org>
- Galileo Home Page: <http://europa.eu.int/comm/energy_transport/en/gal_en.html>
- US Department of Commerce: Technology Administration:<http://www.ta.doc.gov>
- US Department of State: <http://www.state.gov>
- US Coast Guard Navigation Center: <http://www.navcen.uscg.gov>
- US Government Printing Office: US Code: <http://www.access.gpo.gov/uscode/>
- Interagency GPS Executive Board (IGEB): <http://www.igeb.gov>
- Russian Federation Ministry of Defence, Coordination Scientific Information Center: <http://www.rssi.ru/SFCSIC/english.html>
- Japanese Civil Aviation Bureau: <http://www.mlit.go.jp/koku/ats/e/index.html>
- Hein-on-line Collection of Legal Periodicals: <http://heinonline.org>
- McGill University, Institute of Air and Space Law: Air and Aviation Law: <http://www.iasl.mcgill.ca/aviation.htm>