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GNSS-Legal and Institutional Issues

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Dimitri P. Nicolaïdès November 1997

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DEDICATION

To My Family

To Stéphanie

And especially to My Mother, Tanguy and Dan Fiorita

ACKNOWLEDEGMENT

The writer wishes to thank the Institute of Air and Space Law for having allowed the uses of its facilities.

Thanks to Maria, my dear friend Monica and to all those who have given me support.

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ABSTRACT

Should civil aviation reach its promising full potential, it will inevitably be through the use and reliance upon Global Navigation Satellite Systems (GNSS) and its innovative technologies. At present only one option seems clearly and 'directly' operational for the civil aviation challenge, and that is a -USA owned and controlled- GPS based GNSS.

This thesis will critically discuss the legal and institutional issues of the GNSS. The issues considered will be based upon the discussions and conclusions recently reached within ICAO. The object of this thesis is to compare, contrast and criticise ICAO's international law-making propositions, related to GNSS, in the light of the 'practical reality' varying from the users' demands and expectations, passing through the lack of practical experiences, to the USA monopoly as sole basic signal provider.

Whilst ICAO is undeniably a great contributor to global development of civil aviation, it seems that in the case of GNSS implementation, ICAO's role is limited by both its mandate, but equally a lack of political consensus upon potential 'solutions' to hypothetical problems.

The research is based on materials and documents available by the end of May 1997 and does not take into account the later developments in ICAO discussions.

RÉSUMÉ

L'aviation civile devrait-elle atteindre son plein potentiel prometteur, ce sera inévitablement via l'utilisation et la dépendance de Systèmes Global de Navigation Satellite (GNSS) et ses technologies innovatrices. A présent, seule une option apparaît comme étant 'directement' opérationnelle afin d'atteindre ce but; elle consiste en l'utilisation du GNSS basé sur l'utilisation du GPS, appartenant et étant contrôlé par les Etats-Unis d'Amérique.

Cette thèse examinera de façon critiques les questions légales et institutionnelles relatives au GNSS. Les questions traitées se baseront sur les discussions et conclusions atteintes récemment au sein de l'OACI. Le but de cette thèse est de comparer et de critiquer les initiatives de l'OACI à légiférer en matière du GNSS, le tout, tenant compte des réalités pratiques allant des attentes des utilisateurs, passant par le manque d'expériences pratiques, jusqu'au monopole des Etats-Unis d'Amériques en tant que seul fournisseur du signal de base.

Alors qu'il est indéniable que l'OACI contribue grandement au développement global de l'aviation civile, son rôle dans la mise en œuvre du GNSS est limité par son mandat ainsi que par le manque de consensus des états membres quant aux potentielles 'solutions' proposées aux problèmes hypothétiques.

Ce travail de recherche est basé sur des matériaux et de la documentation disponibles à la fin mai 1997, et ne tient pas compte des développements ultérieurs des discutions de l'OACI.

Table of Abbreviation and Technical Terms

I. Abbreviations

AASL	Annals of Air and Space Law
ATC	Air Traffic Control
ATM	Air traffic Management
AMSS	Aeronautical Mobile Satellite Services
CNS	Communication Navigation surveillance
EGNOS	European Geostationary Navigation Overlay Service
ESA	European Space Agency
EUROCONTROL	European Organisation for the Safety of Air Navigation
FANS	Future Air Navigation Systems
FIR	Flight Information Region
GLONASS	Global Orbiting Navigation Satellite System(*)
GNSS	Global Navigation Satellite System
GNSSP	Global Navigation Satellite System Panel
GPS	Global Positioning System (*)
ICAO	International Civil Aviation Organisation
ICJ	International Court of Justice
INMARSAT	International Mobile Satellite Organisation
INS	Inertial Navigation System
ITU	International Telecommunications Union
LORAN	Long Range Navigation (Navigation Aid)
NASA	National Astronautics and Space Administration
RNP	Required Navigation Performance
SA	Selected Availability
SITA	Société Internationale de Télécommunications Aéronautiques
SARPs	Standards and Recommended Practices

VFR	**Visual Flight Rules**
VHF	**Very High frequency**
WASS	**Wide Area Augmentation System**

(*) See Annexe I

II. Technical Terms

Basic Signal: **GPS/GLONASS signal (not enhanced) and upon which the GNSS would be** relying for its functioning.

Enhanced Signal: **Basic Signal which is enhanced in order to meet a high degree of** navigation precision.

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GNSS-Legal and Institutional Issues

Part I

Introduction

... Men stared at the skies many centuries ago
when discovering and traveling through vast regions.
With the Stars in the skies men could go
for the Stars were means of navigation...

Our solar system has assisted navigators for centuries. Since then, various navigating instruments were invented and used, hurling the sexton and its stars into disuse. At the dawn of a new technological era, men are facing the skies again for means of navigation, however artificial satellites have substituted the Great Bear and the Southern Cross.

At the dawn of aviation, pilots were navigating by means of ground reconnaissance. Landscapes and natural or artificial identifiable features such as churches, castles, rivers, railway lines, hills and other visually identifiable objects, were the sole elements enabling pilots to assess the three dimensional geographical position of their aircraft[1]. In addition pilots had no means to position themselves with regard to other flying aircraft. Visual means were the limit of safe flying.

[1] The visual flight technique relying on identifiable points are subjects to the so-called Visual Flight Rules (VFR) in Annexe 2, Chapter 4 of the Chicago Convention.

Civil aviation, pushed by public demand, quickly developed and as a result the number of aircraft flying simultaneously increased. Navigation techniques and technology followed the 'rapid' pace of development in order to accommodate numerous aircraft in an area limited by its nature...the skies.

The post world wars periods were probably the phases during which air navigation witnessed the greatest improvement, exploiting research and development (required and financed) by the military.

Whereas aircraft as such are ever evolving from a technological point, the same cannot be said regarding communication, navigation and surveillance (CNS). Indeed, unlike technological revolution such as the passage from propelled to jet engine aircraft, CNS is still at present very much relying on technology basically developed before the second world war. It results that although aircraft are ever evolving, the potential of these aircraft is not being realised; the problem is not the plane or who fly them, the problem is the system in which they are forced to fly[2].

Means of navigation today

A constraint to civil aviation?

Present navigation is mostly radio navigation. The aircraft is assisted by ground based stations. Basically, an aircraft is guided and informed about its geographical position by ground stations systems. These ground systems are various but all have a point in common; they are ground based and basically use radio wave signals to communicate with the flying aircraft[3].

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[2] Dr. A. Kotaite in TV-14749 R-1, in 'FANS. The Global Advantage' -video produced by FANS Stakeholders'Group.

[3] Several systems such as -OMEGA navigational system- LORAN-C, INS, VOR/DME, etc. do exist, but most are progressively falling into disuse... if not already out of use.

Objectively, pressures emanating from various sources transcend the 'ground system' air navigation technology. Indeed, the current systems are essentially criticised from a safety and cost-efficiency perspective[4].

The safety of civil aviation mainly relies on two features; the maintenance and performance of the aircraft and the navigation system used[5]. The current system has reached a point of saturation[6]. The ground system using radio wave signals is limited by distance and terrain. Some areas of the world have no radar coverage at all and communications often are poor on long over water routes[7].

Where radar is lacking, aircraft use inboard computers and autonomous inertial navigation system (INS) in order to have its approximate position. But civil aviation safety tolerates no approximate information; it thus results that aircraft are to be widely separated to ensure safety. This extensive separation limits the number of planes that can fly on a given route[8].

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[4] The International Civil Aviation Organisation (ICAO) being highly concerned with the safety, regularity and economy aspect of air navigation, it appears that the current system saturation was an invitation for ICAO to legitimately intervene and propose an alternative system.

[5] Dr. M. Milde, 'Institutional and Legal Problems of the Global Navigation Satellite System(GNSS)- Solutions in Search of a Problem?', in unpublished and informal notes for oral presentation at the International Conference on Air and Space Law of Buenos Aires, April 1997.

[6] As explained above, the modern civil aviation in general is constrained by the present system.

[7] Dr. A. Kotaite, *Supra* note 2.

[8] Ibid.

The limitations of the current system could be summarised in three basic points:

-the line-of-sight propagation of current systems and/or the accuracy and reliability constraints resulting from variability [9] in the propagation characteristics;

-the difficulty, for a variety of reasons, in implementing present systems and operating them in a consistent manner in large parts of the world;

-the limitations of voice communications and lack of digital air-to-ground data interchange systems[10].

Ground navigation facilities are further considered as being costly and troublesome for controllers who have to mentally visualise their airspace aided by random position reports and cardboard flight strips.

Although the existing systems have served civil aviation in a positive way, it is now time to turn the page and move on to a new way of flying, a way that integrates state of the art technology.

Global navigation satellite system

A response to civil aviation needs?

It could be argued that the needs of today's civil aviation are established by the shortcomings of the current systems.
But in fact the GNSS, which is an integral part of the Future Air Navigation System

[9] Atmospheric conditions may influence the propagation of wave signals.

[10] Dr. M. Enein, Raytheon, 'A Unique Approach to CNS/ATM Implementation', in ATC, August 1996, Vol.2 No.2, at 10.

(FANS)[11], goes further in that it innovates.

The technological degree of innovation between the present system in use and the proposed system can hardly be compared, or if so it would amount to comparing a facsimile means of communication to the Internet and its World Wide Web.

Basically the GNSS is the key element of the Communication/ Navigation/Surveillance/Air Traffic Management (CNS/ATM) Systems consisting mainly of a marriage of space technology and computers[12].
The GNSS is a satellite based positioning system and time transfer system that provides world-wide services for location and time to anyone possessing a GNSS receiver[13]. It uses multiple satellite constellations[14]; namely the US Global Positioning System (GPS) and the Russian Global Orbiting Navigation Satellite System (GLONASS)[15], aircraft receivers, ground monitoring equipment and system integrity monitoring to perfect navigation solutions. In addition to the positioning satellites complementary components such as ground based means of surveillance, and technologies using geostationary orbital receptors[16] are available.

The International Civil Aviation Organisation (ICAO) has adopted the concept of Required Navigation Performance (RNP), which defines a capability necessary for the

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[11] For more information on FANS see Part II of this work.

[12] J. Huang, 'Sharing Benefits of the Global Navigation Satellite System within the Framework of ICAO', in IISL, 1996, at 1.

[13] S. Harksen, 'Is the World Ready for the Future Air Navigation System (FANS)?', in ATC Systems, May/June 1995, at 11.

[14] The reality of things leaves doubts with regard to the word constellations. Indeed, it is the belief of many that the GNSS will solely rely upon the existing US GPS.

[15] For technical details on the GPS and the GLONASS see Annexe I.

[16] P. A. Salin, 'Les Systèmes de Navigation Aérienne par Satellite et l'Aviation Civile', in Annals of Air and Space Law, Vol. XIX-1994 Part I, at 460.

aircraft to navigate in an airspace segment. The capability can be implemented using the GNSS which would be able to provide a high integrity, highly accurate navigation service, suitable as a primary means of navigation for en-route, terminal, and non-precision and Category I precision approach and landing phases of a flight[17]. Just as the differential GPS provides an integrated information, using ground stations, similarly the GNSS will be assisted by third enhancement systems augmenting the positioning accuracy to a highly precise degree which will also monitor the GNSS integrity.

The GNSS and -Safety

-Air Traffic Demand

-Airlines' opinion

-Costs to States

Safety

A modernised form of air navigation surely would enhance safety, especially in the vicinity of airports where traffic is extremely dense and/or where aircraft approach may be rendered difficult by other features such as bad weather conditions or steep landscape. Knowledge of real positioning in real time and knowledge of the location of other traffic will contribute to the prevention of collisions and of 'controlled flight into terrain'(CFIT). The loss of 65 lives on the Tupolev 134 of Vietnam Airlines on September 3rd 1997 is one tragedy among other civil aviation catastrophes that should not be accepted in the light of the existing technology and its potential.

The use of more precise and reliable means supporting air navigation by navigator and controllers will increase ATM efficiency and thus render landing and take-off generally much safer. The GNSS will allow more aeroplanes to be put on the most efficient routes with no compromise in safety.

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[17] Dr. M. Enein, *Supra* note 11, at 11.

Air traffic demand

The GNSS will equally respond to the contemporary air traffic demands. The demand for civil aviation services is constantly increasing. It results that routes capacity is exceeded and that air traffic service providers and users alike, are permanently under pressure. Airspace and airports resources are strained as they attempt to meet the growing demand while respecting safety.

Albeit the use of GNSS makes possible the greater number of flights, its automation features actually make efficient work easier for air traffic controller.

Airlines 'opinion

Precision approach is the most demanding phase of a flight. Indeed, the terminal and approach areas still claim the highest rate of accidents and a significant proportion of these occurs where limited non-precision approach aids exists.

Civil aviation tragedies, other than the recent one mentioned above, of major CFIT, include the July and September 1992 disasters of the Thai and Pakistani Airbuses in Nepal during a non-precision approach to Kathmandu where less than perfect navigational aids caused or contributed to fatal crashes in a difficult mountainous terrain[18]. On 27 March 1977, the collision of the KLM and PANAM Boeing 747 on the ground at Tenerife, where 575 lives were lost, was attributable to the lack of knowledge of the precise relative position of the two aircraft.

The GNSS (including differential readers) is therefore a necessity, as means to provide, on a global basis, adequate guidance to most airports in the shortest laps of time.

The current systems for air traffic control places limitations on the airlines'efficiency in

[18] Dr. M. Milde, *Supra* note 5, at 2.

general[19]. Delays do more than frustrate passengers. Recent work by IATA estimates that added costs and lost business attributed to deficiencies in the air transport infrastructure are equivalent to 10 billions dollars a year world-wide. By the end of the century, delays in departure and arrivals will cost European airlines the sum of 6 billion dollars[20]. Direct routing without delays will let the airlines maximise the use of their fleet.

Costs to States

Is the implementation of the GNSS worth the cost?

Using existing satellite networks to provide global navigation eliminates the needs for governments to invest in costly and restrictive, and somehow out of date, ground facilities. Furthermore, in many sparsely populated areas (Africa, Latin America) and over the high seas and deserts, the building of ground-based facilities is either financially or technically impossible.

The annual savings to the airlines alone in reduced fuel and operational costs will be a multiple of the implementation cost of the GNSS.

Civil aviation being the fastest growing form of commercial transportation, a more fluent civil aviation will generate a more dynamic global market and the economical and social benefits will be manifold.

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[19] A. Shand, 'GPS- an Airline User's View', in The Journal of Navigation, September 1995, Vol.48, No.3, at 319.

[20] Dr. A. Kotaite, *Supra* note 3.

GNSS related laws

Does the chick come before the egg?

The full implementation of the GNSS will take place within a given social context -the Globe- and will thus require a global social interaction. The actors of the interactions, of the GNSS, will be diverse entities varying from aircraft and avionics manufacturers, physical persons, corporation bodies (public or private), States or group of States etc.[21]. International organisations are likely to play an important co-ordinating role in that they will facilitate negotiations, and in the case of regional organisations such as EUROCONTROL, all EUROCONTROL Member States could be represented directly by that organisation, thus rendering international negotiations more expedient.

Because no technology in the long run ever functions in a legal vacuum, or if so, the legislator rapidly intervenes[22] in order to control and/or stabilise the system and its further development, one may wander what legal provisions will harness the GNSS[23].

When cars first appeared, there was no law addressed to cars directly; laws were arbitrarily construed in order to encompass social interaction between cars and the environment in which they moved. Immediately after the arrival of cars there was no Road Traffic Act, nor any legislation compelling car owners to insure their vehicle.
Cars were in advance of 'car related' legislation.

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[21] Dr. M. Milde, *Supra* note 5, at 3.

[22] See how governments all over the world are now seeking to legislate upon issues such as indecent material and copyright matters linked to the World Wide Web.

[23] The term to 'harness' should be in the present case construed as a way in which a technology and its research and development are both controlled and furthermore enhanced.

Today little has changed, the legislator is still not capable of anticipating social relations and/or accompanying potential conflicts. And it may be that this is the way things ought to be for laws are nothing but the expression of the political will. Seldom will legislators be able to comprehensively anticipate the functioning of a system within a society. It thus appears that it could be concluded that rules seeking to balance conflicts of interests and/or harmonise the social relations engendered by an innovative technology should succeed and not precede the said technology[24].

The air industry represents a substantial interest to every single State[25]. For its development, it will need a new way of flying, namely the Future Air Navigation System having the GNSS as its major component[26].

To be optimal, the GNSS requires the social interaction of States. This catch 22 reality where "all States need the GNSS but will all be compelled to collaborate for its working" has been discussed within the best-suited arena for civil aviation development, namely ICAO.

Among all its aims, ICAO has to encourage air navigation services. The GNSS is a well-suited instrument for the ambit of this task. For this reason, and by virtue of Article 44 of the Chicago Convention, ICAO has been identified from the beginning as the means of enhancement of the GPS/GLONASS into a GNSS[27].

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[24] Dr. M. Milde, *Supra* note 5, at 2.

[25] Pr. H. Wassenbergh, "Legitimate' Shares of States Under Air and Space Transportation Regulation', in Annals of Air and Space Law XX-1, 1995, at 83-111.

[26] For more details on FANS see Part II.

[27] P. A. Salin, *Supra* note 16, at 464-5.

Within ICAO

The technical complexity of the GNSS surely renders the ICAO efforts to formulate legal and institutional implications difficult[28]. Nevertheless ICAO has identified within its various committees a number of issues relating to the legal and institutional implications related to the GNSS[29].

It is now too early to ascertain ICAO's proposals. However, and as a starting point, the author has based the present work upon ICAO's conclusions and proposals related to the legal and institutional implications of the use of the GNSS[30].

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[28] The author wishes to add that the conflicting political views of ICAO members have to be included in the list of factors.

[29] Final Report of the First Meeting, LTEP/1 dated 23/12/96.

[30] Such proposals are contained in ICAO DOC LC/29-WP/3-2.

PART II

ICAO's Efforts to Implement FANS

Part one of the present work compared and contrasted the current and the future navigation technologies. The international civil aviation will, or rather is [31], relying more and more on a Global Navigation Satellite System.

Because of the different proposed systems [32], the global dimension of civil aviation and numerous other factors internationalising such activity, it follows that the GNSS, being global by nature, will require to be addressed globally. Consequently, it seemed inevitable that the International Civil Aviation Organisation, being a forum where civil aviation issues (whether technical or legal in nature) could be considered by a wide range of States, was

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[31] The present tense is more appropriate for some airlines, such as British Airways and Singapore Airlines, which are already experimenting with the GPS. Such information was given to the author by Gerry Selves, British Airways Manager Projects & Strategic Development, in a letter to the author dated 15 April 1997. Boeing is equipping its B-777 models with an in-built GPS. The ATAG(Air Transport Action Group) video presentation, see *Supra* note 2, revealed that FANS is not a theory waiting for proof; FANS is an existing technology. Virtually every wide body jetliner rolling off the assembly line today is factory equipped with FANS compatible equipment. FANS is being implemented now in South Pacific with plans to expand the system throughout Asia.

[32] The two different basic systems being the GPS and the GLONASS, see Annexe I.

to play an important role in the development of a GNSS.

Part II of the present work will consist of describing ICAO FANS II Committee's evolutionary path. Although it is highly descriptive, the author believes that part II is paramount for a global understanding of the issues discussed and criticism made later in the work.

The arrival of GNSS on the ICAO Agenda [33]

ICAO saw at the end of the 70's the increasing limitations of the currently used systems of air navigation, and thus started to consider the need for potential amelioration [34].
ICAO's initiative regarding, initially the study, and subsequently the establishment of a GNSS institutional framework, emanates from the Preamble of the Chicago Convention and its Articles 37 [35], 44 [36], 54[37], and 90[38].
ICAO itself recognised that it is the sole and most appropriate international organisation in a position to effectively co-ordinate the new system's activities [39].

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[33] ICAO Document LTEP/1-WP/3 provides a comprehensive summary of the GNSS approach by ICAO.

[34] J. Huang, *Supra* note 12, at 1.

[35] Article 37 requires States to collaborate with ICAO on ...*all matters*...facilitating and improving air navigation.

[36] Article 44 defines one of ICAO objectives as promoting the growth of international civil aviation, encourage the development of airways and air navigation, promote safety of flights, etc.

[37] Article 54, related to Chapter X, allows the Council to establish the Air Navigation Commission and to adopt Standard and Recommended Practices (SARPs).

[38] M. Ghonaim, 'The Legal and Institutional Aspects of Communication, Navigation, Surveillance and air Traffic Management Systems for Civil Aviation', in McGill Institute of Air and Space Law Doctoral thesis 1995, at 112.

[39] ICAO 29th Assembly (22 September- 8 October 1992) Resolution A29-8 " The ICAO communications, navigation, surveillance/air traffic management (CNS/ATM) system.

In 1987, ICAO's FANS Committee stated that, in the light of future civil aviation developments, the use of satellite technology to provide telecommunication, navigation and surveillance was the only viable solution that will enable airlines, CNS, ATM and in general the whole of civil aviation, to overcome the shortcomings of the current systems used for air navigation [40]. As early as 1981 ICAO presented a document to the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, affirming that it was responsible for the development of the position of the international civil aviation on all matters related to the study of questions involving the use of space technology for air navigation purposes, including the determination of international civil aviation's particular requirements in respect of space technology [41].

The above statement may raise doubts for it appears that both the US and the Russian Federation are the one dictating the technical specificities of GNSS while ICAO is rather left with a role in which it merely models its rules and procedures upon existing technical requirements.

The Convention on International Civil Aviation could be qualified as the fundamental instrument to promote civil aviation safety. Safety being the fundamental prerequisite of civil aviation, it follows that any new technology seeking to enhance the safety of flights, has to be analysed by ICAO in order to promote its globalisation. Indeed, the safety upgrading of civil aviation is not solely due to modernisation of aircraft technology, but equally by the provision of adequate and reliable infrastructure and compatibility of

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[40] ICAO Doc. FANS(II)/4-WP/9, para.1.2.1

[41] ICAO, Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Report on the Civil Aviation Interest in the Use of Outer Space, Background Paper 1, A/CONF.101/BP/IGO/1 (1981).

air/ground, ground/air and air/air communication and co-ordination.

In the present decade, a new technology has emerged. It is undeniable; the use and reliance upon the GNSS for air navigation is, as it was expressed by ICAO[42], the only technically available answer to the needs of civil aviation which is ever growing on a global scale.
The GNSS is a technology or a 'mode of flying' which, if implemented, could be a tool to promote ICAO's efforts to fulfil its vast mandate in generally promoting safety, cost efficiency and regularity of civil aviation on a global scale.

ICAO has retained the GNSS alternative as 'new means of air navigation', but has not done so without some reservations regarding the legal and institutional problems that may result from the global use of GNSS.

[42] ICAO Doc. FANS(II)/4-WP/9, para.1.2.1

Historical perspective

To comprehensively understand the legal implications of the use of the GNSS, it is necessary to return to the roots of the present debate.

The aim of the present section is provide the reader with a summary of the developments and the current state of work on the legal framework with regard to GNSS and to offer an overview of the relevant issues which have been identified in the process of the advancement of a legal framework[43].

As early as 1983, the ICAO Council established the Special Committee on Future Air Navigation Systems (FANS Committee), for the purpose of making recommendations for the co-ordinated development of global air navigation[44] for the next twenty-five-years[45]. Initially, the FANS Committee was mandated to identify, study and assess new concepts and technologies in the field of air navigation, including the satellite option. Further, the FANS Committee was to analyse the institutional issues relating to potential future air navigation systems. Pressured by factual reality of new technological developments, the FANS Committee developed a systems concept principally focusing on a hybrid system embracing the satellite based CNS/ATM concept and greatly improved arrangements on the ground for the purpose and benefit of a global Air Traffic Management[46]. In addition,

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[43] The author wishes to remind the reader that the present historical perspective is solely based upon ICAO's work on the establishment of a GNSS. It is not the intention of the author to express any criticisms at this stage.

[44] The pressing need for alternative CNS/ATM technologies was emphasised by the release of ICAO Doc. 222-AT/90 in which it was revealed that the expansion of scheduled passenger and freight traffic was to double from 1978 to 2000.

[45] ICAO LTEP/1-WP/3, at p. 2.

[46] FANS II/4-WP/9, p. 2, para. 1.2.1.

and for the sake of international civil aviation, the FANS Committee expressed a statement of operational requirements for Global Navigation Satellite Services. At this stage, institutional aspects were only addressed with regard to surveillance and communication applications.

The FANS Committee was followed by the FANS phase II [47]Committee upon approval by the Council in 1989. The FANS II Committee was responsible for the monitoring and co-ordination of development and transition planning for future air navigation systems. The FANS II Committee gave birth to a set of principles relating to institutional arrangements[48]. These principles referred to as 'Guidelines for Acceptable Institutional Arrangements Relative to the Implementation of Aeronautical Mobile-Satellite Services (AMSS) and Global Navigation Satellite System for Civil Aviation' were to be what the author referred to previously as the 'ICAO conditions' upon which a GNSS would be deemed acceptable.

We shall concentrate upon the guidelines relating to GNSS, but it ought to be mentioned that the guidelines were aimed at all CNS, AMSS Systems, and GNSS. The Tenth Air Navigation Conference and the Council subsequently reviewed the FANS II Committee's Guidelines.

The outcome of the revision was mainly that even though the FANS II guiding principles, now being referred to as the 'Guiding principles on Institutional and Legal Aspects', had no legal force, they were, however, a good base upon which ICAO, as a matter of urgency, had to develop institutional arrangements as a basis for the continued availability of GNSS for civil aviation[49].

The above paragraph shows the considerable contribution brought by the FANS

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[47] Hereafter referred as FANS II.

[48] The term 'birth' has been used even though the principles were embryonic in nature.

[49] ICAO 10th Air Navigation Conference, Recommendation 4/4.

Committees to the GNSS debate.

The legal and constitutional aspects of a GNSS were discussed in different ICAO bodies. The Legal Committee considered the matter for the first time at its 27th Session[50], expressing its desire for future studies to be conducted, to be based upon the FANS Committee's reports[51].

It was in the following Session[52] that the Legal Committee concluded that the implementation of the CNS/ATM systems encountered no legal barriers and further, was in harmony with the Chicago Convention. The Legal Committee went on in approving the 'Guidelines' for acceptable institutional arrangements for the implementation of AMSS and GNSS for civil aviation.
The GNSS, or rather the establishment of its legal framework, issue was now given the highest priority in the Work Programme of the Legal Committee by the Council, pressured by the civil aviation needs.

The GNSS issue reached the ICAO Assembly at its 29th Session (22 September- 8 October 1994). The Assembly endorsed the above mentioned General Work Programme by adopting two resolutions (Resolutions A29-8 and A29-9)[53] approving and calling for the implementation of the ICAO CNS/ATM concept.

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[50] The Legal Committee was entrusted with this task by the ICAO Council's 124th Session on 29 June 1988.

[51] LTEP/1-WP/3, at 3.1.

[52] Report of the 28th Session of ICAO Legal Committee, confirmed by its 29th Session in 1994, see Doc. 9630-LC/189.

[53] ICAO Assembly Resolution A29-8 " The ICAO communications, navigation, surveillance/air traffic management (CNS/ATM) system".
ICAO Assembly Resolution A29-9 " Harmonisation of the implementation of the ICAO CNS/ATM systems".

The 137th (November 1992) and 138th Sessions (March 1993) of the Council were paramount to the implementation of a GNSS. It was at those particular sessions that the envisaged 'implications' were defined. The Council expressed its concern with respect to the institutional elements, and more specifically with the following issues:

-the reliability of the quality of the information provided to end-users;
-the continuity of the services;
-the respect by civil aviation authorities of ICAO Standards and Recommended Practices whilst providing services in their sovereign air space;
-degree of control of States ATS upon elements influencing their continuity, accountability, safety, etc.

In the light of such issues, it was further decided by the Council that the Legal Committee also had to consider the institutional elements of a GNSS from an ownership and control, system funding, cost and equitable cost recovery and liabilities point of view.

In addition, the possible role of ICAO in the long-term provision and the need for co-ordination with other potential users of GNSS was to be analysed. Anticipating the institutional limits of ICAO[54], the Council invited the Legal Committee to consider the content of an ICAO-GNSS Service Provider States arrangement as a possible basis for the development of a legal framework for the provision of long term GNSS.

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[54] ICAO's role in the provision of long term GNSS could only be 'minor' due to both a lack of mandate and of funds. ICAO is not an "operating" agency and cannot become a GNSS service provider.

The Legal Committee equally had to consider the obligations of GNSS providers to fully comply with the relevant ICAO Standards and Recommended Practices (SARPs).

To make matters even more complicated and diluted within ICAO, the Global Navigation Satellite System Panel (GNSSP) was established by the Air Navigation Commission in November 1993. The Panel's main task was to develop guidelines of the SARPs for the above-mentioned long-term GNSS. The task entrusted to the Legal Committee was thus complemented by the work performed by the GNSSP in relation to the establishment of the SARPs institutional demands for a GNSS[55]:

a) low cost/benefit ratio
b) complete civil control
c) complete safety scrutiny and certification capability
d) capability to invoice direct user charges.

The GNSSP further expressed the desirability to consider the signal enhancers'[56]point of view regarding institutional issues[57].
As a result, and upon the request of the Council[58], ICAO Secretary-General drafted an

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[55] It is now too early to enter into a debate, but one may clearly appreciate that the listed guidelines are not likely to adhere to the political and technological realities of the GNSS signal providers.

[56] Today several private companies and/or agencies are providing an enhanced signal. EUROCONTROL uses the GPS. The Company 3S NAVIGATION(MAN Technology)uses a combination of both the GPS and the GLONASS to produce and provide an enhanced signal. For more information contact Dr-ing. Martin Haunschild, MAN Technologie AG, Satellitennavigation, Postfach 1347, 85751 Karlsfeld, Germany.
The US Federal Aviation Administration(FAA)has awarded on August 3, 1995 the Wide Area Augmentation System (WAAS)contract to Wilcox Electric Inc., and Hughes Aircraft Company. The FAA's objective is to use the GPS as a primary means of navigation for all phases of flight from take off to en route to CAT I precision landings by 1998. For more details see, D. J. Welde, 'Wide-Area and Local-AREA DGPS Lead Way to Era of Satellite-Based Navigation', in ATC Systems January/February 1996, Vol.2 no.1, at 25-31.

[57] The signal enhancer at this stage was EUROCONTROL which issued a report on its proposed European Geostationary Navigation Overlay Service (EGNOS).

[58] The Council in its 138th Session on 26 March 1993.

overall ICAO CNS/ATM policy containing the ICAO policy elements to be incorporated in the legal framework for a GNSS. At this stage, one could sum up the situation, or rather evolution of the GNSS project, by stating that following approximately 10 years of attention and discussion in various committees and panels, ICAO's position with regard to GNSS, reached a stage whereby on the 9 March 1994, the Council adopted the Statement of ICAO Policy on CNS/ATM Systems Implementation and Operation[59]upon which the 'Future System' was to be built[60] [61].

The Legal Committee was thus to integrate the ICAO Policy Statement on CNS/ATM in its legal framework proposal. The ICAO Statement principally restates most of the points that were already discussed in the sense that while producing the proposal, the Legal Committee had to focus on the issues of sovereignty, authority and responsibility of Contracting States, the technical and co-ordinating role of ICAO, continuity and quality of service, reasonable cost allocation to users and non discriminatory universal accessibility of the GNSS. The Statement integrated a further element in that the proposed institutional arrangements should as far as possible and practicable rely upon existing organisational structures and legal regulations[62].

The Legal Committee at its 29th Session[63] drafted the proposal basing its work on the ICAO Statement as well as

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[59] Such Statement is embodied in ICAO Doc. C-DEC 141/13.

[60] Again, the author wishes to remind the reader that the historical perspective here presented is 'ICAO-centric' thus no criticism is offered at this stage.

[61] The Statement seemed to be strongly influenced by the Chicago Convention.

[62] It is to be presumed that ICAO wanted to optimise the existing international rules and institutions, not to create new institutions.

[63] The ICAO Legal Committee held its 29th Session in Montreal from 4th to 15th July 1994.

the Report of the Rapporteur, Dr. K. Rattray from Jamaica[64]. The report added to the ICAO Statement the issue of global/universal acceptance of the contemplated GNSS. The Rapporteur's guidelines were founded upon the concerns expressed by the international Community[65].

Dr. Rattray's report completes the previous GNSS legal institutional framework requirements in that it provided for:

-provisions in respect of augmentations of the basic signal;
-provisions for consultation and co-operation including regional arrangements;
-provisions for relationship with other international organisations dealing with satellite communications such as INMARSAT and ITU;
-provisions for settlement of disputes.

The report in its paragraph 7 further proposed a listing of possible legal instruments.

Dr. Rattray's Report's main contribution to the progress of the GNSS within ICAO lies in the Rapporteur's statement which explicitly asserts the role of ICAO in focusing on the establishment of a regulatory institution which would be responsible for the supervision and oversight of GNSS providers, but without ownership of the system[66].

Dr. Rattray through his Report appears to have reduced the role that ICAO is to play in the establishment of a GNSS, in that the said role proposed in the report is supervisory and regulatory and not constitutive in nature, as it may have been ICAO's initial intention[67].

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[64] LC/29-WP/3-1

[65] Ibid, Para. 6 of the Report.

[66] LC/29-WP/36-1, para. 8.

[67] By the term 'constitutive' the author implies a hypothesis by which ICAO is responsible for the creation and development of a GNSS and further ICAO would own or operate the system to a certain degree.

The Report went on advocating a legal framework as an international agreement adopted under the auspices of ICAO. This last point is pertinent in that it is certain that ICAO could contribute to the development of a GNSS.
However, seeing the length of time required for a mere amendment to the Chicago Convention[68], it ought to be born in mind that a Diplomatic conference is really the best alternative if one desires the GNSS to be adopted rapidly and globally.

The goal of the suggested international agreement is to create obligations for GNSS providers, in that providers will be required to obtain a certification from ICAO. In such a way, ICAO will ensure that it has its influence, or even limited control in the operation and development of a GNSS that it will not own.
Paragraphs 16 and 17 of Dr. Rattray's Report equally address the need for transitional provisions which would recognise the existence[69], or more exactly the factual reality of the existing basic signals providers as component part of the evolutionary approach to the definitive GNSS[70].

Upon the Rapporteur's Report and the ICAO Council Statement of Policy on CNS/ATM, and other documents and interventions, the Legal Committee concluded its 29th Session by recognising the need for a legal framework for the implementation of the GNSS.
The establishment of a GNSS had to go through a two-phase approach, initially and take into account the existence of already developed in-use systems[71] but furthermore the needs

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[68] One may appreciate even more the veracity of this statement regarding the slowness of amendment, when one bears in mind that Article 83 bis of the Convention came into force in June 1997- 17 years after its unanimous adoption by the Assembly in 1980.

[69] The Report could not have made a more pertinent statement, both GPS and GLONASS are not only the sole providers of the basic signal, but furthermore, as mentioned previously, GPS is already in use by some airlines.

[70] The Report mentions the existing GPS and GLONASS systems, but signals enhancement providers too will have to be taken into account and recognised.

[71] Systems such as GPS/GLONASS.

of today's civil aviation.

A legal framework had to be created in order to accommodate such systems. Secondly and in a long-term perspective, there is a need for the elaboration of a more comprehensive and lasting instrument for the future use of a GNSS.

The Legal Committee's conclusions were given weight by the adoption and approval of:

- a draft agreement, for the immediate future, between ICAO and the providers of the GNSS signals regarding the provision of signals for GNSS services[72];
- a checklist of items to be considered in contracts for GNSS signal provision with signal providers in the context of long-term GNSS[73].

According to the checklist, the standard contract for GNSS signal providers shall mainly incorporate general contractual clauses relating to the object, conditions and duration of the provision of services, but equally a statement of recognition of ICAO Policy on CNS/ATM systems, liability etc.

The applicable operational requirements for GNSS signal provision and the need for its compliance with SARPs in accordance with the Chicago Convention was also part of the above-mentioned checklist[74].

Interaction between ICAO and basic signal provider(s)

Two States have at present the capacity to provide the 'basic' signals for the GNSS. Both the US and the Russian Federation, are respectively possessing the GPS and the GLONASS. These satellite constellations were initially solely developed for military purposes even though, just as INTERNET, with time they were made available to civilian

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[72] LTEP/1-WP/3, ADDENDUM, Attachment F.

[73] LTEP/1-WP/3, ADDENDUM, Attachment G.

[74] Ibid.

users and uses.

Stimulated by political strategies, to which we shall come back later, both the US and Russia, for the purpose of facilitating further development of the GNSS, each offered their systems to ICAO as means to support the evolutionary development of GNSS.
In an exchange of letters between ICAO and the US, ICAO accepted the US offer made to the international aviation community of a free use of the GPS for a defined period.
Nearly two years afterwards, a similar exchange of letters granted the international civil aviation community a free use of the GLONASS[75].
The legal meaning of these 'letters'[76] will be discussed at a later point.

A GNSS being extremely technical by its nature, many issues discussed, or to be discussed, will inevitably require technical expertise. At its 31st Session (22 September -4 October 1995), the Assembly agreed upon the proposal of the Legal Committee which, driven by the above technical complexity of a GNSS, recommended in its 29th Session to entrust a Panel of legal and technical experts to consider and elaborate the appropriate legal framework for the introduction of a long-term GNSS. The Assembly left the establishment date of such Panel at the discretion of the Council which established the Panel of Experts on December 6th, 1995 during its 146th Session.

As seen above, the Panel was entrusted to draft a legal framework with regard to GNSS, with terms of reference set out in LTEP/1-WP/2. LTEP/1-WP/2 lists all paramount working papers relating to the establishment of a GNSS. The Panel of Experts, in elaborating a legal framework, had to pay attention to all these valuable reports and works

[75]The exchange of letters between the US and ICAO and the Russian Federation and ICAO are set out in Annexe II.

[76] See Part III of the work.

already made on GNSS which were contained in the LTEP/1-WP/2. The LTEP/1-WP/2 being so extensive, the Panel was expected to assess the various forms that could be envisaged for the creation of a long-term legal framework for GNSS. The Panel, by being entrusted with such a demanding assignment, was given a Herculean task. Indeed, the Panel's work had to be comprehensive and complete in order to present to the Legal Committee and the Council all the viable options and all reasonable possibilities for the creation of a long-term GNSS legal framework.

The present Chapter sought to give the reader a concise description of ICAO's approach towards such emerging reality that emanated from terrestrial application of satellite technology. The debate started in the 80th and is still ongoing. But one may now clearly see the trends of the discussions within the ICAO arena, giving rise to conclusions that, even though they produced no solutions, surely managed to reveal potential/hypothetical legal problems. It is upon these specific legal problems that the Panel of Experts[77]will concentrate its attention.

States' interests with regard to the full implementation of the GNSS are not homogenous. States that have already invested a great deal in existing ground and airborne equipment could be less eager to see an immediate GNSS implementation than other States possessing poor ground facilities.

This political reality causes the author to believe that expecting ICAO to act as the catalyst with regard to GNSS implementation may not achieve the expected results.

Being an effective civil aviation international organisation, ICAO could certainly be an adequate forum for GNSS implementation working parties/committees to co-operate and/or co-ordinate their efforts.

On the other hand, and on a more political note, ICAO's voting procedure for standards and recommended practices being what it is, it could be presumed that states reluctant to

[77] Panel of Experts on the Establishment of a Legal Framework with Regard to GNPs.

implement GNSS would take advantage of the Chicago Convention voting procedures contained in Chapters VIII and IX in order to slow down the implementation process[78].

ICAO's legal and institutional GNSS-related considerations are still undeveloped due to both a lack of political will/consensus and an extremely complicated technology[79].
ICAO will only be able to make further progress once the political will of member States is clearly defined.
ICAO can only act within its mandatory powers and ICAO member States' political will[80].

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[78] Also see e.g. Dr. M. Milde, 'The Chicago Convention-Are Major Amendments Necessary or Desirable 50 years Later?', in Annals of Air and Space Law, Vol. XIX Part I, 1994 at 401-452.

[79] Ibid.

[80] The Chicago Convention, Article 49 confers upon the ICAO Assembly the power to influence the Council by controlling the budget. Should the Council vote upon a project (requiring substantial funds) unpopular within the Assembly, it is unlikely that such project would be funded.

The following Part of the present work will not only look at the legal and institutional implications engendered by the GNSS, but will equally comment upon ICAO's view and role in the implementation of the GNSS.
ICAO in its Statement of Policy principally expressed the idea that the implementation and operation of the new CNS/ATM systems shall adhere to the following precepts[81]:

-Universal Accessibility
-Sovereignty, Authority and Responsibility of Contracting States
-Responsibility and Role of ICAO
-Technical Co-operation
-Global Navigation Satellite System
-Airspace organisation and Utilisation
-Continuity and Quality of Services
-Cost recovery

It ought to be mentioned that ICAO's Statement is not a source of law, but it has the merit to give an initial preview of the emerging consensus of the international community concerning the legal and institutional environment in which the GNSS is to be evolving.

As a concluding remark the author wishes to draw the reader's attention upon the fact that ICAO's proposal, as it stands, seem to confer too many responsibilities upon ICAO in light of its mandate contained in the Chicago Convention. The implementation of the proposals as such is likely to place ICAO into an ultra vires 'realm of action'.

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[81] LC/29-WP/3-2.

PART III

Legal and Institutional Issues

The present Part of the work is based upon ICAO's Statement of Policy on CNS/ATM Implementation and Operation approved by ICAO Council on 9 March 1994.

I) GNSS and State Sovereignty

ICAO calls for global co-ordination of efforts along the lines of accepted policies and regulatory norms, particularly in light of GNSS' impact on the traditional concept of airspace sovereignty, which includes the right to regulate and control the provision, operation and management of air navigation services within the States' territory. Implementation and operation of CNS/ATM systems which States have undertaken to provide in accordance with Article 28 of the Chicago Convention 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' authority shall be preserved in the co-ordination and control of communications and in the augmentation, as necessary, of satellite navigation services[82].

Already in 1919 whilst flying on aircraft was an innovation, the Paris Convention on International Air Navigation, succeeded 25 years later by the Chicago Convention, recognised the complete and exclusive sovereignty of States over their national air space[83]. A right to exercise national air space sovereignty is enjoyed by a State over its national territory and territorial waters[84]. Albeit the horizontal limitation of a national territory is

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[82] DR. M. Milde, *Supra* note 5, at 4.

[83] Ibid.

definable by the spread of the landmasses of the State, there is no vertical recognised limitation. However, one could consider as acceptable a vertical limitation starting and ending at a 'technologically possible' flying altitude[85].

Article 1 and 2 of the Chicago Convention clearly recognise the sovereignty principle; such principle being the very core of the notion of entry into binding pacts[86].
Although the Sovereignty principle is a fundamental well-respected principle of international law, such principles know limitations.
In theory, State Sovereignty is generally absolute and furthermore tolerates no exception. The political reality is somehow different. Sovereignty is confronted and challenged by a globalisation trend.

The meaning of sovereignty was surely different for European States prior to the signing of the Rome Treaty in 1957 establishing the European Economic Community, followed by the Single Act Treaty 1986 and moreover by the Maastricht Treaty 1992 seeking to establish a politically cohesive Europe, where decisions made in Brussels by the central government are binding upon the 15 member States.
The European Union is nothing but a resolution by 15 States to willingly diminish their sovereignty for a superior set of Rules[87].

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[84] It ought to be mentioned that in addition to the air space sovereignty right above a national territory, some States exercise a right known as the Air Defence Identification Zones (ADIZ). ADIZ consists of a zone adjacent to a state's territory and/or territorial waters and upon which the state exercises a quasi-right, rendering mandatory the positive identification by any aircraft entering such adjacent zone.

[85] The vertical delimitation issue has been, and still is, a never ending debate for such delimitation will inevitably always have to be argued in light of ever improving aviation technology, enabling aircraft to fly ever higher.

[86] Dr. A. Kotaite, 'Sovereignty under great pressure to accommodate the growing need for global co-operation', in ICAO Journal, December 1995, Vol.50, No.10, at 20.

[87] Nearly all European Union States national courts have recognised the supremacy of European legislation over national legislation.

Sovereignty may also be challenged by factors beyond State's control. Which government can reasonably pretend to be able to control data flow via new means of communication such as Internet or Television satellite dishes?
The sovereignty of States remains paramount in the functioning and interaction of States within the international community, however such Principle is ever evolving. In fact, the word 'evolving' could easily be replaced by 'eroding'.

The erosion of the sovereignty reality can be attributed to several factors ranging from the will of a State to partly vest its sovereignty in a trans-national form of government, to a *de facto* situation where a State cannot exercise its sovereignty lacking the control mechanism to do so.

The sovereignty debate is and will be an endless one. The author does not wish to enter into such debate. Nevertheless, the author is of the opinion that the issue can be resolved. This can be done by recognizing that, although a State can decide to limits its sovereignty right, it can theoretically also choose to denounce a binding international treaty[88] or promulgate a legislation forbidding all means of communication upon which the State cannot legitimately exercise a form of control[89], as in the above examples.

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[88] The freedom of States to repudiate a treaty was expressed by the Honourable Lord Denning M R in the British case of *Macarthys Ltd v. Smith [1979] 3 All England Reports 325 at 329.*
Lord Denning's opinion's is a landmark in European law. Any Sstate member of the European Union will always be free to repudiate any form of international norm limiting its exercise of sovereignity.

[89] Some governments such as the Taliban government of Afghanistan, not being able to exercise its 'legitimate' control over the different forms of media, has on September 28th 1996 decided to exercise (and abuse) its sovereignty by rendering illegal the listening of Radio, television and videos. For more information see, Baktash B., 'Afghanistan Diary', in Marie Claire, August 1997, at 42.

It is the author's opinion that States are always capable of exercising their sovereignty right even though it may be that the exercise of such right will force a State to isolate itself from the international globalisation and co-operation trends.

The sovereignty 'dilemma' that the author sought to explain above has been formulated more concisely by Professor Wassenberg, Chairman of the International Institute of Air and Space Law at Leiden University, who expressed the view that:
"States are free to choose what they feel is right...The ultimate choice is between absolute independence and "national" freedom on the one hand and international economic, financial, technological, social and environmental inter-dependence and international Co-operation"[90].

GNSS pressuring State national sovereignty

As suggested above, the predominance of sovereignty is gradually fading away to the globalisation phenomena and trend.
A question comes to mind as to whether the GNSS represents an unprecedented threat to sovereignty or whether it is just another feature of a rational, and economically logical, globalisation strategy.

The number and quality of participants vesting a mutual interest in the GNSS project reveals the significance of such revolutionary technology[91]. GNSS is a 'running train' to progress in civil aviation[92], States either catch it and collaborate in driving it to its destination as the most efficient navigation tool, or States stay off and inevitably stagnate in their 'out of date' navigation technology.
While all interested States and industries are co-operating in the promotion of the

[90] Dr. A. Kotaite, *Supra* note 86, at 21.

[91] Ibid.

[92] Part I generally describes the advantages brought by the GNSS to Civil Aviation.

GNSS[93], its success will above all be conditioned by more co-ordinated and cohesive actions at the global, inter-regional and intra-regional levels and thus *ipso facto* reduce the purely national approach of theses co-operating States[94].
Article 1 of the Chicago Convention will inevitably be eroded by the full implementation of a Global Navigation Satellite System.

At present, air navigation safety, regularity and efficiency are essentially relying upon Flight Information Regions (FIRs), providing air traffic services.
FIRs generally cover a portion of a national territory, aligned by States' national boundaries and are adjacent to one another. When FIRs cover and are contained within the national territory of one State, they are in perfect harmony with the sovereignty principle and also with Article 1 of the Chicago Convention, in that a State controls and provides the air traffic services over its own national territory.

One can note here that within the European region at present, the French air traffic control authorities have delegated part of their control, or more accurately part of a French Flight Information Region to the authority of a Swiss entity based in Switzerland[95]. This illustrates how the sacrosanct principle of national sovereignty recognised by the Chicago Convention may be sacrificed for the benefit of reducing the cost and improving the efficiency of the air traffic services.

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[93] The full implementation of the GNSS will require a paramount level of international co-operation between numerous different entities; between national and international public and private entities concerned with political and technological aspects of the GNSS. An example of the complexity of such co-ordination efforts, is the 1995 agreement between Airport Systems International Inc. and Interstate Electronic Corp. (both GPS technology experts) and Swissair and Crossair, the Swiss carriers. Such agreement plans to enable the carriers to benefit from the integrated differential Global Positioning System (DGPS) and ultimately leading to a SCAT I Certification of Airport System's ground station and equipment of Crossair's fleet with Interstate' s avionics. Source: Jamie Roberts and Clay Showen, in "*Joint Development of a next Generation GPS Landing System*", in ATC System, July-August 1995, Vol.1 No.3, at 3.

[94] Dr. A. Kotaite, *Supra* note 86, at 21.

[95] Information gathered during one of Dr. Francis Schubert, SWISSCONTROL Head of International Relations, lectures in 1996 at the Institute of Air and Space Law, McGill University, Montreal.

Most States realise the needs and enthusiastically anticipate the creation of a satellite based global system. However, they remain concerned with the idea that one of the predominant features of such system, that is to say the constellation of satellites, is operated, controlled and owned by another State, namely the US[96].

A GNSS will not only rely upon co-ordination but integration of resources. Following the EUROCONTROL example in cost reduction and optimisation of the use of resources, the GNSS will avoid unnecessary use of resources and enhance cost efficiency by reducing the number of systems running in parallel and which could be grouped as one.
The GNSS will require a very limited number of ground stations established in each region [97].

The picture seems unclouded; under the proposed GNSS and CNS/ATM a given State will have a more efficient integrated national ATM but will depend both upon a US and/or Russian operated GPS/GLONASS and further a ground station in an (possible) adjacent State.
The above description of the GNSS system may appear to be contradictory to Article 1 of the Chicago Convention. If so, will it imply that the GNSS is incompatible with civil aviation in general?
To simply[98] answer this question, one has to ask whether the Chicago Convention requests States not to restrict their sovereignty over their national airspace? The answer to such question can only be negative; Article 1 of the Chicago Convention is declaratory, and not only it is indifferent towards sovereignty issues, but it further encourages States to team up

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[96] The US owns the GPS which, today, seems to be the only reliable primary satellite system upon which a GNSS could be based.

[97] Dr. A. Kotaite, *Supra* note 86 at 23.

[98] The author wishes to emphasise the term 'simply'. A simple, and perhaps naive construction of a convention may often enable the implementation of the convention, while a 'too deep' interpretation of the same convention is very likely to position interpreters upon their own (and state-centred) interpretation and consequently slowing-down the implementation of the convention's ambit.

in order to promote the ambit of the Convention as it has done for the establishment of EUROCONTROL[99].

The European Union itself[100] stated that a strict application of the sovereignty concept encompassed in the Chicago Convention would be a barrier to CNS/ATM capacity and efficiency[101].

States' sovereignty concern would be legitimate if either ICAO or a regional organisation forces or leaves no choices to its member States but to limit their sovereignty. But such manoeuvre by an international organisation would violate Article 1 and would thus be against international law.

To conclude this sovereignty pseudo-legal problem, the author is of the belief that an absolute and exclusive sovereignty of airspace expressed in Article 1 of the Chicago Convention, is a wealth that ICAO member States will one day manage together for the greatest benefit of the international aeronautical community[102]. How can a sovereignty conservatism be reconciled with Dr. Assad Kotaite's statement expressing the view that: "*the key element for the global implementation of FANS is to work globally together*"?[103].

Neither ICAO nor any other institution will be able to impose the GNSS to any States. No State will ever be strained against its will to integrate the GNSS within its territory.
However such refusal is likely to exclude the State from the 21st century civil aviation scene.

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[99] Y. Lambert, 'Eurocontrol et l'OACI', in Annals of Air and Space Law, Vol. XIX-1994 Part I, at 351.

[100] European Union Commission, *Exposé relatif au changement de statut des services allemands de navigation aérienne*, Doc.CE/R 12.04.1994, point 2.1.

[101] Y. Lambert, *Supra* note 99, at 366.

[102] This last point of view is based upon a statement expressed by Y. Lambert, *Supra* note 99, at 367.

[103] Dr. A. Kotaite, *Supra* note 3.

Does the GNSS represents an unprecedented threat to sovereignty?

As for the GNSS emitted signal as such, which will initially be produced by a GPS or its upgrade, there is no sovereignty infringement for nothing physical occurs within State territory. Just as today, anyone is free to receive the GPS passive and non-intrusive signal with a GPS receiver anywhere in the world or ignore it.

The GNSS does not as such infringe upon State sovereignty. States are free, and will remain so, to either opt in and enjoy the full benefits offered by the GNSS, or stay out, and continue using available means of navigation.

At this point it ought to be mentioned that among the in-use means of navigation, the currently used OMEGA navigational system has been researched and developed by the US military, the transmitters are spread in different countries, the system is not regulated by any international standards yet no 'sovereignty infringing' issue has ever been raised[104].

Assuming that the GNSS will, in its first phase, solely rely on the GPS signal, and that all existing ground navigation systems will be abandoned and utilise the GPS as the basic signal provider, other States[105] (users) are untitled to be anxious. In the present configuration, GNSS is facing world-wide scepticism because of its primary dependence upon GPS, which is controlled by United States of America Department of Defence[106]. The concern is that GPS operation is at the discretion of the US Military and it could be turned off or rendered unusable for civilian users.

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[104] Dr. M. Milde, *Supra* note 5, at 5. It should be noted that the OMEGA System is to be decommissioned by the end of 1997.

[105] States' fears are legitimate on several grounds. States need the GPS raw signal in order to provide their own national CNS/ATM services.
However, States equally have a direct interest in that civil aviation functions well, as air transport is an integral part of their economy. Any malfunctioning in air transportation will inevitably have negative consequences on individual state economy.

[106] S. Harksen, *Supra* note 13, at 11.

The US and Russia have sought to relieve other States' fears and neutralise the existing concern related to their monopoly as signal providers, by both addressing a formal letter to the President of ICAO. ICAO answered the letters[107].

The letters were in fact engagement by both States to offer a free use of their respective navigation system to the international community.
However, such 'generous' offers in both cases are conditioned by a stipulation stating that the availability of the offered systems is dependent upon availability of funds. The US offers 10 years of use free of direct charges[108] with a 6 years notice prior to termination of GPS operations.
Russia's offer is for 15 years with a 6 years notice.

Generally, the offers could be summed-up as proposing a system available on a continuous world-wide basis and on a non-discriminatory basis to all users of civil aviation, such offer being of course subjected to a sufficient budget and/or military strategic need of signal providers.
The US letter addressed to ICAO further implicitly expresses the view that the US government wishes to see the GNSS based upon its GPS, and ICAO SARPs to be GPS compatible. In other word, the US government has seen a potential market and is now trying to maintain its monopoly as the basic signal provider.
Furthermore, it is very probable that most GPS signal enhancers (differential) likely to be used in CNS/ATC, will be coming from the same State as the one providing the basic signal. The US has seen a huge commercial opportunity and spin-offs, and is determined to

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[107] A copy of the 4 letters are contained in Annexe II.

[108] The term 'free of *direct* charges' is unclear; does it imply that there will be another form of charges namely *indirect*?

exploit it.

In light of the above paragraph, the author wishes to draw the reader's attention to the fact that it will be in the interest of many States to consider the US commercial dominance and the US monopoly (as sole signal provider) as a same issue, both a 'threat' to sovereignty.

A binding proposal

Considering that the GPS/GLONASS (both developed for military uses) will, in the initial phase, be the key element of a GNSS and that both systems are respectively solely controlled by one State, it appears legitimate that other States resent the GNSS as it is at present.

Such fears would not be inevitable, had the GPS/GLONASS, as basic signal providers, been held by an international consortium of the INMARSAT type.

It could be counter-argued that both the US and the Russian Federation's government statement of policy could be held as binding and thus acting as a guarantee with regard to the provision of the GPS/GLONASS basic signals[109].

The legally binding weight of both letters is controversial.

These letters could well represent an international agreement in the light of the existing principles on international law.

The International Court of Justice's jurisprudence in the Nuclear Test Case opposing both Australia and New Zealand to France in 1974[110] recognises unilateral declaration as being potentially binding[111]. Was ICAO legally equipped (did it have a mandate) to enter into an agreement with both governments? It does not really matter for both letters constitute a statement to the President of the Council of 185 States.

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[109] See Annexe II.

[110] Nuclear test Cases (1974), [1974] ICJ Rep 253

[111] Martin Dixon & Robert McCorquodale, 'Cases and Material on International law', Blackstone Press Limited 1991, at 50-53, 454-5.

Considering for argument's sake that both letters are legally binding and that as a result both the US and the Russian Federation are under the obligation to provide the basic signal in good faith, the issue arises as to whether other States, likely to use and rely upon the basic signal for their own civil aviation, would be reassured with respect to sovereignty's uncertainties.

Let us consider for argument's sake that both letters are legally binding and that as a result both the US and the Russian Federation are under the obligation to provide the basic signal in good faith. Would it reassure other States upon the sovereignty uncertainties?
The answer can only be negative. Even if the above mentioned letters were binding it ought to be observed that while the whole civil aviation navigation would be relying principally on either of these nationally controlled systems, the global availability of such systems will remain conditional upon the terms and conditions contained in the letters.

It thus could be concluded that the entire civil aviation navigation would rely, in the initial phase of the GNSS, upon the good faith of the basic signal provider. Is it a risk to take?
States will have to consider such question in the light of alternative systems. It is undeniable that the GNSS in its current(available) form is not compatible with States' sovereignty, but it is equally undeniable that alternative systems are not foreseeable in a near future. A solution will only be possible once a compromise, between States and the basic signal provider(s), has been found and such compromise relieves States from their sovereignty related uncertainties.

II) GNSS has to be Universally Accessible

The principle of universal accessibility without discrimination shall govern the provision of all air navigation services provided by way of the CNS/ATM systems[112].

The 'Universal accessibility with no discrimination' principle has been discussed at different times and different levels within the ICAO arena and by now it can be said that such principle is governing the provision of all air navigation services by CNS/ATM systems[113]. The above assertion is corroborated by the fact that the principle appears in both the US and the Russian Federation's letters to ICAO.

It seems logical that for the GNSS, which has a global coverage and which further will require an unprecedented level of international co-operation and integration of ATM/ATCs, to be implemented, all States and their airlines shall have a universal non-discriminatory access to the signal.

The Universal Access principle imposes upon the signal provider two main obligations, a passive and an active obligation.
If the term 'Universal accessibility' is to be understood as being the provision of a signal on a geographically global and politically non-discriminatory pattern, it results that the signal provider will have a duty (active) to ensure that the signal is available on a global scale[114],

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[112] LC/29-WP/3-2.

[113] LTEP/1-WP/4, at 3.1.

and a negative duty in that the provider will not be allowed to discriminate against any of its signal 'recipients'.

As mentioned in Part III.I (GNSS and State Sovereignty) at present the only guarantees offered by the two signal providers are contained in their respective letters and are secured by their good faith.

Obligation upon GNSS signal provider(s) in general

At present, only one State is considered for the provision of the basic signal[115] and the 'universal accessibility' duty seem not to be a problem in the present case[116]. But such lucrative business is likely to interest other parties, whether private or public. In addition, as mentioned in
Part I, other entities will be providing enhanced /differential signals to assist civil aviation on regional levels[117].

As a result ICAO's next concern was how to render the universal accessibility principle

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[114] The subtlety here is that the geographically global provision engenders not only a duty to initially "provide" a signal but further to maintain it. If one of the GPS or GLONASS satellites is destroyed by a solar flair, it could result that the signal provider will have a duty to restore the signal a soon as possible, instead of doing it when it best suited the state.
The active obligation to provide and maintain the signal is encompassed by the ICAO Principle relating to 'Continuity and Quality of Services', see Part III. viii (Continuity and Quality of Services) of the present work.

[115] Whilst the GPS is a well and reliable navigation tool, the GLONASS constellation still appears unreliable (both technically and politically).

[116] The US Letter to ICAO stipulates the US' engagement to respect the principle.

[117] EUROCONTROL's EGNOS and MAN technology are two different systems providing an enhanced GPS basic signal. See *Supra* note 54.

applicable to all GNSS signal providers/enhancers.
To address such issue, ICAO has envisaged[118] a legal framework mainly taking the form of a 'model' contract. The contract regulating the relationship between the signal provider (whether private or public) and the signal user will contain general terms and conditions.
The contractual modalities will seek to provide assurance for the provision of GNSS services.

The weakness of such 'model contract' lies in the fact that its success is mainly relying upon an homogeneity/uniformity of countless contracts between different providers and users[119]. It results that all signal users-providers contracts must be similar.
ICAO recognised two ways in which the 'Model Contract' can be enforced in the perspective to guarantee the universal accessibility Principle[120].

It could (the model contract) be adopted by the relevant ICAO bodies and then left to the contracting parties to go through a subsequent ratification process. But the simplicity of such adoption procedure is counterbalanced by the difficulty of ensuring compliance with the model contract[121].

If the signal/service provider is a State, it appears that the universal accessibility could be secured by a binding declaration of the State.
On the other hand, if the provider is within the private domain, as it is likely to be, there will be no obligation upon such provider to include in its service contract and/or memo of

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[118] LTEP/1-WP/5, ICAO Panel of Experts on the Establishment of a Legal Framework with Regard to GNSS, at 2.2.

[119] The same contract is to be used between a basic signal provider and a signal enhancer, so that 'similar' contracts regulate relationships from basic signal providers to end of the line users.

[120] LTEP/1-WP/5, at 2.2.

[121] See *supra* note 120, at 2.2.2.

understanding, any clause relating to the universal accessibility principle.
It thus results that States will have to render the inclusion of the universal accessibility clause compulsory through their respective national legislation.

As another alternative for the implementation of the 'model contract', ICAO referred to the cases where model contract provisions are widely accepted not on the basis of their binding or non-binding character but on the basis of their intrinsic professional value, such as the General Conditions of Carriage adopted by the International Air Transport Association (IATA). Such General conditions although not binding, are nevertheless accepted as standards of the industry and incorporated into the contracts between the airlines and their customers by almost all IATA members.
There are different alternatives to the implementation of the 'Model Contract', or rather chain of contracts. The best alternative will inevitably be the one that expediently guarantees the principle.

The author believes that the most practical contract system that could guarantee the Principle of universal accessibility, would be similar to the Société Internationale de Télécommunications Aéronautiques (SITA)[122] contract policy.
SITA has made a multilateral contract which closely resembles a multilateral convention, although it is concluded by non-governmental parties.

Regarding the content of such a multilateral contract, one could easily imagine that its terms and conditions would be inspired by existing and future SARPs [123] on the matter.

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[122] SITA is a private non-profitable organisation providing a variety of services to airlines and other users on the basis of a contract or contracts without discrimination.

[123] ICAO has already initiated the development of a number of SARPs applicable to GNSS services. These SARPs have numerous advantages in the sense that they are usually the expression of widest possible consensus, that Standards may be regarded as obligatory to the extent that States have not filed

At this stage, however, one should remember that at present there is only one basic signal provider. This provider may be reluctant to see its proposed services regulated by ICAO. However, ICAO has no alternative but to rely on such signal and the good faith of its provider for the GNSS functioning.

differences, and that they may be formulated within the existing ICAO institutional structure.

III) Responsibility and Role of ICAO

In accordance with Article 37 of the Chicago Convention, ICAO shall continue to discharge the responsibility for the adoption and amendment of SARPs governing the CNS/ATM systems. In order to secure the highest practicable degree of uniformity in all matters concerned with the safety, regularity and efficiency or air navigation, ICAO shall co-ordinate and monitor the implementation of the CNS/ATM systems on a global basis, in accordance with ICAO's regional air navigation plans and global co-ordinated CNS/ATM systems plan. In addition, ICAO shall facilitate the provision of assistance to States with regard to the technical, financial, managerial, legal and co-operative aspects of implementation. ICAO's role in the co-ordination and use of frequency spectrum in respect of communications and navigation in support of international civil aviation shall continue to be recognised[124].

There is nothing extra-ordinary about the above precept contained in ICAO' Statement of Policy on CNS/ATM. As mentioned in part II, ICAO is probably the international organisation in a position to effectively co-ordinate global CNS/ATM activities.

However, this precise precept could be the most problematic issue when applied to the implementation of the GNSS.

As mentioned in part II, when issuing SARPs, ICAO should acknowledge all different available technologies and select the one, or combination of technologies, most likely to implement or contribute to the implementation of ICAO's mandate. But it seems that, following ICAO's above-mentioned precept, the roles may be somehow inverted.

It goes without saying that ICAO will be a useful catalyst in the implementation of the GNSS in many ways, through its co-ordination, co-operation, advice, assistance etc. to States.

However, and bearing in mind that at present there is only one basic signal provider, it seems irrational that ICAO (the Council) imposes SARPs upon an existing and in-use

[124] LC/29-WP/3-2.

technology. The GNSS Standards and technological requirements were developed long before ICAO even contemplated the establishment of the FANS study group.

GNSS related SARPs are necessary for a proper 'integration' and co-ordination of CNS/ATM systems. But it would be more logical, as requested by the US[125], for ICAO to model its SARPs upon existing GPS standards[126].
In fact, the GPS/GLONASS systems are already utilised world-wide, augmentation technologies are already in use and have a promising future[127]. It appears that the remaining phase in the GNSS implementation project is of a co-ordination nature.
ICAO's role should therefore be limited in producing SARPs that will have two main functions:

- the creation of acceptable GNSS related standards, the goal of which are to set common minimum standards[128];
- ensuring that the adoption of a common standard will facilitate the globalisation of the GNSS.

The creative law-making function of the Council (in the elaboration of GNSS related SARPs) is not needed in the present case and ICAO's role should be to formulate SARPs in respect to the practice of the actual signal providers as accepted by the users.

Should ICAO decide to establish its own GNSS, it would follow that the Council would

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[125] In its letter to ICAO, the US expressed the view that it would appreciate for GNSS related SARPs to be GPS compatible. See Annexe II.

[126] The same request was made by the Russian federation regarding the GLONASS.

[127] See *Supra* note 96 and D. J. Welde, 'Wide-Area and Local-AREA DGPS Lead Way to Era of Satellite-Based Navigation', in ATC Systems January/February 1996, Vol.2 No. 1 at 25-31.

[128] Understanding that the GNSS related SARPs be related to the in-use GPS/GLONASS, etc.

have more liberty and flexibility to create SARPs as it sees fit, in the sense that it will not be directed by existing standards[129].

Another issue raised by the Legal Committee is whether ICAO's regulatory role should be extended so as to enable the Council to review and advise States with respect to charges imposed for the use of GNSS[130]. A capricious interpretation of Article 15 of the Chicago Convention (which relates to the Council's power to review and recommend charges imposed for the use of airports and other facilities) is viewed as the legal basis for the reviewing and recommending power of the Council with respect to the cost recovery scheme of GNSS services.

Some writers have made parallels between the GPS/GLONASS and other navigation instruments such as OMEGA and LORAN-C[131], and came to the conclusion that there was no necessity for GNSS related SARPs, as no SARPs were ever made for the two above-mentioned systems.
Such parallel comparisons are not always pertinent. In the present case, the GPS/GLONASS will be providing a basic signal upon which, all CNS/ATM will rely.

The GPS/GLONASS will be the central component of the GNSS, and is therefore not similar to the OMEGA-LORAN-C systems.
The GPS/GLONASS basic signal will be integrated world-wide in regional/national CNS/ATM. The same cannot be said about the Omega and LORAN-C systems.

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[129] Understanding that all SARPs are commonly accepted by Member States.

[130] LTEP/1-WP/4, at 4, para. 6. 4.

[131] Both systems being developed originally as US military systems and are now in use world-wide.

Should a Global Navigation Satellite System be developed and financed solely for the civil aviation use by an international consortium, the matter would be different and ICAO would probably play a greater role in law-making.

In his report to the 29th Session of the Legal Committee, Dr. Rattray envisaged several alternative roles ICAO could play in different scenarios[132].
Excluding the scenario where ICAO would own the GNSS[133], three potential situations remain (where ICAO could have a 'licensing/certifying' role)[134].

ICAO could be entrusted with the certification/licensing of the GNSS signal providers. The certificate would confirm that the provider is meeting ICAO's standards and recognises ICAO's Policy[135].
Such proposition takes us back to the point where ICAO is seeking to create standards upon an already existing technology. Furthermore and beside the fact that ICAO has no mandate conferring certification/licensing powers, the certification would solely depend upon the two interested parties namely the signal providers and users[136].
In the case a signal provider doesn't obtain ICAO's certification, nothing in the Chicago convention can prevent it from providing the signal, and furthermore, nothing in the Convention prevents a member State from making use of this 'non-ICAO recognised' signal[137].

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[132] LC/29-WP/3-1, at 4.

[133] ICAO has no budget and further no mandate to develop a system similar to the GNSS.

[134] LC/29-WP/3-1, at 9.

[135] Dr. M. Milde, *Supra* note 5, at 11.

[136] Ibid.

[137] For more details, see Dr. M. Milde, *Supra* note 5, at 11-12.

Whilst many hypotheses may be formulated regarding ICAO's role in the implementation of the GNSS, the author is of the belief that the Council's role should be limited in seeking to fulfil its mandate by facilitating the provision of assistance to States with regard to the technical, financial, managerial, legal and co-operative aspects of implementation. In addition, GNSS related SARPs will facilitate an unfragmented implementation of the GNSS, but such SARPs are to be based on existing technology and not ICAO's vision of how the system should be run.

IV) Technical Co-operation

In the interest of globally co-ordinated, harmonious implementation and early realisation of benefits to States, users and providers, ICAO recognises the need for technical co-operation in the implementation and efficient operation of CNS/ATM systems. Towards this end, ICAO shall play its central role in co-ordinating technical co-operation arrangements for CNS/ATM systems implementation. ICAO invites States in a position to do so to provide assistance with respect to technical, financial, managerial, legal and co-operative aspects of implementation[138].

The spirit and the letter of the Chicago Convention is probably represented at its best through the above precept. It may even be a reminder, through the co-operation and assistance spirit of the above Precept, that ICAO is a United Nation agency.

'The introduction of the ICAO CNS/ATM concept represents a significant departure from present ground-based air navigation structures. Unprecedented co-operation between civil aviation administrations, international organisations, service providers and users will be required in order to implement CNS/ATM'[139].

By the technical co-operation precept ICAO surely confirms its central role in co-ordinating technical co-operation arrangements for CNS/ATM systems implementation. The precept further solicits States in a position to do so to provide assistance with respect to technical, financial, managerial, legal and co-operative aspects of implementation.
The technical, and all other forms of co-operations are an essential aspect of the global implementation scheme.

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[138] LC/29-WP/3-2.

[139] D. J. Welde, 'Wide-Area and Local-AREA DGPS Lead Way to Era of Satellite-Based Navigation', in ATC Systems January/February 1996, Vol.2 no. 1 at 31.

Not all States have the same level of technological development, managerial skills, know-how, and so on.

Already now we can see how developed States are anticipating the GNSS. With GPS technology developing so rapidly, strategic alliances have become necessary in order to provide the best products and services to the customers[140].
Developed States will co-operate to ensure that their respective CNS/ATM systems are compatible and/or can be integrated to provide the best services.
ICAO's role in promoting technical co-operation between industrialised and developed entities will be minor for such entities[141] will probably want to participate (and profit from) the implementation of the GNSS.

But what will be the position of underdeveloped States in the GNSS implementation phase?
The future CNS/ATM has to be global in order to be optimal. It results that underdeveloped States, not having the necessary resources, will have to be 'assisted'[142] for the GNSS to be fully implemented rapidly, and in order to avoid a fragmented global implementation.
An early GNSS implementation will inevitably require a high level of co-operation and assistance.

The full implementation of the GNSS will be more profitable to some States than to

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[140] J. Roberts and C. Showen, 'Joint Development of a Next Generation of GPS Landing System', in ATC System, July/August 1995, Vol.1 No.3, at 3.

[141] The term 'Entities' refers and encompasses all potential signal providers(whether public or private). See *Supra* notes 56 and 57.

[142] The author has used the term assistance while ICAO uses the term co-operation.

others.

States having made considerable investments and already possessing a developed CNS/ATM ground infrastructure (developed State), will have less to gain than States having poor ground facilities. Full scale FANS implementation will more likely be fostered in the developing countries[143]. Developing States will be able to leap forward and offer similar CNS/ATM facilities as 'developed' States, and such at minimum cost[144].
On the other hand, industrialised States/entities (possessing the GNSS technology and know-how) could, through their co-operative spirit, gain access to important markets within developing States.

With its long experience and know-how in the matter, ICAO could greatly contribute to the technical co-operation phases required for the GNSS implementation. Few other neutral, international and respected fora would be better placed than ICAO to host such co-ordination and co-operation.

Unfortunately, ICAO's above mentioned paramount contribution is subjected to Member States political will. States policy is influenced by national interest[145], it thus can be foreseen that conflicts of interest could slow down the various co-ordination and co-operation programmes, such programmes almost fully relying on political support and private(non-ICAO) funding[146].

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[143] S. Harksen *Supra* note 13, at 14.

[144] The cost of upgrading CNS/ATM systems to the 'current in-use' standard is substantial. Through the global implementation of the GNSS, developing States will be able to possess state of the art CNS/ATM systems. Such systems would probably be obtained at a low cost since they would be purchased within a program of co-operation.

[145] Or interest of national industries

[146] Even though ICAO is a U.N. Specialised Agency and has been created in a spirit of common understanding and co-operation, ICAO has no budgetary resources of its own to implement technical co-operation and assistance.

States could have several approaches towards their participation, both politically and financially, in ICAO technical co-operation programmes. States may be reluctant to contribute to a programme that will not specifically serve their own national interests. On the other hand, States may see in ICAO technical co-operation programmes an opportunity to participate, soliciting their national industries, gain the confidence of other States, and in the long run, gain a 'market'.

But States may equally decide to be more market oriented and more aggressive when it comes to promoting their own national industries, and while disregarding ICAO programmes, such States could propose its own alternative co-operation programmes to demanding States.[147].

Whatever policy a State decides to choose, it is undeniable that ICAO can be seen as one of the best options, as ICAO can provide technical assistance to States as well as indirectly create the structure of a multimillion dollars market[148].

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[147] For ICAO's technical co-operation programmes to work, adequate funding must be made available, and ICAO, in a cost/efficiency perspective, must be efficient and competitive compared to alternative options such as those that could be provided by States and their industries.

[148] ICAO's technical co-operation would contribute to an expedient and global implementation of the GNSS, but could equally serve participating States interests (possessing the technology and know-how) by opening the access to a GNSS technology market.

V) Institutional Arrangements and Implementation

The CNS/ATM systems shall, as far as practicable, make optimum use of existing organisational structures, modified if necessary, and shall be operated in accordance with existing institutional arrangements and legal regulations. In the implementation of CNS/ATM systems, advantages shall be taken, where appropriate, of rationalisation, integration and harmonisation of systems. Implementation should be sufficiently flexible to accommodate existing and future services in an evolutionary manner. It is recognised that a globally co-ordinated implementation, with full involvement of States, users and services providers through, inter alia, regional air navigation planning and implementation groups, is the key to the realisation of full benefits from CNS/ATM systems. The associated institutional arrangements shall not inhibit competition among service providers complying with relevant ICAO Standards and Recommended practices and Procedures[149].

The ambit of the above statement is so broad that it may cause difficulty in understanding ICAO's aims. The statement is very vague. The proposition of making use of existing organisational structures is meritorious[150]. However, the reference to existing institutional arrangements and legal regulations is confusing for no such arrangements or regulations have been agreed upon yet. It is the author's understanding that the institutional debate, with all its divergent views, was in process, but that nothing had yet been made 'enforceable' or 'binding'. The same comment could be made regarding the last sentence of the precept stipulating that entities wishing to participate in the provision of GNSS related services, had to comply with relevant ICAO Standards, Recommended Practices and Procedures[151].

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[149] LC/29-WP/3-2.

[150] Using existing structures is a way to take advantage of 'proven efficient' systems.

[151] Part III. iii (Responsibility and Role of ICAO) describes that ICAO's GNSS related SARPs are not yet elaborated, and even less accepted as it is suggested in the present precept.

The rest of the statement simply reiterates the fact that CNS/ATM implementation should be harmonised and global, should involve States, users, service providers, regional air navigation groups, etc.

The precept further demands for the implementation to be 'flexible enough to accommodate future services'. Once again, it is hard to understand the meaning of such concept for while it is generally desirable to have a flexible organisation that could promptly respond to 'new needs'[152], it is less clear to discern what is meant by 'flexible implementation'.

While various propositions/scenarios have been discussed regarding GNSS institutional arrangements[153], only one is determined. The GNSS in its implementation will make use of the GPS[154].

When discussing GNSS framework issues, some considerations (realities) are to be borne in mind. There seems to be no definite agreement among States for the need of any specific arrangement in the form of a legal framework. Furthermore considering that such agreement is reached at one stage, it is to be assumed that the US, being the GPS owner, will significantly influence the debate.

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[152] The rigidity of many international institutions has repeatedly been severely criticised. It often appears that the mandate of these institutions is so restrictive that it takes tremendous time and efforts to adapt the activity of the institution to the present need of the field for which it was initially created.

[153] ICAO has highlighted five possible system combinations for the GNSS. They are as follows:
(1) GPS or GLONASS, plus integrity monitoring and augmentation.
(2) GPS and GLONASS, as above.
(3) GPS/GLONASS as above, plus overlay.
(4) GPS/GLONASS as above, plus several civil GNSS satellites.
(5) Civil GNSS satellites.
For more details see M. C. Altink-Pouw, 'Perceived obstacles to GNSS institutional arrangements can be overcome in near future', in ICAO Journal, December 1993, Vol.48, No.10, at 20.

[154] As mentioned above, the GPS is the sole 'market accepted- available and reliable' basic signal provider.

According to ICAO, the implementation of the GNSS that is truly international raises an institutional issue which needs to be fulfilled as urgently as the GNSS technical issue[155]. It appears undeniable to the author that ICAO has proposed the 'institutional arrangement and implementation' precept upon the concerns that:

-the 'military controlled' GPS will maintain its national status in the GNSS scenario;

-that the shortcomings of the GPS, namely its lack of integrity, reduced availability and limited accuracy, are giving other States an opportunity to start their own GNSS activity;

-that there is a need for a new structure to be designed with the aim to protect the local industry policy, to fulfil the legal requirements, and to be economically balanced.

ICAO's institutional arrangements and implementation precept is, as Dr. M. Milde qualified it, a 'solution in search of a problem'[156].
Indeed, while not only does it appear that no consensus has been reached among States for the need for GNSS institutional arrangement and framework, the author further believes that GNSS related issues (such as GPS ownership, integrity, reliability, etc.) will be solved in the near future by responding to market demand/ pressure and without the need for institutional arrangements.

ICAO has sought to propose a solution to 'problems' that could, and surely will, be solved naturally[157]. Furthermore the present precept appears ill-founded in that it has no clear

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[155] O. Carel, 'Les Institutions du GNSS', in Navigation, April 1995, No.170, at 153.

[156] Dr. M. Milde *Supra* note 5.

[157] The term 'naturally' in the present context is referring to changes/amelioration occurring due to market pressure, and is opposed to changes occurring through institutional arrangements.

political support and ICAO's mandate is not of a nature that would allow ICAO to easily co-ordinate the proposed arrangements. It could well be said that ICAO, through the discussed precept, is seeking to issue GNSS policy instead of merely assisting and collaborating to its implementation.

VI) Global Navigation Satellite System

The global navigational satellite system(GNSS)should be implemented as an evolutionary progression from existing global navigation satellite systems, including the United States' Global Positioning System (GPS) and the Russian Federation's Global Orbiting Navigation Satellite System(GLONASS), towards an integrated GNSS over which Contracting States exercise a sufficient level of control on aspects related to its use by civil aviation. ICAO shall continue to explore, in consultation with Contracting States, airspace users and service providers, the feasibility of achieving a civil, internationally controlled GNSS[158].

At this point it seems that ICAO, through the present precept implies a recognition that the GNSS will initially be GPS/GLONASS based. It ought to be mentioned that the precept uses the word 'including' when referring to the role of both systems, as if there were other similar systems available!

More importantly, ICAO reiterates its endeavour to shift from a US/Russian Federation 'controlled' system towards an integrated GNSS over which Contracting States could exercise a sufficient level of control on aspects related to its civil aviation. It is undeniable that the level of control over the GNSS, however it may be, is a crucial point in that States' ATC/ATM must in one way or another be able to ensure that the GNSS responds to their respective needs.

While the first part of the precept stated ICAO's ends (to allow GNSS users to exercise control over the system), the last phrase reveals ICAO's means to achieve it, namely by exploring the feasibility of achieving a civil internationally controlled GNSS.

[158] LC/29-WP/3-2.

An acceptable level of control

The Europeans made their case strongly, regarding GPS civil control, before the Institute of Navigation's GPS-93 Conference[159]. They argued that there was a real concern that in the future ground-based navigation systems could be eliminated leaving countries dependent on stand-alone satellite systems which they neither own nor operate.

Undeniably GNSS users should be able to influence the GNSS general management[160] and technical development. However there need not necessarily be a form of 'international civil ownership' over the system, a simple agreement would suffice to guarantee 'civil aviation' acceptable level of 'control' over the used GNSS. By means of bilateral agreements with owner/provider of GNSS, all issues could be solved, but a successful resolution depends on the willingness of the GNSS provider to satisfy the requirements of States[161].

At present, the civil aviation has no alternative but to rely upon the GPS, owned and controlled by the military of one State. The creation of a civil owned and controlled GNSS would surely satisfy the international aspiration for independence from the monopoly of the current provider and from essentially military roots and nature of the GPS[162]. By stating that it would pursue its exploration of the feasibility of achieving a civil,

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[159] B. Nordwall, 'Navsat users want civil control', in Aviation Week & Space Technology, October 1983, Vol.139, No.16, at 57.

[160] By 'influencing GNSS management' the author refers to the means to influence executive management in such a way that civil aviation requirements are accounted for.

[161] The US' willingness to satisfy GNSS users' requirements will surely be conditioned by the fact that the GPS is the sole system that could be used in a near future and that 'users' have no real alternative.

[162] Dr. M. Milde *Supra* note 5, at 14.

internationally controlled GNSS, ICAO has omitted to consider the costs of such ambitious project.

A civil internationally controlled GNSS

An internationally controlled GNSS[163] would surely satisfy those States concerned by the actual US monopoly and more importantly, military ownership and control over the GPS. However, and considering that alternative solutions such as an international agreement binding the US to respect and take into consideration civil aviation needs in its GPS management, is not acceptable, one question remains as to whether the establishment of an internationally controlled GNSS is feasible.

First of all, is it feasible from an economical point of view[164]?
Trucks, taxis, private cars, commercial and pleasure boats, and even hikers are at present taking advantage of GPS technology[165].
The availability of the GPS signal is free, and guaranteed to be so for the next ten years, if not more[166]. The US, through its U.S. Global Positioning System Policy[167] has further declared that it had the intention to discontinue its use of GPS Selective Availability(SA) within a decade, rendering the GPS signal more accurate[168].

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[163] Note that the term 'civil' has been abandoned in the present term for should the GNSS be internationally controlled, it will be automatically by and for civilians.

[164] The author assumes that there are no technological barriers to the creation of an international GNSS for both Europe and the Russian Federation would be technically capable of developing such system (in the case the US is not willing to co-operate in the development of the international GNSS).

[165] N. Warinsko, 'Du GPS au GNSS: le point sur la situation internationale', in Le Transpondeur, June 1995, No. 13, at 19-31.

[166] See Exchange of letters re acceptance of GPS in Annexe II.

[167] For more details see the Presidential declaration of 26 March 1996, The White House, Office of Science and Technology Policy, National Security Council, available on Internet **Error! Reference source not found.**.

[168] GPS Selective Availability device enables the US to decrease the GPS signal precision so that potential

It is undeniable that even though it was primarily for military purposes, by now the GPS has become a public utility and natural resource on a global scale[169].

In the light of the above realities and considering the costs[170] for the creation of the proposed alternative to the existing GPS (namely the internationally controlled GNSS), the GPS will inevitably remain a key element to the GNSS. Moreover, the alternative system would be created solely for civil aviation purposes and bearing in mind that civil aviation represents a tiny fraction of all present GPS users, it can only be concluded that once again ICAO's precept related to the creation of an internationally controlled GNSS is likely to fall short of political and financial support. In fact Overlay systems such as the European EGNOS[171] by making use of the GPS signal *de facto* recognises and adopts the GPS signal.

Notwithstanding the unreasonableness of the creation of an internationally controlled alternative system, the required level of control could be achieved in the various stages through the following means:

- agreement with GNSS provider by a single State;
- agreement with the GNSS provider by a group of States;
- in addition to or instead of agreements, by defining, supporting and enforcing international regulation that provide the framework of operations of the GNSS provider whether a single State, group of States or an international organisation[172] [173].

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enemies could not take advantage of the GPS precision.

[169] Dr. M. Milde *Supra* note 5, at 14.

[170] The developing and installing costs of an alternative system would be counted in US $ billions.

[171] See *Supra* note 56 and 57.

[172] M. C. Altink-Pouw *Supra* note 153, at 20.

[173] These international regulations could be drafted after generally accepted SARPs'.

One could equally well contemplate the possibility of a shifting of ownership from US military control to a US civilian control, or even an international ownership of the GPS, once it is no more a fundamental feature for the US military. Should the GPS become internationally owned, the required level of control could be satisfied by means of an agreement with an intergovernmental organisation or through membership in an international organisation providing GNSS services[174].

[174] The author wishes to express his opinion that this last option (the transferring of GPS property and control from the US to an international organisation) is improbable.

VII) Airspace Organisation and Utilisation

The airspace shall be organised so as to provide for efficiency of services. CNS/ATM systems shall be implemented so as to overcome the limitations of the current systems and to cater for evolving global air traffic demand and users requirements for efficiency and economy while maintaining or improving the existing levels of safety. While no changes to the current flight information region organisation are required for implementation of the CNS/ATM systems, States may achieve further efficiency and economy through consolidation of facilities and services[175]

The airspace organisation and utilisation precept is not innovative in that it simply reiterates the rationale behind the CNS/ATM studies. It states things as they are or more accurately as they are logically likely to be in modern aviation.
States determination to implement the GNSS is obviously to enable civil aviation to fly more efficiently, thus fulfilling global air traffic demand and user requirements for efficiency and economy without diminishing levels of safety. In fact the reliance upon the GNSS will globally improve the levels of safety[176].

The precept follows by reassuring States that, in the context of GNSS based CNS/ATM, airspace organisation and utilisation will not require flight information regions to be altered, even though further efficiency and economy could be obtained through consolidation of facilities and services. Even though flight information regions do not have to change, it is foreseeable that changes will occur. Just as the GNSS will modify the current existing navigation systems by providing a more efficient and economical system, it seems evident that States, in a spirit to optimise the cost/use of their respective services,

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[175] LC/29-WP/3-2.

[176] GNSS will especially improve landing approach phases which are still accountable for most civil aviation catastrophes. For more details see introduction.

may want to further their CNS/ATM efficiency by joining their efforts (and costs) in providing CNS/ATM services. Such reality could well be illustrated by the example of EUROCONTROL[177] or the Japanese MTSAT programme[178].

[177] See part I (GNSS related laws).

[178] The Japanese Civil Bureau of Aviation (JCBA) has elaborated an ambitious programme - MTSAT- which beyond satellite navigation, intends to cover the whole of CNS/ATM activities in the Northern Pacific region. The MTSAT will be GPS based.
For more details see N. Warinsko *Supra* note 165, at 27.

VIII) Continuity and Quality of Services

Continuous availability of services from the CNS/ATM systems, including effective arrangements to minimise the operational impact of unavoidable system malfunctions or failure and achieve expeditious service recovery, shall be assured. Quality of system service shall comply with ICAO Standards of system integrity and be accorded the required priority, security and protection from interference[179].

Precept No. XIII is certainly one of the most pertinent ones. The continuity and quality of services is undeniably directly linked to the GNSS 'control' issue. It could well be imagined that, should both the continuity and quality of service issues be solved to the expectations and satisfaction of member States, the GNSS implementation process would undergo significant progress.

As mentioned earlier[180], in our days, national sovereignty related issues are not as crucial as they were in the direct post wars eras. However, and equally mentioned earlier on[181], no State would be willing to abandon its respective and nationally controlled CNS/ATM for CNS/ATM based upon a US controlled GNSS unless States have a firm guarantee regarding the continuity and quality of service[182].

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[179] LC/29-WP/3-2.

[180] See Part III. ii (Sovereignty).

[181] See Part III. v (Institutional arrangement and implementation) and Part III. vi(Global navigation satellite system).

[182] The service in the present context being the GPS signal.

Continuity of service

Two distinct features can be understood by the term 'continuity'. Continuity may relate to the fact that the signal should have a back-up system in order to insure the continuity of the signal, should a technical problem occur. But such understanding of the term 'continuity' should really be part of the 'quality assurance' obligation of the signal provider and will be dealt with later under the heading 'quality of service'.

The second meaning of the term 'continuity' is likely to generate uncertainties.
Should civil aviation CNS/ATM solely rely upon the GNSS, civil aviation will want guarantees regarding the continuity of the service. The uninterrupted continuity of GPS signal has been guaranteed by the US[183]. Yet two distinct exceptions, or rather derogations impede upon the certainty of continuity of the signal provision.

Firstly, a close reading of the US Government offer made to ICAO[184] reveals that the GPS signal is offered on a continuous world-wide basis subject to availability of funds[185]. The funding is directly dependant upon the will of the US Congress, and as a consequence renders the continuity of the GPS signal uncertain from one Congress to another[186].

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[183] See Exchange of Letters re Acceptance of GPS in Annexe II.

[184] Ibid.

[185] J. Moxon and R. Lopez, 'ICAO seeks firm GPS Guarantees', in Flight International, 2-8 March 1994, at 5.

[186] Some of the greatest co-operative projects between the National Astronautics and Space Administration (NASA) and the European Space Agency (E.S.A.) have been aborted due to a change of the US government and thus in the political will of Congress. Basically, a US government cannot politically bind the next one.

The second exception that could interrupt the continuity of service is found in the Chicago Convention itself. Article 89 permits States to derogate from their obligations in case of war or national emergency. The provision contained in Article 89 is corroborated by general principles on international law recognising the right for States to derogate from their obligations in case of wars[187].

Although the US' offer made to ICAO seems genuine, the guaranteed continuity nevertheless knows two exceptions. Should the GNSS (based on GPS) become the sole means of civil aviation navigation, measures will have to be taken to counter these two exceptions.

Before moving on to the quality of services, the author wishes to raise one more particular point related to the continuity of the signal. It is surprising that among all the various Committees and groups that have discussed the continuity and availability of signal provision issues, the following point has never been mentioned:
Should the US decide to voluntarily interrupt the provision of the GPS signal, its own civil aviation would be the first one to bear the consequences. When one has in mind not only the size of the US civil aviation, but further that out of all 'users', the US'ATC/ATM are already experiencing some form of 'GNSS flying', one would easily realise that the continuity and availability of the services are strongly influenced by the owner and controller itself[188].
Furthermore, and considering that the 'GPS based' GNSS is used and relied upon, any interruption in the signal provision would be detrimental to the civil aviation of all States including the US.

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[187] See Articles 73 of the 1969 Vienna Convention on the Law of Treaties.

[188] It is a fact that the US aviation lobby can exert a strong pressure upon political decision-making related to the signal provision by the military.

Quality of service

The quality of service requirement seeking to ameliorate the system's integrity and availability could be sub-divided into 4 features:

- technical requirements-minimising the unavoidable system malfunctions or failure;
- technical requirements ensuring expeditious service recovery should system failure occur;
- quality insurance of the system-establishing a permanent quality control;
- warning device (whether GPS integrated or independent) should the signal become unreliable[189].

Integrity and availability problems could easily and inexpensively be overcome in a near future[190]. Quality control and warning services could be performed by an independent company/organisation.

The quality, integrity and reliability of service being technical issues, it could well be imagined that the upgrading of the GPS (to GNSS users expectations and standards) will not be a source of conflicts in that the system will simply have to respond to security requirements. Either it will respond to the security requirements, or it will not. If the US want to impose their system, they will have to ensure that it responds to GNSS users' needs and requirements. It is probably in such context that ICAO could play an important role by setting the minimum standards with respect to the quality of services and

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[189] For more details see N. Ward , 'Monitoring integrity of GNSS', in The Journal of Navigation , Vol. 47, No.2, at 181-190.

[190] For further details on a low cost approach to overcome GPS integrity and availability problems and improving the performance of stand-alone GPS through integration of information from inertial navigation systems (INS), other satellites and barometric altimeter aiding, see D. Fuqua , L. Bishop, T. O'Brian and R. Lord (Dimensions International Inc.), 'A COTS system development approach to GPS/INS aiding', in ATC Systems, August 1996, Vol.2, No.2, at 28-29.

operational security[191].

The continuity and availability issues of the GNSS are *sine qua non* conditions for a transition from current CNS/ATM to GNSS based CNS/ATM. It seems that as much as technical issues (quality/availability) could easily be solved, the same is not true concerning the continuity issue. While it could be deemed acceptable to GNSS users to see a brief interruption of service due to things such as solar flares, or other uncontrollable and unforeseeable events (acts of GOD), the two exceptions attached to the US guarantee for signal continuity, namely the availability of funds and Article 89 of the Chicago Convention, are not acceptable.

The US' offer thus hinging on these two conditions, States may desire a greater level of certainty with respect to the continuous availability of the system than the US is offering. The best guarantee for these criteria would thus be an internationally constituted service provider who would not be constrained by any particular State budget and/or national security policy[192].

[191] LTEP/1-WP/4

[192] Whilst it has been argued that a mere shift from military to civilian control could provide sufficient guarantees to GNSS users, a question remains as to whether a civilian 'US provider' would not be under the obligation to interrupt the services should the US Government require so in case of national 'interest'.

IX) Cost Recovery

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[193].

The cost recovery precept and its reference to Article 15 of the Chicago Convention is not really appropriate in the GNSS context. Whilst Article 15 is mainly based upon an equity principle for charges of all air navigation facilities provided for public use within the jurisdiction of particular States, Article 15 is not well suited to apply to GNSS services. Indeed, the provision of GPS is free of charge for the next 10 years. Should the basic service provider (US) decide in future to impose charges it would only be then that the issue should be discussed[194].

Should the CNS/ATM services remain as they are at present, namely within individual States control and jurisdiction, Article 15 would apply as is. But the GNSS will require complementary systems/services such as basic GPS signal augmentation/enhancement, quality assurance, integrity monitoring and other services[195] contributing to a safe utilisation of the basic signal.

The difficulty for Article 15 to apply, lies in the fact that augmentation services are likely to be provided over determined regions and not over national jurisdiction as it is the case

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[193] LC/29-WP/3-2.

[194] 10 years in advance seems unreasonable to deal with the GPS charges bearing in mind that no one knows for sure what will the GPS status be in future(public-private).

[195] See part III. viii(continuity and quality of service).

at present[196]. It can be presumed that cost/efficiency policy will invite adjacent States to join their efforts in CNS/ATM and augmentation services provision and unite into regions.

The foreseeable difficulties engendered by the reliance upon Article 15 lie are that the GNSS related services will not be covering a definite national territories, and will further not solely be used by civil aviation.
Civil aviation being a insignificant proportion of all GNSS users, an equitable cost sharing of GNSS services among all users will be an uneasy task. It could further be suggested that while ICAO could certainly set up GNSS standards, the financial and cost recovery aspects could be taken care of by GNSS users.

ICAO could play an important role in the recovery of costs as it is doing in the joint financing agreements used for Iceland and Greenland[197]. While the air navigation facilities are jointly financed by the Contracting States Parties to the Joint Financing Agreements, and operated by Denmark and Iceland, the Secretary General is responsible for generally administering the arrangements: a section of the Secretariat makes the day-to-day estimates and assesses actual costs, evaluates requests for new capital expenditures or resources, prepares the assessment levels for Contracting Governments, determines the level of user charges and arranges for the handling of funds and payments to the provider States. It has been suggested that the similar arrangements could be applicable to GNSS, wherein the ICAO Council may, within the framework of Chapter XV of the Chicago Convention, agree to provide, maintain, and administer facilities related to GNSS[198]. The idea is interesting for it would safeguard closer international control and collective

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[196] An example of such regional service provision can be seen through the EUROCONTROL example. While EUROCONTROL provides European CNS/ATM services at present, it is in the phase of completing the EGNOS, see *Supra* note 56.

[197] See *Supra* note 68.

[198] LTEP/1-WP/4

decision-making with respect to charges, at least for those services provided by a multinational facility[199], but nevertheless it still does not reconciles the fact that civil aviation (as GNSS users) will assume the GNSS related costs for all GNSS users. A solution to such financial inequity could be the imposition of an utilisation license on all GNSS users.

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[199] Dr M. Milde *Supra* note 5, at 18.

X) Further Legal and Institutional Implications

In addition to ICAO's nine precepts, several other GNSS issues have been raised. This will now be discussed in a general way.

Liability issues

Today, countries control and accept liability for the radio navigation systems that aircraft use in their air space[200]. A question, legal in nature, arises as to which nation would assume financial responsibility if an aircraft accident occurred in a country that had no control over a stand-alone satellite navigation system and the system and the satellite performance were implicated.

Such legal question should not be a 'controversial' new issue. Airlines have been using the OMEGA system for more than 20 years without having anyone questioning the responsibility problem in case of incidents due to the fault of the system[201]. But it ought to be mentioned that malfunctioning, when it occurred, was imputable upon the receiver manufacturer and not upon the OMEGA system as such[202].
But the GNSS is not fully comparable to the OMEGA in that the last one is not configured for approach phases as the GNSS will. The use of GNSS will generally involve higher

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[200] B. Nordwall *Supra* note 159, at 57.

[201] O. Carel *Supra* note 155, at 159.

[202] Ibid.

risks[203]. While both the US and the Russian Federation Governments have offered their services free of charge for a determined period, both governments equally and expressly rejected the idea of any reference to responsibility or liability towards signal users[204]. Both signal providers have listed their duties/obligations in their respective offer made to ICAO. It is clear that the providers have no intention to add 'responsibility/liability' obligations to the list.

The liability issue has been qualified as difficult within ICAO discussion groups[205]. This is not surprising bearing in mind that the matter is not unrelated to the long-standing issue of liability of air traffic control agencies. Two remarks can be made at this point concerning ICAO's position on the GNSS liability issue. Firstly, it must be emphasised that ICAO recognises the liability as being of lesser importance than other considerations such as accessibility, reliability and continuity[206].
Secondly, ICAO (probably contemplating the complexity of liability issues) stated that the choice of rules to be contained within the legal framework would be ascertained only once the liability issues would have been determined.

It can be concluded that ICAO's position seems to be cautious in that in the fear of unnecessarily delaying the implementation process, the liability issue has been given less importance than more 'practical' issues related to the GNSS implementation. It can easily be anticipated that the choice of law rule within the legal framework will generate difficulties in reaching a consensus upon which regime (strict-limited-unlimited liability,

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[203] The GNSS and its various augmentations systems will permit Cat. I to Cat III approaches and reduces general flight separation (safety) channels. For more details, see K. Daly , 'Cat III GPS feasible, US will tell ICAO, in Flight International, March 1995, Vol.147, No.4458; 15-21, at 9.

[204] ICAO Doc. 9630-LC/189, p. 3-7 and 3-8, para. 3:38:7.2.

[205] ICAO Doc. LTEP/1-WP/4, at p. 5.

[206] Ibid.

who has the right to claims etc.) the rule will be based upon. Furthermore, States do not seem to have indicated any support for an international solution, or else it would appear in one of ICAO's precepts.

ATC/service providers' liability issue is no novelty. ATC/service providers were never prevented from operating while 'discussions on their liability' went on. Answers to liability issues were often brought empirically, by factual cases where several parameters (often not theoretically envisaged) had to be taken account of[207]. Why shouldn't the GNSS 'benefit' from the same treatment? GNSS related liability issues should be 'solved' only once the GNSS is fully implemented, and not before[208].

ICAO's efforts can surely be appreciated, but bearing in mind that ICAO never managed to provide any consistent answers to 'liability' issues regarding the current in-use systems, and that the GNSS system is certainly more complex than the current systems, a reasonable approach towards liability issues would be: to wait for cases and jurisprudence in the matter to develop, and from there seek to solve any responsibility problems by means of an international agreement should it be necessary and desired.

ICAO's potential contribution to the implementation of the GNSS

Generally ICAO can investigate and recommend which aids should be adopted and can set

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[207] By 'parameters' the author refers to all and every single facts and actors susceptible of influencing the outcome of an issue.

[208] Indeed, GNSS related Liability issues can only reasonably be addressed once the GNSS is fully implemented on a world-wide basis, and practical questions such as possible damages and type of claims, allocation of blame and liability in the chain of all GNSS service providers (varying from GPS signal provider, through augmentation providers to air traffic controllers, aircraft commander, etc.).

technical standards, but it possess no, or limited, operational or implementation powers[209]. Member States usually accept its recommendations, but the manner in which systems are implemented is left to individual States themselves.
ICAO has been, and still is certainly, a great contributor to a global modernisation of civil aviation, but it ought to be said that in the GNSS context ICAO's role is not as pertinent as it may have been in other contexts.

ICAO took the initiative to undertake a thorough study on technical and legal matters related to FANS (which was to become the GNSS). Once a potential system, namely the GNSS, was foreseen, ICAO continued with its studies, seeking to elaborate various forms of 'legal instruments', the goal of which was the implementation and regulation of the said system. The proposed instruments were in the form of:

- a Draft Agreement between ICAO and the [GNSS signal provider] regarding the provision of signals for GNSS services[210];
- a Checklist of Items for contracts with users on GNSS signal provision[211];
- a contract for GNSS signal provision with signal providers in a context of long-term GNSS[212];
- ICAO Council Resolution subsequently adopted as an International Convention[213].

The above list of ICAO's initiatives is not exhaustive, but contains the most important propositions.

Although ICAO's various proposals/studies are interesting, they are nonetheless lacking

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[209] W. F. Blanchard, 'Institutional requirements for a global navigation satellite system' in The Journal of Navigation, May 1995, Vol.48 No.2, at 249.

[210] LTEP/1-WP/3.

[211] Ibid.

[212] Ibid.

[213] Ibid.

the vital elements that could make them pertinent to the GNSS implementation.

ICAO has fostered considerations and legal instruments supposed to regulate a system which is not yet fully configured and were potential actors (services providers)are still to be determined.

Whatever scenario is 'chosen' regarding the GNSS' full implementation[214], it appears that at present no political consensus has been reached that could be used, as far as possible, as guidelines for an international legal instrument. Should such consensus be agreed upon, it is inevitable that it will not only have to bear in mind, but rather include, the US policy(especially in the context of responsibility/ liability).

ICAO's efforts also revealed that whilst actively working on the establishment of a legal instrument, ICAO should equally consider the power and limits of its mandate contained within the Chicago Convention[215].

Notwithstanding the potential co-operation and co-ordination role ICAO is likely to play in the GNSS global implementation, ICAO's effort to establish some form of legal instrument is premature given the existing level of technical and 'social'[216] development in the GNSS implementation.

GNSS presents a set of new problems not only for the engineer but also for the regulator and lawmaker. It is no criticism of the International Civil Aviation Organisation institution to point out that it is unable to deal with the control, operation and administration of Global Navigation Satellite Systems; it was never set up to do so[217].

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[214] The term 'chosen' does not accurately describe the GNSS implementation for it is clear, if not inevitable, that in the first phase, the GNSS will be 'GPS based'.

[215] The Draft Agreement between ICAO and the GNSS signal provider(s) prepared by the 29th Session of the ICAO Legal Committee was illegitimate for ICAO has no constitutional standing to enter into such agreement.

[216] The term 'Social development' in the present case refers to all inter-actions between actors participating in the provision of GNSS related services.

[217] W. F. Blanchard *Supra* note 210, at 249.

Conclusion

The author wishes to express the view that the purpose of the present work is not to criticise the International Civil Aviation Organisation institution as it may appear, or if so, all criticisms should be interpreted in a constructive manner.

In order to elaborate a constructive work on the legal implementation of the establishment of the GNSS, the author has based his analysis upon the efforts of the sole institution which has sought to thoroughly study and express a view on the subject matter.

The need for a new way of flying is indisputable. Modern civil aviation will only be able to reach its full potential once the way in which aircrafts are forced to fly is no longer a constraint. Modern aircrafts already rely on satellite technology on some routes. The GNSS technology exists and needs to be globally accepted and integrated into the system of each State. The market demand is clear; the GNSS is directly responding to the user's needs. The sooner the GNSS is fully implemented, the sooner will our civil aviation reach its promising potential.

The legal implications directly/indirectly linked to the implementation of the new system are numerous but not *per se* problematic. Whilst safety requirements ought to be regulated upon, whether through ICAO or in any other reliable form, it appears that the lack of

consensus among States indicates that all other matters, that could be qualified as less important, varying from the sovereignty to the liability issue, ought to be left aside for the time being. Further debates will be welcomed only if they are seeking to respond to practical difficulties encountered during or once the GNSS is fully implemented.

Whereas most discussions engendered by the GNSS were debated upon by States, it certainly could be said that the industry would like the implementation to be more expedient.

It is undeniable that States, in the GNSS implementation context, will have a different approach than civil aviation (the users) in general. The rationale behind civil aviation demands and expectations is purely practical in essence. General safety and cost efficiency are the basic motivation for a shift from current systems to the use and reliance of the GNSS. States on the other hand, while considering civil aviation needs for a shift to a GNSS technology, feel compelled in their decision-making to consider the GNSS implementation in light of their national policies (sovereignty protectionism).

At present it seems that civil aviation, including aircraft manufacturers, has decided to integrate the GPS in current flying. Not only is civil aviation increasingly relying upon GPS on certain routes, but furthermore it becomes difficult to purchase a new aircraft not being equipped with GPS as standard equipment.

The international community, or more accurately 'States' have a the choice of accepting what is readily available and to make the best use of it, or continue to block the implementation process waiting for an 'internationally' controlled alternative system to become available[218].

[218] Dr. M. Milde *Supra* note 5, at 24.

ICAO can certainly and actively participate in the inevitable GNSS implementation process. But ICAO's contribution to the GNSS implementation will only be beneficial, for the time being, if it acts through its co-operative and collaborative actions, as a catalyst and simultaneously refrains from enunciating 'solutions in search of problems'[219].

Any form of GNSS related legal regulations should only be undertaken once problems/conflicts related to the use of the GNSS are clearly identified and further, when there is a real political consensus to legislate upon such problems.

[219] Ibid.

Annexes

Annexe I

Technical configuration of GPS

The GPS consists of 24 satellites in 6 circular, orbital planes going around the earth at 20.200 kilometre altitude, approximately every 12 hours. The spacing of the satellites is such that at least 5 satellites will be visible to a user at any time, any place in the world. The satellites transmit two separate navigation signals that are digitally modulated with a pseudo random code.

These two signals provide two different levels of navigation accuracy. The standard positioning service provided by GPS consists of the Coarse Acquisition(C/A) coded navigation data message and is available to anyone in the world that wishes to use it.

This standard service guarantees horizontal location accuracy of 100 meters. 95% of the time and 300 meters. 99% of the time. GPS system time transferred to users is within 100 nanoseconds of Co-ordinated Universal Time. The more precise navigation data message, P-code, is encrypted and reserved for military use.

Technical configuration of GLONASS

GLONASS is a constellation of 21 satellites plus 3 spares.

These satellites operate in an 11 hour and 15 minutes orbit on an altitude of 19.000 km.

The level of accuracy for GLONASS is similar to GPS operating in the C/A mode. The reception and decoding of the GLONASS broadcast information, to determine position and range, are similar to that for the GPS except each GLONASS satellite transmits on a unique frequency using the same pseudo noise code.

Operation of a Differential GPS (DGPS)

Basically, a differential GPS signal is a GPS signal enhanced(inaccuracy) by ground segment.

The DGPS increases the accuracy of GPS to levels appropriate for approaches and landings. The DGPS uses a stationary, ground based(thus not operational for flights such as transatlantic), reference GNSS receiver that is precisely and permanently surveyed.

As the reference, receiver collects GPS C/A Code transmissions, it dynamically computes and re-transmits the calculated error. Airborne receivers equipped with the DGPS capability, receive and subtract this error from their independently derived position solutions. Dynamic accuracy in the order of centimetres is obtainable.

ANNEXE II

U.S. Department of Transportation
Federal Aviation Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 14 1994

Dr. Assad Kotaite
President of the Council
International Civil Aviation Organization
1000 Sherbrooke Street West
Montreal, Quebec, Canada H3A 2R2

Dear Dr. Kotaite:

This letter supersedes my letter of April 14, 1994.

I would like to commend, on behalf of the United States, the Committees on Future Air Navigation Systems (FANS) of the International Civil Aviation Organization (ICAO) for pioneering progress in the development of global statellite navigation for civil aviation. I note in this regard that the ICAO Council, on December 11, 1991, requested the Secretary General of ICAO to initiate an agreement between ICAO and Global Navigation Satellite System (GNSS) provider states concerning the duration and quality of the future GNSS.

I would like to take this opportunity to reiterate my Government's offer of the Standard Positioning Service (SPS) of the United States Global Positioning System (GPS) for use by the international community. As the United States made clear at the ICAO Tenth Air Navigation Conference and the 29th ICAO Assembly, the United States intends, subject to the availability of funds as required by United States law, to make GPS-SPS available for the foreseeable future, on a continuous, worldwide basis and free of direct user fees. This offer satisfies ICAO requirements for minimum duration of service (10 years) and freedom from direct charges. This service, which will be available as provided in the United States Government's technical sections of the Federal Radio Navigation Plan on a nondiscriminatory basis to all users of civil aviation, will provide horizontal accuracies of 100 meters (95 percent probability) and 300 meters (99.99 percent probability). The United States shall take all necessary measures to maintain the integrity and reliability of the service and expects that it will be able to provide at least 6 years notice prior to termination of GPS operations or elimination of the GPS-SPS.

The GPS/SPS is a candidate component of the future GNSS as envisioned by FANS. The United States believes that making the GPS available to the international community will enable states to develop a more complete understanding of this valuable technology as a component of the GNSS. The availability of GPS-SPS, of course, 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 the coming years, the international community must decide how to implement an international civil global navigation system based on satellite technology. The United States pledges its full cooperation in that endeavor and in working with ICAO to establish appropriate standards and recommended practices (SARP) in accordance with Article 37 of the Convention on International Civil Aviation (Chicago Convention). Consistent with this goal, the United States expects that SARP's developed by ICAO will be compatible with GPS operations and vice versa and that states will be free to augment GPS-SPS in accordance with appropriate SARP's. The United States will also undertake a continuing exchange of information with ICAO regarding the operation of the GPS to assist the ICAO Council in carrying out its responsibilities under the Chicago Convention.

I would be grateful if you could confirm that International Civil Aviation Organization is satisfied with the foregoing, which I submit in lieu of an agreement. In that event this letter and your reply will comprise mutual understandings regarding the Global Positioning System between the Government of the United States of America and the International Civil Aviation Organization.

Sincerely,

David R. Hinson
Administrator

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE
ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL
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THE PRESIDENT OF THE COUNCIL

Ref.: LE 4/49.1
(F.LEB0513)

27 October 1994

Sir,

I have the honour to acknowledge receipt of your letter dated 14 October 1994 which supersedes your letter of 14 April 1994.

The letter of 14 October 1994 reads as follows:

" I would like to commend, on behalf of the United States, the Committees on Future Air Navigation Systems (FANS) of the International Civil Aviation Organization (ICAO) for pioneering progress in the development of global satellite navigation for civil aviation. I note in this regard that the ICAO Council, on December 11, 1991, requested the Secretary General of ICAO to initiate an agreement between ICAO and Global Navigation Satellite System (GNSS) provider states concerning the duration and quality of the future GNSS.

I would like to take this opportunity to reiterate my Government's offer of the Standard Positioning Service (SPS) of the United States Global Positioning System (GPS) for use by the international community. As the United States made clear at the ICAO Tenth Air Navigation Conference and the 29th ICAO Assembly, the United States intends, subject to the availability of funds as required by United States law, to make GPS-SPS

.../

Mr. David Hinson
Administrator, Federal
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available for the foreseeable future, on a continuous, worldwide basis and free of direct user fees. This offer satisfies ICAO requirements for minimum duration of service (10 years) and freedom from direct charges. This service, which will be available as provided in the United States Government's technical sections of the Federal Radio Navigation Plan on a nondiscriminatory basis to all users of civil aviation, will provide horizontal accuracies of 100 meters (95 percent probability) and 300 meters (99.99 percent probability). The United States shall take all necessary measures to maintain the integrity and reliability of the service and expects that it will be able to provide at least 6 years notice prior to termination of GPS operations or elimination of the GPS-SPS.

The GPS-SPS is a candidate component of the future GNSS as envisioned by FANS. The United States believes that making the GPS available to the international community will enable states to develop a more complete understanding of this valuable technology as a component of the GNSS. The availability of GPS-SPS, of course, 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 the coming years, the international community must decide how to implement an international civil global navigation system based on satellite technology. The United States pledges its full cooperation in that endeavor and in working with ICAO to establish appropriate standards and recommended practices (SARP) in accordance with Article 37 of the Convention on International Civil Aviation (Chicago Convention). Consistent with this goal, the United States expects that SARP's developed by ICAO will be compatible with GPS operations and vice versa and that states will be free to augment GPS-SPS in accordance with appropriate SARP's. The United States will also undertake a continuing exchange of information with ICAO regarding the operation of the GPS to assist the ICAO Council in carrying out its responsibilities under the Chicago Convention.

I would be grateful if you could confirm that International Civil Aviation Organization is satisfied with the foregoing, which I submit in lieu of an agreement. In that event this letter and your reply will comprise mutual understandings regarding the Global Positioning System between the Government of the United States of America and the International Civil Aviation Organization. "

At the 12th Meeting of its 143rd Session on 26 October 1994, the Council of ICAO considered the offer contained in your letter, and I am pleased to inform you that the arrangements outlined in the offer are acceptable to the International Civil Aviation Organization. This offer will be communicated to all ICAO Contracting States.

Accept, Sir, the assurances of my highest consideration.

Assad Kotaite

MINISTRY OF TRANSPORT
OF THE RUSSIAN FEDERATION

Moscow, 4 June 1996

Sir,

This letter supersedes my letter of 5 February 1996.

The introduction of satellite technologies into world civil aviation operations marks a new stage in the practical implementation of the future CNS/ATM concept developed by the International Civil Aviation Organization (ICAO). On behalf of the Russian Federation, I would like to congratulate ICAO on its great achievements in planning for the future air navigation system and express my hopes for its successful implementation in practice.

One of the most important parts of the future air navigation system is the global navigation satellite system (GNSS). At the Tenth ICAO Air Navigation Conference in 1991, the Government of the USSR offered the world aviation community free use of the GLONASS global satellite navigation system. It was guaranteed that the system would operate for at least 15 years from the time of its full deployment in 1995.

The Russian Federation has now completed the full deployment of the space constellation and ground control system for GLONASS, and the GLONASS system is operational, providing the intended aircraft position determination performance.

Using the powers conferred on me, I would like to confirm, on behalf of the Government of the Russian Federation, the proposal made at the Tenth Air Navigation Conference concerning the provision of a standard-accuracy GLONASS channel to the world aviation community on a non-discriminatory basis for a period of at least 15 years with no direct charges collected from users, subject to the allocation of resources, as required under the legislation of the Russian Federation. This channel will be accessible to all civil aviation users and will provide position information with an accuracy of up to 60 metres in the horizontal plane (with a probability of 0.997) and up to 75 metres in the vertical plane (with a probability of 0.997). It is not intended that any methods will be used to degrade accuracy.

The Russian Federation will take all necessary measures to maintain the integrity and reliability of the service and expects that it will be able to provide at least 6 years' notice prior to termination of services.

To ensure GNSS use by world civil aviation, the Russian Federation is prepared to co-operate in every way with ICAO in preparing appropriate GNSS Standards and Recommended Practices (SARPs) in accordance with the provisions of Article 37 of the Chicago Convention, and also to keep ICAO constantly informed of the operational status of the GLONASS system.

The Russian Federation hopes that the SARPs developed by ICAO will be compatible with GLONASS system characteristics and, conversely, that the various States will be free to introduce the augmentations which they require to increase the effectiveness of GLONASS use, in accordance with the ICAO SARPs.

The Russian Federation will also undertake a continuing exchange of information with ICAO regarding the operation of GLONASS to assist the ICAO Council in carrying out its responsibilities under the Chicago Convention.

The provision of the GLONASS system to the world aviation community is not intended in any way to limit the right of any State to control aircraft operations and enforce flight safety regulations in its sovereign airspace.

Since ICAO is to act as the international co-ordinating body for the global implementation of the future air navigation system, we are prepared to conclude an agreement with ICAO for the use of the GLONASS system by the world aviation community as an element of the GNSS with the above-mentioned characteristics.

I would be grateful if you would confirm that the International Civil Aviation Organization is satisfied with the positions set out above. If that is the case, this letter and your reply will constitute a mutual agreement between the Government of the Russian Federation and the International Civil Aviation Organization concerning the GLONASS satellite navigation system.

Yours truly,

N. P. Tsakh
Minister of Transport

Dr. Assad Kotaite
President of the Council of ICAO
Montreal

Ref.: LE 4/49.1

29 July 1996

Sir,

I have the honour to acknowledge receipt of your letter dated 4 June 1996 which supersedes your letter of 5 February 1996.

The letter of 4 June 1996 reads as follows:

" This letter supersedes my letter of 5 February 1996.

The introduction of satellite technologies into world civil aviation operations marks a new stage in the practical implementation of the future CNS/ATM concept developed by the International Civil Aviation Organization (ICAO). On behalf of the Russian Federation, I would like to congratulate ICAO on its great achievements in planning for the future air navigation system and express my hopes for its successful implementation in practice.

One of the most important parts of the future air navigation system is the global navigation satellite system (GNSS). At the Tenth ICAO Air Navigation Conference in 1991, the Government of the USSR offered the world aviation community free use of the GLONASS global satellite navigation system. It was guaranteed that the system would operate for at least 15 years from the time of its full deployment in 1995.

The Russian Federation has now completed the full deployment of the space constellation and ground control system for GLONASS, and the GLONASS system is operational, providing the intended aircraft position determination performance.

Using the powers conferred on me, I would like to confirm, on behalf of the Government of the Russian Federation, the proposal made at the Tenth Air Navigation Conference concerning the provision of a standard-accuracy GLONASS channel to the world aviation community on a non-discriminatory basis for a period of at least 15 years with no direct charges collected from users, subject to the allocation of resources, as required under the legislation of the Russian Federation. This channel will be accessible to all civil aviation users and will provide position information with an accuracy of up to 60 metres in the horizontal plane (with a probability of 0.997) and up to 75 metres in the vertical plane (with a probability of 0.997). It is not intended that any methods will be used to degrade accuracy.

Mr. N.P. Tsakh
Minister of Transport
Ministry of Transport
of the Russian Federation
Sadovaja Samotechnaja, 10
101438 Moscow GSP-4

The Russian Federation will take all necessary measures to maintain the integrity and reliability of the service and expects that it will be able to provide at least 6 years' notice prior to termination of services.

To ensure GNSS use by world civil aviation, the Russian Federation is prepared to co-operate in every way with ICAO in preparing appropriate GNSS Standards and Recommended Practices (SARPs) in accordance with the provisions of Article 37 of the Chicago Convention, and also to keep ICAO constantly informed of the operational status of the GLONASS system.

The Russian Federation hopes that the SARPs developed by ICAO will be compatible with GLONASS system characteristics and, conversely, that the various States will be free to introduce the augmentations which they require to increase the effectiveness of GLONASS use, in accordance with the ICAO SARPs.

The Russian Federation will also undertake a continuing exchange of information with ICAO regarding the operation of GLONASS to assist the ICAO Council in carrying out its responsibilities under the Chicago Convention.

The provision of the GLONASS system to the world aviation community is not intended in any way to limit the right of any State to control aircraft operations and enforce flight safety regulations in its sovereign airspace.

Since ICAO is to act as the international co-ordinating body for the global implementation of the future air navigation system, we are prepared to conclude an agreement with ICAO for the use of the GLONASS system by the world aviation community as an element of the GNSS with the above-mentioned characteristics.

I would be grateful if you would confirm that the International Civil Aviation Organization is satisfied with the positions set out above. If that is the case, this letter and your reply will constitute a mutual agreement between the Government of the Russian Federation and the International Civil Aviation Organization concerning the GLONASS satellite navigation system."

At the 15th Meeting of its 147th Session on 14 March 1996, the Council of ICAO had considered this matter and the terms on which the offer of the Russian Federation should be accepted. Based on the decision of the Council at that meeting, I am pleased to inform you that the arrangements set forth in the offer are acceptable to the International Civil Aviation Organization. Accordingly, I confirm that your letter dated 4 June 1996 and my present letter of acceptance constitute a mutual agreement between the Government of the Russian Federation and the International Civil Aviation Organization concerning the GLONASS satellite navigation system. Your offer as well as my present letter of acceptance, will be communicated to all ICAO Contracting States.

Accept, Sir, the assurances of my highest consideration.

Assad Kotaite

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