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Free Flight: The Future of Air Transportation Entering the Twenty-First Century

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FREE FLIGHT: THE FUTURE OF AIR TRANSPORTATION ENTERING THE TWENTY-FIRST CENTURY

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I. INTRODUCTION

TO THE UNINITIATED, "Free Flight" may merely sound like another airline pricing scheme. It is, however, actually a goal that envisions a complete overhaul of the national and international air transportation system. In essence, free flight would shake aviation free from shackles imposed by decades of increasingly earth-bound control over the airspace users—control that was made necessary by the terrestrial nature of the limited technology available at an earlier time.

Free flight recognizes that technological advancements in communication, navigation, and surveillance systems have occurred that enable vastly improved information availability to those involved in flight operations—including pilots, air traffic service providers, planners, dispatchers, and others. Free flight would return many of the decisions currently made by ground-based controllers to the aviation users themselves, transforming the nature of ground based personnel duties from Air Traffic Control (ATC) to Air Traffic Management (ATM). Impositions on the flexibility of the pilot would "only be necessary when (1) potential maneuvers may interfere with other aircraft operations, (2) traffic density at busy airports or in congested airspace precludes free flight operations, (3) unauthorized entry of a special use airspace is imminent or (4) safety of flight restrictions are considered necessary."[1]

The return of some responsibilities to pilots will, in turn, free the ground-based air traffic service providers from the routine separation chores that currently occupy a disproportionately large percentage of their time and allow them to focus on larger

[1] FINAL REPORT OF RTCA TASK FORCE 3: FREE FLIGHT IMPLEMENTATION 25 (RTCA, Inc. ed., 1995) [hereinafter TASK FORCE 3 REPORT].

scale traffic flow management. The result would be an increase in freedom, efficiency, economy, and safety.

The beneficiaries of free flight cut across the fabric of aviation. To the airlines, free flight represents efficiency advantages that result in significant savings of time and money. In a modest prelude to free flight, American Airlines has demonstrated savings of $2.2 million per year through the simple use of wind routes negotiated with the Federal Aviation Administration (FAA).[2] These savings just scratch the surface of the potential economic benefits of free flight. Currently, delays along an aircraft's journey from departure gate to arrival gate may amount to a cumulative cost to the industry of $3.5 billion per year.[3] Free flight has the potential to reduce these delays significantly, resulting in monumental cost savings to the airlines and their passengers.

Other factions of the aviation industry are also excited about the possible benefits of free flight. To general aviation users, free flight would enhance the flexibility and efficiency enjoyed in the current system and protect against future encroachment on that flexibility.[4] To the government and the maintainers of the air transportation infrastructure, free flight would represent significant cost savings by removing the need to maintain costly terrestrial-based Navigation Aids (navaids).[5] To the flying public free flight should present the probability of substantial safety

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[2] *Id.* at 92; *see also* Bruce D. Nordwall, *Road Map Leads FAA to "Free Flight"*, AVIATION WK. & SPACE TECH., Nov. 6, 1995, at 34 (also noting annual fuel savings estimated by Delta of $16.8 million based on freedom to optimize aircraft route, speed, and altitude).

[3] TASK FORCE 3 REPORT, *supra* note 1, at 25 (citing Air Transportation Association's (ATA) estimate of delays due to air traffic control inefficiencies). The cost savings for a change from the preferred instrument flight rule (IFR) route structure that was in existence in 1995 and the routes that users would optimally have taken amounted to $1.28 billion. *Id.* at 5 (citing National Aeronautics and Space Administration (NASA) study, G.J. COULURIS & S. DORSKY, ADVANCED AIR TRANSPORTATION TECHNOLOGIES (AATT) POTENTIAL BENEFITS ANALYSIS, NASA-AMES REPORT AATT-95-001 (Sept. 1995)).

[4] *See generally id.* app. F.

[5] *See id.* at 5 (noting "indirect benefits to the provider in view of shrinking government budgets, and the ability to supply more services with fewer resources"); *FAA Awards Contract to Develop and Install Satellite Navigation System*, U.S. Dep't of Transp. News Release, Aug. 3, 1995, *available in* WESTLAW, 1995 WL 459310 (noting eventual benefit to taxpayers from decommissioning ground-based navigation systems); Catherine Fahy, *MIT Tracks Planes with GPS-Squitter*, MASS. HIGH TECH., Dec. 18, 1995, at 1 (comparing cost of one ground radar station at $4 to $5 million with cost of comparable ground-based surveillance system that does not require radar at $50,000 to $100,000).

benefits, due to the "improved navigation capability, faster and more reliable communication and an improved approach to surveillance and separation."[6]

This Comment explores free flight. It begins by developing an understanding of the basic concept of free flight. Then, it reviews the recent technological advances that make the gradual transition to free flight possible. A discussion of the legal framework forming the boundaries of the transition to free flight follows, leading to a discussion of legal issues to determine what obstacles the law poses to the transition to free flight. Institutional issues are then explored since they play such a large role in the future of free flight.

II. FREE FLIGHT: THE ALPHA AND THE OMEGA OF AIR TRANSPORTATION

The concept of free flight is not easily defined and its ramifications are not easily understood. One way to understand the concept of free flight and its inherent advantages is to compare the movement of aircraft toward an airport to an attempt to move a room full of people out of a single door.[7] Imagine one person in the room, designated the "controller," who stands on a table. Everyone else represents aircraft trying to reach the airfield. Like the aircraft operating in today's airspace, those people are effectively unaware of others around them, so all of the

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It should be noted that the benefits of free flight may not be as significant in countries where there is less air traffic and less controlled airspace—some questions whether the benefits outweigh the costs in these countries. *See Australian Cites Pitfalls in Pushing New Technologies*, AVIATION WK. & SPACE TECH., Jan. 27, 1997, at 580 (noting that free flight may offer little benefit in Australia and suggesting that airspace modernization should be tailored to the needs of the individual country rather than being solved by one worldwide standard).

[6] Nordwall, *supra* note 2, at 34. While there is substantial support for the belief that free flight will enhance the safety of the National Airspace (NAS), a distinct minority are not convinced. *See, e.g.*, Alfonso Chardy, *Future of Air Travel May Ride on "Free Flight": Pilots to Determine Routes, Altitudes, Speeds*, MIAMI HERALD, Sept. 21, 1995, at A16 (quoting "serious safety concerns" of Andrew Cantwell, president of Miami chapter of National Air Traffic Controllers Association).

Further free flight is not a panacea to all aviation problems. David Hinson, the former Administrator of the FAA, points out that the biggest constraint to efficient aircraft movement through our national airspace may ultimately be the capacity of our airports. Hinson Says FAA Reform Within Reach, AVIATION DAILY, Jan. 23, 1997, at 127 (quoting David Hinson speaking to the Aero Club of Washington). The benefits of increased efficiency in aircraft travel between airports may be minimized if the takeoffs and landings are themselves gridlocked. *Id.*

[7] This analogy is used by Captain Bill Cotton, United Airlines Air Traffic and Flight Systems.

"aircraft" must close their eyes during the evolution. Only the controller can see everyone. He must then direct people out of the room, without allowing them to bump into each other or into a wall. Presumably he will pick out one individual and give him directions, such as: "Turn left and go forward three steps." While working with that one person, the others in the room would be unable to show any initiative to maneuver to maintain separation from each other, since they are effectively blinded to any other person's position.

This analogy shows just how good air traffic controllers are today, given the responsibilities imposed on them as sole keepers of all of the air traffic information under the limitations imposed by the current system. More importantly, however, it highlights just how imposing those limitations are. Under free flight, everyone in our mythical room could open their eyes. Pilots could then contribute to the safe and efficient movement towards the door by taking the first steps to avoid interference with each other. The controller, now that the aircraft are assuming some responsibility for their separation, is freed from devoting so much time to giving detailed, routine instructions. The controller can now focus not only on providing a redundant safety backup to the aircraft, but also on larger scale issues, such as the effect of one sector on other sectors. The result is increased efficiency, with no sacrifice in safety.

One organization involved in the planning necessary to implement free flight is RTCA, Inc.,[8] formerly known as the Radio Technical Commission for Aeronautics.[9] RTCA is a Federal Advisory Committee that "develops consensus based recommendations on contemporary aviation issues."[10] The FAA Administrator charged RTCA to "form a new task force, led by an appropriate representative from the civilian aviation community, to develop consensus regarding free flight implementation."[11] This RTCA Task Force released its final report in October 1995, including its recommendations to implement free flight.[12] RTCA defines free flight as follows:

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[8] RTCA, Inc. is a nonprofit corporation formed for the benefit of the public through the advancement of aviation. TASK FORCE 3 REPORT, *supra* note 1, at 16.

[9] Les Blattner, *Free Flight: The Possible Dream*, AIR LINE PILOT, Jan. 1996, at 33.

[10] TASK FORCE 3 REPORT, *supra* note 1, at foreword.

[11] *Id.* at 15. In addition to the cited *Task Force 3 Report*, a "white paper" was submitted to the FAA by a select committee chaired by L. Lane Speck, Director, FAA Air Traffic Rules and Procedures Service. *Id.*

[12] *See generally id.* (including 46 recommendations).

> [A] safe and efficient flight operating capability under instrument flight rules (IFR) in which the operators have the freedom to select their path and speed in real time. Air traffic restrictions are only imposed to ensure separation, to preclude exceeding airport capacity, to prevent unauthorized flight through Special Use Airspace (SUA), and to ensure safety of flight. Restrictions are limited in extent and duration to correct the identified problem. Any activity which removes restrictions represents a move toward free flight.[13]

Free flight consists of many subcomponents, each of which may spawn its own unique advantages and benefits to air transportation. The realization of the advantages of all these subcomponents taken to the full extent is a concept becoming known as "mature free flight."[14] Mature free flight may actually be a utopian ideal, unobtainable in its purest form. Practical free flight will always be constrained by some factors. Yet, the subcomponents share the common attribute of each being beneficial in its own right. Each will, to some extent, increase for the user, "the flexibility to fly where, when and how operating efficiency, safety and capacity dictate."[15] Each of these subcomponents contributes to what will be an "incremental evolution to 'Free Flight.'"[16] Together, they will have the synergistic effect of multiplying the efficiencies that each could independently bring to the flow of air traffic.

Mature free flight represents the ends of progress in three phases.[17] These three phases are in keeping with the approach to modernization emphasized by the International Civil Aviation Organization (ICAO), which has adopted the acronym of CNS/ATM—highlighting the transition of the three phases of communication, navigation, and surveillance (CNS), in conjunction with the accompanying transition to ATM.[18] Communications will move from the current emphasis on voice communication

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[13] *Id.* at 23.

[14] *See id.*

[15] *Id.* at 13.

[16] *Id.* at 8.

[17] As RTCA describes, "the triad of technology capabilities referred to as CNS—for communications, navigation and surveillance—provide a transition to a new air traffic management (ATM) system." *Id.* at 23. It should be noted that a fourth area will be necessary for the full implementation of free flight—advanced decision support equipment for dealing with air traffic. *Id.* at 2.

[18] *See* Vladimir D. Zubkov, Introduction of CNS/ATM—Global Perspective (An ICAO View) (Nov. 16, 1995) (unpublished outline of presentation, on file with the author).

to the use of data link as the primary means.[19] The navigation will shift from reliance on ground-based navigation aids, such as very high frequency omnidirectional ranges (VOR), standard distance measuring equipment (DME), and instrument landing systems (ILS), to the use of the space-based Global Navigation Satellite System (GNSS).[20] The surveillance aspect will shift from the current dependance on terrestrial radar to an Automatic Dependent Surveillance System (ADS).[21] The accompanying concept of ATM is typified by the belief that "[o]nly under circumstances of severe capacity limitations or to prevent separation violations would ATM intervene with the aircraft's flight."[22]

Before examining the legal issues involved, it is important to understand the recent and ongoing technological changes that will enable the transition to free flight. We will start with a discussion of the limitations from which these technologies will free us.

A. The Old Way

The current air transportation system is easily saturated with air traffic at numerous choke-points. The resulting delays ripple through the system. These delays result from deficiencies in each phase of CNS. Our existing system has been described as a "rather rigid and largely procedural, analog, and ground-based system comprising HF/VHF-voice communications, terrestrial-based navigation systems, radar surveillance, and limited air traffic decision support."[23] We will examine the limitations imposed by each of these technological areas.

1. *Communication: VHF/HF*[24]

In looking first at the existing technology of the communication phase, we see that the current airspace system is served primarily by two-way voice communications. In today's system, each sequential step of an IFR operation, from the taxi instructions out of the gate at the departure airport, to the clearance to

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19 Task Force 3 Report, *supra* note 1, at 12.

20 *Id.*

21 *Id.*

22 *Id.* at 13.

23 *Id.* at 2.

24 *See generally* Federal Aviation Regulations and Aeronautical Information Manual ch. 4, § 2 (ASA 1996) [hereinafter AIM] (discussing communication system currently in use for pilot-controller radio communication phraseology and techniques).

taxi to the gate at the destination airport, requires a clearance. Virtually all of these clearances are given via two-way radio communication between an air traffic controller and a pilot. These communications take place predominantly on a very high frequency (VHF) radio over domestic portions of routes, and on high frequency (HF) radio for oceanic portions or where line-of-sight communication is not feasible.

This current reliance on voice communication for practically all exchanges of information imposes serious limitations on the system. First, limitations are imposed by the difficulties inherent in the time-consuming process of two-way voice communication via radio.[25] This time-consuming process increases the workload on controllers, limiting the number of aircraft that a controller may handle at a given time. Inefficient time lags in the ability of pilots to maneuver when weather or other factors suggest alterations of flight paths are also imposed by this process.

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[25] Consider the difficulties that may occur with even a simple clearance to change an aircraft's altitude. First, the controller must contact the aircraft and issue the new altitude. Hopefully, the pilot picked out this one important communication from among the continuous stream of communications between the controller and all the other aircraft on the frequency. If not, a time-consuming pause follows, which is then followed by a renewed communication attempt by the controller in a tone of voice intended to draw the attention of the appropriate aircraft. Assuming the aircraft now hears the clearance, he will repeat it back. Hopefully, what he repeats back will be what the controller intended the aircraft to hear. If not, and if the controller hears the pilot's erroneous readback, the process must be repeated in an attempt to ensure that the proper altitude was spoken and heard. Eventually, the pilot will repeat back the correct altitude, which confirms that both the pilot and the controller are aware of the aircraft's clearance. Of course, this process assumes that another aircraft, perhaps one that just checked on the frequency, did not attempt to make his obligatory initial radio call to the controller when he perceived a pause in the conversation. Occasionally, that call is made at the same time as one of the calls between the controller and the aircraft that is given the altitude change. In that case, the two simultaneous users of the frequency are oblivious to each other's concurrent use of the system. Of course, everyone else on the frequency is aware of the situation since an attempt by two people to communicate simultaneously on the radio frequency results in a loud squeal or buzzing rather than a human voice. Generally, one of these independent aircraft will be the first to figure out what happened and will announce on the now quiet radio frequency (since all the parties who were talking are now waiting for a response): "Blocked!" The process will begin again from scratch, with neither the controller's attempt at issuing a clearance nor the newly arrived aircraft's attempt to check on having been successful. These difficulties are daily occurrences that result even when professional controllers and professional pilots attempt to use the system of two-way voice communication necessary in the current system.

Additionally, VHF communications are limited to line-of-sight. While this may not impose a limit in the domestic airspace, where the controller work load is likely to be limited by the number of aircraft one controller can effectively communicate with, this line-of-sight limitation may be a factor as aircraft transition to overwater navigation.

One further limitation imposed by voice communications is the language difficulties that often arise in the world of international aviation.[26] Although English is the international language of aviation, dialects and accents make reliance on the vocalization of the language all the more difficult. In addition to the obvious safety problems potentially raised by these communication barriers,[27] these problems only add to the quantity of transmissions on the already overloaded voice channels.[28]

2. Navigation: Ground-Based Navaids

To an even greater extent than with communications, the current navaids impose severe limitations on our use of the airspace. Currently, most air transportation routes are based on a system of ground-based navigation equipment.[29] As a result, the primary routes followed by aircraft are similar to the roads driven by cars in that they often take circuitous paths. In the context of automobiles, this circuitous path is the natural result of obstacles imposed by either physical or economic constraints. Aviation routes are not similarly constrained and lend themselves naturally to the most direct route possible. Unfortunately, the dependence on an earth-based system of navaids to form the

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26 Michael Skapinker, *This Way for Fine Weather: Satellite Technology Will Soon Transform Aircraft Navigation*, FIN. TIMES, July 7, 1995, at 22.

27 Experts conjecture that language difficulties, caused by the reliance on voice communications, were involved in the recent crash of American Airlines Flight 965 near Cali, Columbia. *See* John Ritter, *Cleared for Disaster; Poor Fluency in English Means Mixed Signals*, USA TODAY, Jan. 18, 1996, at 1A (also citing at least three other accidents where improper terminology and language problems have been cited as possible contributory factors).

28 *Cf.* Skapinker, *supra* note 26, at 22 (noting the general problem with overloaded voice channels).

29 *See generally* AIM, *supra* note 24, at ch. 1 (discussing navigation aids). The primary navaids used for defining routes are VHF omnidirectional ranges (VORs) and nondirectional radio beacons (NDBs). *Id.* It should be noted that inertials, loran, OMEGA, and other methods provide fixing information that is global in nature (latitudes and longitudes). Most route structures over land, however, are not predicated on their use, and the routes continue to be driven by earth-bound navaids.

beginning and ends of these routes has led to a route structure that is often anything but direct.

3. *Surveillance: Radar*

The current means of surveillance relies heavily on ground-based radar to determine what an aircraft is doing, imposing further limitations on the system. First, the information is presented only to the controller. The aircraft and its pilots are unaware of any radar contacts indicating other aircraft in their vicinity. As noted earlier, this limitation was at the heart of the transition from aircraft self-control to vesting responsibility for separation of aircraft in the ground-based controller.

Second, radar provides only limited information, even to the controller. For instance, given radar information alone, the controller is aware only of instantaneous position. Unenhanced radar does not show the aircraft's altitude, the pilot's current intentions, or the pilot's desires. The current system imposes the need for the controller to use other means to become aware of factors that allow for future planning. Primarily, controllers rely on the clearance previously issued to the aircraft. Pilots may not normally deviate from that clearance without going through the process of getting an amended clearance.[30] Of course, in the dynamic world of aviation, weather and other unforeseen factors routinely create a desire to deviate from that previous clearance for safety and efficiency reasons. Two-way voice communications are necessary to determine and relay the current intentions and desires of the pilots to the controller in hopes of getting approval for deviation from the clearance. Surveillance limitations, therefore, impose further burdens on communications, which are themselves the cause of limitations to the system.[31]

In sum, this arcane means of aircraft surveillance using radar to the virtual exclusion of all other means, constrains the aircraft to controller-issued clearances and precludes deviation from those clearances absent two-way voice communication. These limitations stem from the fact that pilots, under the current system, are blindly unaware of the specifics of any other

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[30] *Id.* para. 4-4-9.a ("When air traffic clearance has been obtained under either Visual or Instrument Flight Rules, the pilot-in-command of the aircraft shall not deviate from the provisions thereof unless an amended clearance is obtained.").

[31] *See supra* notes 23-27 and accompanying text.

aircraft in their vicinity and are forced to abdicate their share of the responsibility for aircraft separation.[32]

The weakness of the current surveillance system is evident, and some refinements have already been incorporated. Most important is the transponder, used to "increase the capability of radar."[33] The transponder is aboard the aircraft and enhances the use of radar by increasing the chances of an aircraft being seen by radar[34] and by passing aircraft altitude information to the controller.[35] Hence, the transponder increases the surveillance information supplied to the controller. It does not, however, provide any useful information to the pilot. The lack of information to the pilot remains a serious limitation under our present system.

B. Technological Advances

Essential to understanding the legal implications of free flight is an understanding of the technology that led to its possibility. Each of these advances may independently contribute to the evolution toward free flight. At the forefront of the technology that enables transition to free flight are improvements in navigation made possible by satellite navigation.

1. *Navigation: The Global Navigation Satellite System*

Several governments, recognizing the value of a satellite-based, global navigation system, are attempting to create global navigation signals. The major U.S. contribution is the Global Positioning System (GPS).[36] To understand the nature of satellite navigation, we will examine the details of U.S. GPS technology.

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[32] Despite its limitations, radar admittedly offers an important advantage since it is capable of operating independently of any aircraft systems. This advantage will justify the continued use of radar even after the transition to free flight since its independent nature provides data that will amplify other information and simultaneously provide a redundant backup.

[33] AIM, *supra* note 24, para. 4-1-19.a.1.

[34] *Id.*

[35] *Id.* para. 4-1-19.c.

[36] The Russian counterpart to GPS is Glonass. *Glonass Nears Full Operation*, Aviation Wk. & Space Tech., Oct. 9, 1995, at 52. Glonass offers the advantage over GPS of not having the selective availability used by the U.S. system to degrade its performance. *Id.* As a result, it offers increased accuracy when both are unaugmented. *Id.* The Europeans have also indicated a desire to provide satellite signals for navigation use. *Id.* Technologically, these systems operate similarly. *Id.*

GPS receivers supply users with an accurate three-dimensional position.[37] GPS is based on the signals generated by a twenty-four satellite constellation of transmitters[38] orbiting at an altitude of 10,900 nautical miles (NM).[39] The constellation is arranged so that the signals from five satellites may be received from any point on earth at any given time.[40]

The GPS receivers aboard aircraft use accurate internal clocks to measure the time varying signals received from the selected satellites.[41] By comparing the incoming signal to a stored copy of the code, a receiver can derive the time delay between the transmission of the signal by the satellite and the receipt by the GPS receiver.[42] The GPS receiver calculates the time difference to determine a pseudo-range from the satellite.[43] The GPS receiver then takes the pseudo-ranges from three satellites and combines them with information from each of the satellites' known positions.[44] Use of this information from the three satellites,[45] processed through triangulation,[46] allows the GPS receiver to determine an accurate position. Unlike normal navaids, the position provided by GPS is a three-dimensional position, providing altitude as well as latitude and longitude.

The system's accuracy may be varied by the service provider—the Department of Defense (DOD). The precise positioning service (PPS) provides the most accurate position, but its use is limited to "authorized U.S. and allied military, federal government, and civil users who can satisfy specific U.S. require-

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[37] AIM, *supra* note 24, para. 1-1-22.a.

[38] U.S. DEP'T OF DEFENSE & U.S. DEP'T OF TRANSP., 1994 FEDERAL RADIONAVIGATION PLAN 3-30 to 31 [hereinafter FRP]. The Federal Radionavigation Plan is "[t]he official source of radionavigation policy and planning for the Federal Government." *Id.* at xiii.

[39] *Id.* at A-34.

[40] AIM, *supra* note 24, para. 1-1-22.a.7.

[41] *Id.* para. 1-1-22.a.3.

[42] *Id.* para. 1-1-22.a.4.

[43] *Id.*

[44] *Id.* The satellite's known position is one of the pieces of information broadcast by the satellite. *Id.*

[45] These three required satellites, along with a fourth for timing corrections, constitutes the minimum satellites a GPS receiver must have to generate its three-dimensional position. *Id.* para. 1-1-22.a.8. More than four satellites may be necessary to verify the integrity of the signals or to isolate corrupt signals. *Id.*

[46] In some ways, nothing is new. Triangulation is essentially the same method of fixing that has always been used with celestial bodies. Andrew Rozmiarek, *Global Positioning System: The New North Star*, WIRED, Oct. 1995, at 72. However, the decimal points of the resulting position have moved a few places.

ments."[47] The standard positioning service (SPS), which is less accurate than PPS, provides a horizontal accuracy of 100 meters with a 95% probability and an accuracy of 300 meters with a 99.99% probability.[48] While the PPS's use is limited, the SPS is available to "all users on a continuous worldwide basis, for the foreseeable future, free of any direct user charge."[49] Unfortunately, the accuracy of the SPS is not sufficient for certain applications.[50] Fortunately, SPS inaccuracies may be minimized by additional technology that provides augmentation of the GPS signal.

The basic methods for augmenting GPS accuracy are referred to as "survey GPS" and "differential GPS" (DGPS).[51] Of most concern to aviation is the differential GPS system. Under that system, a land-based receiver station uses its precise known position to determine the error in each satellite's data and then passes that information on to any other receivers in the area.[52]

The differential system being touted by the FAA to provide improved accuracy nationally is the wide area augmentation system (WAAS).[53] As envisioned, WAAS would supply thirty-five ground stations across the U.S.[54] to provide the differential corrections necessary to allow for Category (CAT) I precision ap-

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47 AIM, *supra* note 24, para. 1-1-22.a.2. The accuracy of the military's uncorrupted signal may be as accurate as three meters. Rozmiarek, *supra* note 46, at 72.

48 AIM, *supra* note 24, para. 1-1-22.a.2.

49 FRP, *supra* note 38, at 1-10.

50 In addition to the deliberately increased inaccuracy inherent in SPS, there may be additional minor errors in the accuracy of the system due to several sources. These sources include "an ionospheric delay, and time disparities between the atomic clocks in the satellites and the GPS receiver." AIM, *supra* note 24, para. 1-1-22.a.4. In addition to the required three satellites for resolution of the receiver's position, measurements from a fourth satellite are used to factor out time errors induced by the inaccuracies of the quartz clocks in the receivers. Rozmiarek, *supra* note 46, at 72.

51 "Survey GPS" results in millimeter accuracy by using the doppler shift resulting from the raw data from the satellite. Rozmiarek, *supra* note 46, at 72. Along with an increase in accuracy, however, comes a slow down in the real time response due to the increased number of computations. *Id.* As a result, it is less practical than differential GPS augmentation for use in aviation.

52 *Id.*

53 *News Breaks*, AVIATION WK. & SPACE TECH., Aug. 7, 1995, at 17. The Department of Transportation and the FAA recently announced the awarding of the WAAS contract to an industry team led by Wilcox Electric, in partnership with Hughes Aircraft and TRW. *FAA Awards Contract to Develop and Install Satellite Navigation System*, *supra* note 5.

54 *News Breaks*, *supra* note 53, at 17.

proaches based on the improved accuracy.[55] Additionally, local area augmentation systems (LAAS)[56] may be used to improve further the accuracy and integrity of the signal necessary for CAT III landings.[57]

Currently, the FAA has approved the use of GPS as a primary means of navigation for all U.S. civil operators "in oceanic airspace and certain remote areas."[58] GPS may also be supplementally used for IFR navigation for domestic en route segments, for terminal operations, and for certain instrument approach procedures (IAPs).[59] This is part of an ongoing program by the FAA integrating the use of GPS within the National Air System (NAS).[60]

2. *Communication: Data Link and Satellite*

Just as in the navigation realm, the technology for communications between the aircraft and the ground has progressed to a point that allows fundamental changes in the nature of communication. Methods for communicating information between ground and aircraft are midway through an evolution that will vastly enhance the efficient communication of vital information. Instead of relying on the sole use of two-way voice communication, the system will move towards an increased reliance on the

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55 Marc E. Cook, *On the Satellite Express*, AOPA PILOT, Dec. 1995, at 87.

56 Also referred to as local area differential (GPS/LADGPS). *See generally* FRP, *supra* note 38, at D-7.

57 Victor Wullschleger, *FAA Demonstrates GPS Category III Landing Is Feasible*, SATNAV NEWS, Dec. 1995, at 2. The initial flight testing of a GPS autoland to CAT III standards involved a NASA Boeing 757 and took place July 19, 1995. *NASA Flies First Cat III GPS Autoland*, AIR LINE PILOT, Nov.-Dec. 1995, at 55. Testing by Daimler-Benz has also indicated the potential for CAT III approaches that would provide continuous information even if the GPS failed for up to 30 seconds by combining the signal with an inertial navigation system signal. *Researchers Test D-GPS Approaches*, AVIATION WK. & SPACE TECH., Oct. 9, 1995, at 57.

58 AIM, *supra* note 24, para. 1-1-22.a.9.

59 *Id.*

60 *See* FEDERAL AVIATION ADMIN., U.S. DEP'T OF TRANSP., GPS IMPLEMENTATION PLAN FOR AIR NAVIGATION AND LANDING 1 (1994) [hereinafter GPS IMPLEMENTATION PLAN]. For instance, GPS is being phased in for use in instrument approaches under IFR conditions through a three phase program. AIM, *supra* note 24, para. 1-1-22.d. Phase I requires active monitoring of the ground-based navigation aid, Phase II requires that the ground based navigation aid be installed, but not necessarily turned on, and Phase III (the approach is retitled as a "GPS" approach) imposes no need for any ground-based navigation aids to be turned on or even installed. *Id.* These three phases are also referred to as the "multisensor" phase, the "supplemental" phase, and the "primary" phase. GPS IMPLEMENTATION PLAN, *supra*, at 1.

data linking of digital information between those on the ground and those in the aircraft for the transmission of routine information.

The rudimentary beginnings of this transition are already in place. Currently, the Aircraft Communications Addressing and Reporting System (ACARS) is a data link system being used to provide some pre-departure clearances and oceanic clearances.[61] ACARS faces further development to allow for the exchange of other information, such as automated terminal information system (ATIS) messages, issuance of taxi clearances, frequency changes, and hazardous weather information.[62]

Another cutting edge technology that may further evolve to incorporate new communications technologies is the Flight Management System (FMS). Aircraft currently entering the air transportation industry already incorporate FMS for increased navigation capability.[63] They may be further "expanded to include two-way data link (TWDL) and automatic dependent surveillance (ADS) capability."[64]

Ultimately, data link is envisioned as being the primary link between those involved in ATM.[65] "Nonroutine communications" would still use voice communications,[66] but an ADS-broadcast (ADS-B) could be used for broadcasting the bulk of the routine aircraft information. For instance, the broadcast ADS-B information would include "identification, time, position, velocity and other time sensitive surveillance information," as well as information about the aircraft's short-term intentions.[67] Additionally, the aircraft would receive the same information "from proximate aircraft."[68]

Further advances in communication may be available through the assistance of satellite links. Satellite data links are currently being used to provide some communication in remote areas where line-of-sight VHF radio and radar are unavailable.[69] As

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61 TASK FORCE 3 REPORT, *supra* note 1, at 99.

62 *Id.*

63 *Id.* at 98; *see, e.g.*, *Boeing Announces Selection of Smiths Industries Flight Management Computed Systems*, CNS OUTLOOK, Sept. 6, 1995 (noting use of flight management computer system incorporating GPS for use in Boeing 737-700 and 737-800 series).

64 TASK FORCE 3 REPORT, *supra* note 1, at 98.

65 *Id.* at 99.

66 *Id.* at 99-100.

67 *Id.* at 109.

68 *Id.*

69 *Id.*

the demand for such equipment grows, aircraft manufacturers are expanding the usefulness of satellite voice and data communication (SATCOM) equipment to meet the new demands.[70]

Fortunately, there may be some coherence in the development of future communication systems. Much of the communications technology may be guided by a cooperative agreement resulting from the collaboration of the FAA with eleven airlines who have formed an entity known as ATN Systems, Inc.[71] Through that group, the FAA will use a "consensus oriented process to develop system requirements" rather than depending on the normal FAA acquisition process.[72] The end result will be the Aeronautical Telecommunications Network (ATN), which will utilize the "worldwide standard for aviation communication."[73]

3. *Surveillance Systems: ADS*

As in the navigation and communication regime, the technology that will allow free flight is already being implemented to provide surveillance enhancements. Already in place, the Traffic Alert and Collision Avoidance System (TCAS) is an example of the advantages of providing information to pilots regarding other aircraft in their vicinity.[74] TCAS processes the information and displays it to the pilot. Additionally, if TCAS detects the potential for conflict, it may provide a resolution advisory (RA) that indicates the vertical maneuver that would best avoid a conflict.[75] TCAS, thus, is a model for showing that providing information to the airspace users and allowing them a greater role in flight path planning may contribute to both the efficiency and the safety of aircraft operations.

The surveillance system of the future will expand on this concept. Information broadcast by ADS-B will be provided to

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[70] *See, e.g., News Briefs; McDonnell Douglas [MD] and United Airlines [UAL1] Plan this Month to Begin Testing the Cockpit Weather Information Needs (CWIN) System,* AIR SAFETY WK., Sept. 4, 1995, at 7 (noting testing of cockpit weather information needs CWIN system for United Airlines).

[71] *Industry Perspective of FAA R&D Programs: Hearings Before the Subcomm. on Technology of the House Comm. on Science,* 104th Cong., 1st Sess. (1995) (statement of J. Roger Fleming, Senior Vice President, Operations and Safety, Air Transport Assoc. of America).

[72] *Id.* at attachment B.

[73] *Id.*

[74] AIM, *supra* note 24, para. 4-4-15.

[75] *Id.* For additional information regarding pilot maneuvers based on TCAS, see *infra* text accompanying notes 93-95.

nearby aircraft as well as to ground ATM personnel. This information will be combined with radar data to allow increased accuracy as well as redundancy to accept a failure of either radar or ADS.[76] Pilots will be able to use this information for planning purposes. Additionally, the information will be reviewed on the ground by software to "detect potential flight path conflicts and identify optimized resolution actions."[77] If conflict probe software determines that a conflict exists, resolution software would suggest a maneuver to achieve the minimum required separation through the least disruptive maneuver, taking into account each aircraft's intentions.[78] Assuming ATM concurs, the instructions would be passed to the aircraft.[79] It is important to note that these resolution instructions will be designed to have the minimum impact on the aircraft; often involving only minor course changes, for instance. This is in keeping with the free flight concept that any constraints on airspace users should be imposed only when necessary and only to the degree necessary to resolve potential conflicts. After resolution, the constraints would be lifted and the aircraft would again be free in their choice of flight path.

The value of surveillance technology is not limited to increasing efficiency of airborne aircraft. Technology may allow for incorporation of these surveillance techniques to monitor aircraft position on the ground. Testing is underway on a system that will use GPS for position information to allow tower personnel to track up to 500 aircraft and ground vehicles on a display that would portray each vehicle's position, speed, and direction of movement.[80]

C. THE BEGINNING OF THE CONTINUUM TO FREE FLIGHT

Technology has slowly made inroads into some limitations the current system imposes. What makes free flight different from these small steps is that free flight envisions concurrent progress in all three phases of CNS, as well as the development of new decision support technology. Each of these technological

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[76] TASK FORCE 3 REPORT, *supra* note 1, at 100.

[77] *Id.*

[78] *Id.* at 101.

[79] *Id.*

[80] *See* Fahy, *supra* note 5, at 1.

phases is to some extent independent yet linked to the others.[81] However, when progress takes place in each of these phases, there will be additional benefits from the synergistic effect.[82]

Despite the far reaching nature of the goals of free flight and the extensive technological advances it envisions, the basic concept itself is not new—after all, Orville and Wilbur Wright required no clearance to take off at Kitty Hawk.[83] As time went on, however, the airspace became more crowded, and the aircraft flew at increased airspeeds. The old method of separation by "see and avoid," used until the 1950s, became unworkable since pilots did not have sufficient information regarding fast-moving nearby aircraft.[84] For safety reasons,[85] it was necessary to incorporate ground-based assistance, and hence control, to ensure aircraft separation[86] as speeds and congestion increased and particularly as flight in instrument conditions became more common. Thus, the ground-based control in our system evolved, in part, from the lack of information available to airborne pilots and the need for ground-based assistance.

Technology has progressed, however. It has reached a point where additional information can be displayed to pilots, enabling them to take on some of the responsibility for separation of aircraft. Free flight merely returns responsibility and control to the airspace users when they are provided the means for safely making the appropriate decisions.

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[81] For instance, GPS makes increased precision in navigation possible, and WAAS will allow Cat I approaches to be flown whether or not the technological advances through data link surveillance reporting are available. *See id.*

[82] *See generally* Bruce D. Nordwall, *Users Want More Clout in ATC Upgrade Decisions*, AVIATION WK. & SPACE TECH., Jan. 2, 1995, at 38. For instance, the use of a data link to transmit position will allow for decreased separation standards, regardless of the type of fixing information used, simply because of the information's timeliness. If, on the other hand, GPS position is used, the separation standards could be further decreased because of the accuracy of the position. *See* TASK FORCE 3 REPORT, *supra* note 1, at 28-29 (noting that the size of the "protected zone" around aircraft is dependent on the accuracy of position determination). In either case, there will be the additional benefit of decreased use of two-way voice communication, decreasing chances of errors in communication or airwaves congestion.

[83] *ATC System Biggest Drag on Airline Productivity*, AVIATION WK. & SPACE TECH., July 31, 1995, at 51 [hereinafter *ATC System*].

[84] *Id.*

[85] *Id.* "[A]viation grudgingly sacrificed operational flexibility for safety." *Id.*

[86] As it evolved, the existing system yields fixed navigation routes that provide a minimum horizontal separation of five nautical miles and a minimum vertical separation of either 1000 or 2000 feet, depending on the aircraft altitude. TASK FORCE 3 REPORT, *supra* note 1, at 27.

This transfer of responsibility for aircraft separation back to the cockpit may not be as innovative a concept as it seems. Models for returning increased responsibility for aircraft separation into the cockpit exist in our current system. For instance, the concept that the aircraft commander of a state-operated aircraft assumes responsibility for the separation of his aircraft from all other aircraft is accepted both domestically[87] and internationally.[88] Further, under visual flight rules (VFR), all pilots are given the responsibility to see and avoid as the predominant method for separation of aircraft.[89] Even under instrument flight rules (IFR), when ground-based controllers have the primary burden for separation of aircraft, this duty to see and avoid is imposed on pilots when weather conditions permit.[90] Commercial aircraft routinely accept some responsibility for separation on an IFR clearance when executing a visual approach.[91] When a controller directs a pilot to "maintain visual separation" in a terminal area, ATC is relying on the aircraft to provide its own separation.[92]

TCAS indicates that pilot responsibility for separation is technically achievable. It also demonstrates that a shared responsibility for separation of aircraft between the ATS provider and the pilot can increase the overall safety and efficiency of the system. TCAS may thus provide a model for the fluid shift of responsibility for separation to the pilot, and is, therefore, worth exploring in further detail.

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[87] *See* AIM, *supra* note 24, at Pilot/Controller Glossary, "Due Regard."

[88] Convention on International Civil Aviation, Dec. 7, 1944, art. 3(d), 61 Stat. 1180, 1181, 15 U.N.T.S. 296, 298 [hereinafter Chicago Convention] ("The contracting States undertake, when issuing regulations for their state aircraft, that they will have due regard for the safety of navigation of civil aircraft.").

[89] *See* 14 C.F.R. § 91.113(b) (1996) (imposing responsibility on each person operating an aircraft when weather conditions permit); *see also* AIM, *supra* note 24, para. 5-5-8.a. ("When meteorological conditions permit, . . . the pilot is responsible to see and avoid other traffic, terrain, or obstacles.").

[90] 14 C.F.R. § 91.113(b). "When weather conditions permit, *regardless of whether an operation is conducted under instrument flight rules or visual flight rules* . . . ." *Id.* (emphasis added).

[91] *See* AIM, *supra* note 24, paras. 4-4-13, 5-4-20.d (noting that "acceptance of the visual approach clearance constitutes acceptance of pilot responsibility for maintaining a safe approach interval").

[92] *Id.* para. 4-4-13. In that case, acknowledgement of the instructions is acknowledgement not only that the pilot will maneuver the aircraft as necessary to maintain separation from the aircraft, but also "that the pilot accepts responsibility for wake turbulence separation." *Id.* para. 4-4-13.b.

TCAS provides information to the pilot regarding other aircraft in the vicinity, known as traffic advisories.[93] If TCAS software determines the potential for a conflict exists, it is then capable of providing recommendations for resolution of these conflicts by providing a resolution advisory (RA).[94] Under the current system, pilots may deviate from an ATC clearance upon receipt of an RA and notify ATC of that deviation as soon as practicable.[95] This maneuvering, in turn, removes from ATC the responsibility of providing standard IFR separation between aircraft until the aircraft returns to the previously assigned altitude and course or until alternate instructions have been issued by ATC.[96] TCAS thus returns some decision making to the pilot, while recognizing that it "does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight."[97]

The return of responsibility for separation of aircraft to the cockpit, therefore, is not without precedent. Likewise, the free flight goal of giving users increased flexibility over their route planning is not entirely new. As early as 1979, the FAA envisioned a program of direct routing with fewer restraints.[98] This program was tested during a six-month program by United, Pan Am, and Eastern, allowing direct routing between selected city pairs.[99]

Part of the early transition to flexible route planning involved the use of area navigation (RNAV).[100] RNAV allowed for navigation independent of the route structure imposed by ground-based navaids.[101] Unfortunately, this advance in navigation capabilities was not accompanied by a corresponding advance in "procedures and decision support systems"[102] on the ground, thus limiting the usefulness of the concept.

The National Route Program (NRP) represents a recent experiment into flexible route planning.[103] The NRP allows commercial aircraft increased freedom in route planning at higher

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93 *Id.* para. 4-4-15.

94 *Id.*

95 *Id.* para. 4-4-15.b.1.

96 *Id.* paras. 4-4-15.b.3.(a)-(b).

97 *Id.* para. 4-4-15.d.

98 *See* Blattner, *supra* note 9, at 32.

99 *Id.*

100 TASK FORCE 3 REPORT, *supra* note 1, at 23.

101 *Id.*

102 *Id.*

103 William J. McGee, *Getting There Faster and Cheaper*, AIR TRANSPORT WORLD, Sept. 1, 1995, at 46.

altitudes[104] by allowing aircraft that are a sufficient distance from their departure and arrival points to fly the airline's choice of routes,[105] instead of filing for IFR preferred routes.[106] It requires only that pilots file a flight plan, stay on that flight plan, and maintain contact with ATC, without imposing any further restrictions.[107] This relatively simple program is estimated to save airlines over $40 million per year.[108] Even though the NRP represents a significant step in the loosening of navigational constraints, it is only a small step along the same path envisioned by free flight.[109]

D. Mature Free Flight: From Here to the End Result

Just as the process until now has been a gradual evolution, the road to free flight will take place as a continuum of changes. Domestically, one time line for this continuum has been laid down by RTCA. Their October 1995 Final Report and August 1996 Action Plan contained forty-six recommendations for moving to the free flight concept, breaking down the changes into near-term, mid-term, and far-term.[110] For instance, the expansion of the NRP may be achieved in the near-term.[111] Other changes, such as the development of and implementation of

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104 Initially the program applied to any aircraft at 39,000 feet or above, but this altitude has been gradually stepped down. *Id.*; *see also* Task Force 3 Report, *supra* note 1, at 59 (advocating further expansion of the NRP).

105 McGee, *supra* note 103, at 46.

106 Task Force 3 Report, *supra* note 1, at 135.

107 James Ott, *Airlines, General Aviation Weigh Time/Cost Issues*, Aviation Wk. & Space Tech., July 31, 1995, at 41.

108 McGee, *supra* note 103, at 46.

109 The system is still subject to numerous limitations. *See, e.g.*, AIM, *supra* note 24, para. 5-1-7.d.1 ("Random RNAV routes can only be approved in a radar environment."); AIM, *supra* note 24, para. 5-1-7.d.4. (addressing random RNAV routes for airport-to-airport flight plans only above FL 390).

110 *See generally* Task Force 3 Report, *supra* note 1 at 133 (noting the aggressive projections set down for these time frames indicating 1997 as a goal for near-term, 1998 through 2000 as a goal for mid-term, and far-term as post 2001); Free Flight Action Plan 12-59 (RTCA, Inc. ed., 1996) [hereinafter Free Flight Action Plan].

111 Task Force 3 Report, *supra* note 1, at 59-60. *Task Force 3* recommended expanding the NRP from its limitation to higher altitudes to as low as flight level (FL) 290. *Id.* at 135. Altitudes referenced to a standardized barometric setting are referred to as flight levels (FL) rather than altitudes, with the final two digits dropped for simplification. AIM, *supra* note 24, at Pilot/Controller Glossary, "Flight Level." Thus, RTCA recommends lowering the NRP in the near-term to approximately 29,000 feet.

LAAS to achieve CAT II and III capabilities are not immediately achievable and are considered far-term goals.[112]

In the international forum, ICAO's Future Air Navigation Systems (FANS) committee was formed to plan the transition of the international air transportation system.[113] FANS was adopted in 1991 by ICAO as a "key element of the Air Traffic Management system."[114]

III. OVERVIEW OF EXISTING LEGAL FRAMEWORK

As expected with a sweeping concept like free flight, numerous problems may be encountered. Thorny legal issues will be among the problems, along with significant political and institutional issues. Before proceeding to these issues, it is important to review the legal framework that will affect this area.

A. Laws of Outer Space

Because of the importance of satellite-based navigation to the concept of free flight, some space law concepts will affect the implementation of free flight and should be reviewed. Two treaties are important to exploring the sovereignty and liability issues.

The Outer Space Treaty of 1967[115] requires that the use of outer space be "for the benefit and in the interests of all countries."[116] It further specifies that customary international law applies in outer space.[117] To accomplish this, it specifies that there is *no sovereignty* in outer space.[118] Article VI provides that the country bears responsibility for "national activities in outer space, . . . whether such activities are carried on by governmental agencies or by non-governmental entities."[119] Article VII fur-

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112 Task Force 3 Report, *supra* note 1, at 151. The FAA has reached agreement with manufacturers and airlines on the groundwork for the local area augmentation system (LAAS) that will enable precision approaches down to Category 3 conditions, as well as airport surface navigation. *FAA, Industry Reach Agreement on GPS-Based Landing System*, Aviation Daily, Dec. 20, 1996, at 465.

113 Task Force 3 Report, *supra* note 1, at 11.

114 *Id.* at 24.

115 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

116 *Id.* at 2412-13, 610 U.N.T.S. at 207.

117 *Id.* at 2413, 610 U.N.T.S. at 207-08.

118 *Id.* at 2412-13, 610 U.N.T.S. at 207-08. Article VIII provides for jurisdiction, even without sovereignty. *Id.* at 2416, 610 U.N.T.S. at 208.

119 *Id.* at 2415, 610 U.N.T.S. at 209.

ther provides that the country from whose territory the satellite was launched "is internationally liable for damages to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space."[120]

The Convention on International Liability for Damage Caused by Space Objects[121] gives further guidance on the liability issue. The Convention provides that "[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight."[122] This Convention will bear heavily on our discussion of international liability.

B. Existing Laws Regulating Aviation

In addition to space law, the relatively earthbound laws of aviation will also affect the implementation of free flight. It is therefore necessary to examine both the laws governing the international aspects of air transportation and the laws governing the domestic aspects.

1. *International Law*

The Chicago Convention[123] forms the basis for the organization of international air transportation. It provides that each "State has complete and exclusive sovereignty over the airspace above its territory."[124] The Convention specifically excludes military, customs, and police services from its governance.[125] It also offers specific requirements for overflight of states. State aircraft may not fly over another contracting state without authorization.[126]

Scheduled international air service is likewise prohibited from operating "over or into the territory of a contracting State, except with the special permission or other authorization of that

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120 *Id.*

121 Convention on International Liability for Damage Caused by Space Objects, March 29, 1972, 24 U.S.T. 2389; 961 U.N.T.S. 167 [hereinafter Liability Convention].

122 *Id.* at 2392.

123 Chicago Convention, *supra* note 88.

124 *Id.* at 1181, 15 U.N.T.S. at 298. The sovereignty is further extended by defining territory to include the adjacent territorial waters. *Id.*

125 *Id.*

126 *Id.*

State."[127] For aircraft not engaged in scheduled international air services, the Convention establishes the right to "make flights into or in transit non-stop across its territory and to make stops for non-traffic purposes without the necessity of obtaining prior permission . . . ."[128]

The Convention also grants each state the right to establish restricted and prohibited areas, so long as the areas apply to domestic aircraft from that state as well as international aircraft.[129] Additionally, the Convention charges each contracting state with the responsibility of providing radio services and air navigation facilities[130] and with the adoption of the standard system of communications procedure.[131]

The Chicago Convention charges ICAO with the responsibility of promoting uniformity to facilitate and improve air navigation.[132] To achieve this goal, ICAO is to adopt international standards for communications systems and air navigation aids,[133] as well as rules of the air and air traffic practices.[134]

2. *Domestic Law*

Consistent with the view of sovereignty under the Chicago Convention, the United States Government has statutorily claimed exclusive sovereignty over the airspace of the United States.[135] Within that airspace, the Administrator of the FAA is charged with prescribing air traffic regulations dealing with navigation, the protection of individuals and property on the ground, the efficient use of the airspace, and the prevention of collisions involving aircraft.[136] With respect to international air transportation, the Secretary of Transportation and the Admin-

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127 *Id.* at 1182, 15 U.N.T.S. at 300.

128 *Id.* at 1181, 15 U.N.T.S. at 298.

129 *Id.* at 1182, 15 U.N.T.S. at 302.

130 *Id.* at 1188, 15 U.N.T.S. at 314.

131 *Id.*

132 *Id.* at 1190, 15 U.N.T.S. at 302. For current status of the annexes to the Chicago Convention, see R.I.R. Abeyratne, *The Legal Status of the Chicago Convention and Its Annexes*, 19 AIR & SPACE LAW. 113, 118 (1994).

133 Chicago Convention, *supra* note 88, at 1190, 15 U.N.T.S. at 302.

134 *Id.*

135 49 U.S.C. § 40103(a) (1994).

136 *Id.* § 40103(b)(2)(A)-(D). The regulations most directly affecting pilots are the Federal Aviation Regulations (FARs), which the Administrator of the FAA is charged to prescribe. 49 U.S.C. § 40103(b)(2). Even more specifically, the Administrator is charged with the development of "long range plans and policy for the orderly development and use of the navigable airspace, and the orderly development and location of air navigation facilities, that will best meet the needs of,

istrator of the FAA are required to "act consistently with obligations of the United States Government under [any] international agreement."[137]

IV. LEGAL ISSUES RAISED

Both legal issues and the institutional issues will be examined. The legal issues will focus on sovereignty and liability issues.

A. Sovereignty Issues

The transition to free flight raises sovereignty issues in two ways. First, electromagnetic signals emanating from the navigational aids will be entering the sovereign airspace of other states. Second, under free flight concepts aircraft could physically intrude upon national airspace without traditional clearances from air traffic service providers.

As a starting point, treaty provisions frame the basic sovereignty principles. The Chicago Convention specifically notes that the airspace over a state is sovereign,[138] although it does not delineate the upper limit to this sovereignty. By contrast, the Outer Space Treaty declares that outer space is not sovereign,[139] but does not delineate the lower limit of this principle. Against this backdrop of international sovereignty principles, one can look to the possible intrusion of sovereign airspace.

1. *Electromagnetic Intrusion of Sovereign Airspace*

"Navigation satellites do not enter the sovereign space of states; however, the navigation signals that control the navigation in sovereign space of aircraft, ships and vehicles do enter sovereign airspace."[140] Thus framed, the question is whether the GPS signal itself invades the sovereign territory.

The issue of electromagnetic intrusion of sovereign airspace is not unique to GPS. The issue has been addressed in other contexts, such as direct broadcasting systems (DBS) and other communications systems. Comparing the experience of GPS with

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and serve the interests of, civil aeronautics and the national defense." *Id.* § 44501(a).

[137] *Id.* § 40105(b).

[138] *See supra* text accompanying notes 123-31.

[139] *See supra* text accompanying notes 115-20.

[140] Paul B. Larsen, Recent Changes in Space Law's Concept of Sovereignty, *in* The American Society of International Law: Proceedings of the 88th Annual Meeting 264, 265 (1994).

these other systems, it appears that objections have been all but nonexistent with GPS.[141] With DBS, the issue was initially heavily debated.[142] The result of the debate was a United Nations (UN) resolution, adopted over United States opposition,[143] which imposed tight constraints on states either conducting DBS broadcasting activities or private companies broadcasting their own signals.[144] This early "confining" attitude toward states that allowed the broadcasting of radio signals into other states did not last. Not only have other technologies, such as wireless communications, not met this resistance to implementation, but even DBS appears to have evolved into a smoother, less contentious existence.[145]

One possible reason for the relative ease with which wireless communication is being introduced may be the international nature of the controlling companies.[146] In the case of wireless communication, Iridium is one of the key players, and it is jointly owned by companies of three different countries.[147]

Another reason for the minimal sovereignty problems with wireless communication is that it offers services valuable enough to offset objections to any negative external influence caused by the invading radio waves.[148] In the case of DBS, serious objections were raised, in part, due to the perceived cultural influence the transmission of the DBS signals could have on the invaded country.[149] At the time, the Soviet Union even argued that prior consent was required before radio or television broadcasts could be transmitted into a sovereign country.[150] It was thought that DBS radio waves would bring mass media influences into a state and that the "invaded" state should have some

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141 *Id.* at 265-66.

142 *Id.* at 266. The debate was initially carried on in the International Telecommunication Union (ITU), but it was constrained to technical issues and unable to address the political issues involved. *Id.*

143 *Id.* (referring to *1982 United Nations Resolution of Principles on the Use of DBS by States*, G.A. Res. 92, U.N. GAOR, 37th Sess., Supp. No. 51, at 98, U.N. Doc. A/37/51 (1983)).

144 *Id.* at 266. A similar resolution was reached regarding remote sensing as it relates to the concept of sovereign territory. *See id.* (referring to U.N. Doc. A/AC.105/370 at 12).

145 *Id.* at 266-67.

146 *Id.* at 267.

147 *Id.*

148 *Id.*

149 Georgetown Space Law Group, *DBS Under FCC and International Regulation*, 37 VAND. L. REV. 67, 113 (1984).

150 *Id.*

control over them. By way of contrast, wireless communication does not operate in the blanketing way that the DBS broadcast of radio and television programs does and, hence, does not carry the same stigma of being an invading cultural influence. Taken together, the value of wireless communication outweighed its negligible destructive influence.

Perhaps GPS has not met serious resistance on sovereignty grounds for this same reason. GPS, to an even greater extent than wireless communication, stands to offer so much to the *intruded upon* state, while imposing virtually no objectionable influences.

Thus far, it appears free flight may ride the coattails of other technological advances that have pushed the envelope of sovereignty rights. There will likely be little additional objection to the GPS signals on sovereignty grounds, based on the pragmatic advantages of such a powerful technology that is being offered free of charge.[151]

2. *Physical Intrusion of Sovereign Airspace*

While GPS pushes the boundaries of sovereign airspace through the emanation of its radio signals, those boundaries are taken one step further by free flight. Under the current scheme of international air navigation, aircraft routing is accomplished only in accordance with a clearance. This clearance ensures the permission necessary to enter a state under the Chicago Convention.[152] This may be contrasted with free flight, which envisions aircraft selecting and using their own route of flight without receiving a traditional clearance.

Under a system of pure free flight, a flight from departure to destination could involve going over multiple countries with no warning or consistent pattern. A user would be free to alter his normal routing to take advantage of unusual winds or other factors unique to that flight. For many flights, this may not pose a problem, since they might not involve the crossing of sovereign boundaries. For other flights, however, this ability to choose the route may conflict with the Chicago Convention's sovereignty requirements. For instance, an air carrier could select a route that, because of an unusually strong jet stream that day, took the aircraft over countries over which the air carrier did not nor-

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[151] Larsen, *supra* note 140, at 320.

[152] *See* Chicago Convention, *supra* note 88, at 1182, 15 U.N.T.S. at 300.

mally operate. This sort of flexibility was not designed into the Chicago Convention.

The onus will be on ICAO to define the means to satisfy the permission requirements of the Chicago Convention, mindful of the value of imposing minimum constraints on the basic concept of free flight. While thorny from a legal perspective, this may not be a formidable task from a practical view.

First, the issue deals only with scheduled air transportation and would only relegate it to the same status as nonscheduled, nonstate aircraft.[153] Second, to the extent that the permission requirement was based on the ability of the ATS providers to handle the aircraft, free flight offers a corresponding decrease in the workload of these providers relative to the number of aircraft in their airspace. Finally, as with the electromagnetic intrusion of sovereign territory, free flight offers valuable advantages that may offset the disadvantages.

As a result of these factors, it will be advantageous for sovereign nations to accept some possible increase in intrusions by transiting scheduled air transportation traffic in return for the benefits afforded that nation's airlines. The willingness of nations to open their airspace to freedom of air travel is certainly consistent with the recent worldwide trend of countries loosening their overflight restrictions.[154]

B. Liability Issues

Free flight also raises concerns regarding the liability of a state under both international and domestic law. Free flight may also affect the existing division of liability between pilots and controllers.

1. *International Liability Issues*

Because of the use of satellite-based technology for free flight, the Liability Convention will serve as the starting point for examining international liability.[155] Under that Convention, it appears that if a satellite, such as a GPS satellite, caused damage to an aircraft in flight, the United States, as the launching state,

[153] The right of its nonscheduled international air services to transit nonstop across a state's territory is secured by the Chicago Convention. *See id.* at 1181, 15 U.N.T.S. at 298.

[154] *See, e.g.*, McGee, *supra* note 103, at 46 (noting the loosening of overfly restrictions over both China and the former Soviet Union).

[155] *See supra* text accompanying notes 121-22.

would be absolutely liable to pay compensation.[156] Negligence would not even be required on the part of the United States.

The extent of this liability is not clear. For instance, while the Liability Convention explicitly defined the types of "damages" that can be claimed,[157] there is some dispute over whether the Convention would require compensation for indirect damages.[158] The Convention made an explicit decision not to address the issue of indirect damages, which may indicate that indirect damages are not covered.[159] This implication has been noted by some commentators on the subject.[160] From a pragmatic view, it is important to note that this is the view espoused by the United States, which interprets damages as including direct damages resulting from the launch flight and reentry of space objects, but not from "remote or indirect damage for which there is only a hypothetical causal connection with a particular space activity."[161]

Additional aspects of the Liability Convention serve to limit liability. First, the Convention provides for exoneration if the damage is due to "gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of . . . persons it represents"[162] unless such activities were contrary to international law.[163] Additionally, the Convention requires that the claim be made by a state rather than by any individual seeking compensation.[164] Further, the Liability Convention would not apply to cases where nationals of the launching state are seeking compensation.[165]

Thus far, we have examined the issue of liability based on damage caused by the space object. To examine liability based on damage caused by other means, one must move from space law to traditional aviation law. It should be noted that under

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156 Liability Convention, *supra* note 121, at 2392, 461 U.N.T.S. at 189.

157 *Id.*

158 Kevin K. Spradling, *GPS and the Law*, GPS WORLD, Nov.-Dec. 1990, at 48, 50.

159 *Id.*

160 *See, e.g.*, Van C. Ernest, Note, *Third Party Liability of the Private Space Industry: To Pay What No One Has Paid Before*, 41 CASE W. RES. L. REV. 503, 519-20 (1991).

161 Edward F. Hennessey, *Liability for Damage by the Accidental Operation of a Strategic Defense Initiative System*, 21 CORNELL INT'L L.J. 317, 335 (1988) (quoting statement of the U.S. representative to the Legal Sub-Committee of COPUOUS (June 30, 1971)).

162 Liability Convention, *supra* note 121, at 2394, 961 U.N.T.S. at 190.

163 *Id.* at 2394-95, 961 U.N.T.S. at 190-91.

164 *Id.* at 2395, 961 U.N.T.S. at 191.

165 *Id.* In this case, the issue of sovereign immunity would be raised.

space law, a launching country is "both 'responsible' and 'liable'" for damage caused by satellites launched from its territory.[166] This may be contrasted with aviation law, where "[t]he United States exercises a supervisory role (responsibility) with respect to ships and planes owned by the private sector but does not accept the financial risk (liability) for the actions of these assets."[167] Thus, the United States would not be liable for actions of U.S. registered aircraft that cause damage outside of our country.

2. Liability of the United States

Examination of liability issues involving the United States government requires exploration of the means available to overcome the traditional sovereign immunity available to individual governments. Chief among these is the Federal Tort Claims Act (FTCA).[168] Under the FTCA, the district courts are granted exclusive jurisdiction:

> for injury or loss of property, or personal injury or death caused by the negligent or wrongful act or omission of any employee of the Government while acting within the scope of his office or employment, under circumstances where the United States, if a private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred.[169]

This provision is subject to specified tort claims procedures.[170] Among the procedures are numerous exceptions to the jurisdictional grant over claims against the U.S. government.[171]

The most prominent exception from FTCA jurisdiction is the exclusion of claims based on the "discretionary function" of a federal agency or employee of the government.[172] Under the discretionary function exception, the government will not be liable where the claim is based on:

> an act or omission of an employee of the Government, exercising due care, in the execution of a statute or regulation, . . . or based upon the exercise or performance or the failure to exercise or

166 Office of Technology Assessment, U.S. Congress, *Space Stations and the Law: Selected Legal Issues—Background Paper*, 20 OTA-BP-ISC-41 (Washington, D.C., U.S. Government Printing Office, Aug. 1986).

167 *Id.*

168 28 U.S.C. §§ 1346(b), 2671-2680 (1994).

169 *Id.* § 1346(b).

170 *See id.* §§ 2671-2680.

171 *See generally id.* § 2680(a)-(n).

172 *Id.* § 2680(a).

perform a discretionary function or duty on the part of a federal agency or an employee of the Government.[173]

This exception to liability has been defined by a series of decisions beginning with the Supreme Court decision in *Dalehite v. United States.*[174] In that case, the Court declared that the exemption from liability due to discretionary functions would extend to "determinations made by executives or administrators in establishing plans, specifications or schedules of operations."[175] The Court went on to say that no claim may be based on the "acts of subordinates in carrying out the operations of government in accordance with official directions."[176]

This does not guarantee government immunity for all acts merely because the decision to undertake those acts was discretionary. Once the government makes the discretionary policy decision to undertake a service, it is under an obligation to act reasonably in the operational context of providing that service. For instance, *Ingham v. Eastern Air Lines, Inc.*[177] recognized that the decision to undertake the air traffic control function was discretionary.[178] Nevertheless, the government was found liable for what the court found was an unreasonable error by a controller.[179] The court reasoned that once the decision was made to provide a service, "the government's employees were required thereafter to act in a reasonable manner."[180]

As applied to GPS, it appears that policy decisions, such as the decision to supply the GPS signal to civil users, are likely to be discretionary functions.[181] The decision to degrade the signal would also likely be discretionary.[182] Once the decision is made

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[173] *Id.*

[174] 346 U.S. 15 (1953); *see also* Eastern Air Lines v. Union Trust Co., 221 F.2d 62 (D.C. Cir.) (applying FTCA to negligence of control tower operators), *summarily aff'd sub nom.* United States v. Union Trust Co., 350 U.S. 907 (1955).

[175] *Dalehite,* 346 U.S. at 35-36 (footnote omitted).

[176] *Id.* at 36.

[177] 373 F.2d 227 (2d Cir.), *cert. denied,* 389 U.S. 931 (1967).

[178] *Id.* at 238.

[179] *Id.*

[180] *Id.* The court also noted that the exception from liability provided for misrepresentations, 28 U.S.C. § 2680(h), would not apply to the situation where the claim is based on "the negligent performance of operational tasks." *Ingham,* 373 F.2d at 239.

[181] *Cf.* Spradling, *supra* note 158, at 49.

[182] *Cf. id.*

to provide the signal, however, the government undertakes the obligation of providing reasonable service.[183]

The second exception to liability considered under the FTCA denies federal court jurisdiction over any "claim arising in a foreign country."[184] This exception may not provide as much protection as it would first appear, since interpretation of this exception allows suits for injuries incurred in foreign countries, if they result from negligence in the United States.[185] In the case of GPS, this would imply that any negligence in the provision of GPS signal occurring within the United States[186] may subject the United States to liability, even for injury arising in a foreign country.[187]

There is also an exception to the FTCA for claims that may be brought under the Suits in Admiralty Act (SAA).[188] Under the SAA, the United States allows itself to be sued in cases where the same case could be brought in admiralty against a private person or property.[189] Hence, the first hurdle a plaintiff must clear to maintain a suit against the United States under the SAA is to show that the suit could be brought in admiralty.

The boundaries of maritime jurisdiction were recently reviewed by the Supreme Court in *Jerome B. Grubart, Inc. v. Great Lakes Dredge & Dock Co.*[190] In that case, the Court used the two-

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183 Jonathan M. Epstein, *Global Positioning System (GPS): Defining the Legal Issues of Its Expanding Civil Use*, 61 J. AIR L. & COM. 243 (1995); *see also* Spradling, *supra* note 158, at 49 (noting that the decision to provide a given level of accuracies through GPS would likely be discretionary, while errors in providing the signal may be operational and justify liability).

184 28 U.S.C. § 2680(k) (1994).

185 Spradling, *supra* note 158, at 49.

186 Outer space is even included since that is not "in a foreign country." *Id.*

187 *Id.*

188 28 U.S.C. § 2680(d) (referring to 46 U.S.C. app. §§ 741-752) (1994)). The exception also allows suit against the United States under the Public Vessels Act, 46 U.S.C. app. §§ 781-790 (1994). While the distinction between the FTCA and the SAA, both of which create a cause of action against the United States, may seem irrelevant, it may actually raise significant differences. For instance, the SAA has only a two-year statute of limitations, a fact that precluded jurisdiction in T.J. Falgout Boats, Inc. v. United States, 508 F.2d 855, 856 (9th Cir. 1974), *cert. denied*, 421 U.S. 1000 (1975). In that case, the damage done to a privately-owned vessel by a Sidewinder missile launched from a U.S. Navy aircraft was found to create an action in admiralty, thus barring any claim under the FTCA. *Id.* The court felt that the aircraft's operation by the Navy indicated that "the subject aircraft is by its very nature maritime." *Id.* at 857.

189 46 U.S.C. app. § 742.

190 573 U.S. 527 (1995).

prong test set out in *Sisson v. Ruby*[191] in determining whether or not there was maritime jurisdiction. Under the first prong of that test, a court looks to the location, considering "whether the tort occurred on navigable water or . . . was caused by a vessel on navigable water."[192] Under the second prong, a court considers the connection to traditional maritime activity.[193] This second prong is further broken down into two issues. First, the court considers the type of incident involved, asking whether it has the potential to disrupt maritime commercial activities.[194] Second, the court looks to the character of the incident, questioning whether or not there is a "substantial relationship to traditional maritime activity."[195]

There have been divergent views over the usefulness of the SAA in aviation cases. It was an aviation case, *Executive Jet Aviation, Inc. v. City of Cleveland, Ohio*,[196] that signaled the departure from a simple locality test over maritime jurisdiction toward the relatively complicated two-prong test used in *Grubart*. Hence, there is a strong indication that aviation claims are less likely to find a forum in an admiralty court. On the other hand, *Executive Jet* did not completely slam the admiralty door shut against all aviation claims, since the Court refused to decide whether any aviation claim could potentially meet the admiralty test under some circumstances.[197] In the aftermath of *Executive Jet*, several courts have established admiralty jurisdiction over aviation cases.[198] This may indicate that the SAA may provide access for suits against the government if the circumstances meet the *Sisson* test. It should be noted that the SAA does not contain a statutory "discretionary function" exception as does the FTCA.

191 497 U.S. 358, 363-64 (1990).

192 *Grubart*, 573 U.S. at 532 (referring to 46 U.S.C. app. § 740).

193 *Id.* at 532.

194 *Id.*

195 *Id.* (quoting *Sisson*, 497 U.S. at 365).

196 409 U.S. 249 (1972).

197 *Id.* at 271 (refusing to decide whether it would be possible for an aviation tort to "bear a sufficient relationship to traditional maritime activity to come within admiralty jurisdiction").

198 *See, e.g.*, Miller v. United States, 725 F.2d 1311 (11th Cir.) (claim based on alleged negligence of air traffic controller leading to airplane crash into international waters east of Palm Beach, Florida, was within admiralty jurisdiction), *cert. denied*, 469 U.S. 821 (1984); Roberts v. United States, 498 F.2d 520 (9th Cir.) (claim based on alleged negligence of government controllers and rescuers involved in the Flying Tiger Lines cargo plane crash into navigable waters on approach to Okinawa was within admiralty jurisdiction), *cert. denied*, 419 U.S. 1070 (1974).

Nevertheless, this exception has been judicially created where basic policy judgments are made dealing with the public interest.[199]

Along with judicial relief available under the FTCA and the SAA, administrative relief may be available for noncombat claims against the United States government. Under The Military Claims Act[200] and The Foreign Claims Act,[201] the Secretary of each armed service is authorized to settle claims of up to $100,000 arising from noncombat damages caused by either a member of the U.S. armed forces or a civilian employee of the military department.[202] Neither of these Acts actually provides a waiver of sovereign immunity.[203]

3. *Liability of the Airspace Users*

One additional liability issue is worth consideration. Under free flight, much of the responsibility for separation of aircraft will shift from the Air Traffic Service (ATS) providers to the airspace users. Will this cause any redistribution of liability between the users and the controllers?

It is likely that free flight will have little effect on the distribution of liability between ATS providers and pilots. There are several reasons for the limited effect. First, even under free flight, the ATS providers would still be the "ruling entity in separation arbitration."[204] In other words, they have the final say over issues regarding separation of aircraft, just as the pilot will have final responsibility for the safety of his aircraft under both the

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199 *See, e.g.*, Chute v. United States, 610 F.2d 7 (1st Cir. 1979) (United States not liable where Coast Guard used its discretion in marking a submerged vessel, noting that it was a discretionary rather than a mandatory function), *cert. denied*, 446 U.S. 936 (1980); Gercey v. United States, 540 F.2d 536, 539 (1st Cir. 1976) (United States not liable for deaths to passengers of motor vessel that had failed to pass the Coast Guard inspection on the argument that the Coast Guard had failed "to adopt a comprehensive program of protecting the public from decertified vessels"), *cert. denied*, 430 U.S. 954 (1977).

200 10 U.S.C. § 2733 (1994), *as amended by* Pub. L. No. 104-316 § 202(e), 110 Stat. 3826 (1996).

201 10 U.S.C. § 2734 (1994), *as amended by* Pub. L. No. 104-316 § 202(e), 110 Stat. 3826 (1996).

202 10 U.S.C. § 2733 (claims not presented regarding damage in foreign country); 10 U.S.C. § 2734 (claims arising in foreign country).

203 *See, e.g.*, Lloyd's Syndicate 609 v. United States, 780 F. Supp. 998, 1000-01 (S.D.N.Y. 1991) (finding no jurisdiction since the Foreign Claims Act does not provide a waiver of sovereign immunity); *see also* Spradling, *supra* note 158, at 49-50.

204 TASK FORCE 3 REPORT, *supra* note 1, at 6.

existing system[205] and under free flight. Thus, the basic accountability concepts underlying the distribution of responsibility will not be altered.

Second, from a liability perspective, the shift in responsibility is more a matter of degree than a fundamental change. Numerous examples, including "see and avoid," visual separation, due regard, and TCAS, currently exist that would form a model for pilot assumption of additional responsibility for separation of aircraft.[206] The liability issue during a transition to free flight will likely draw from these examples rather than impose any wholesale changes.

V. INSTITUTIONAL ISSUES RAISED

Many of the impediments to the smooth implementation of free flight will result from the wide variety of institutions involved. As a result, the road to implementation may have more political potholes than technological ones.[207] Some of the difficulties arise because of the perception that there is fragmented responsibility for providing the navigation signals that would enable a transition to free flight. While both the DOT and DOD typically provide a joint plan for common use navaids,[208] the division of authority with respect to GPS is not evenly divided.

GPS was initially created, tested, instituted, and is currently operated by the DOD. While it may have been intended as a predominantly military system, the planned use of the system was irreversibly changed following the 1983 destruction of Korean Air Lines (KAL) Flight #007 by a Soviet Union military aircraft over the Sea of Japan.[209] That disaster, brought on in part

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205 14 C.F.R. § 91.3(a) (1996) ("The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.").

206 *See supra* text accompanying notes 83-97.

207 *See, e.g.*, R. Michael Baiada, *ATC System Biggest Drag on Airline Productivity*, AVIATION WK. & SPACE TECH., July 31, 1995, at 51 (noting that the technology already exists for most of the proposed changes and that the major obstacles may be political and business). Further, money is always a factor as the FAA is facing tight fiscal constraints. One observer noted that "there is currently zero money for data link. And if there is no data link, there will be no free flight." Bruce D. Nordwall, *Enabling Free Flight*, AVIATION WK. & SPACE TECH., June 3, 1996, at 28 (quoting J. Roger Fleming, senior vice president of the Air Transportation Association); *see also* Blattner, *supra* note 9, at 32 (noting detrimental effect of Budge Reduction Act on the purchasing of new equipment necessary to implement free flight technology).

208 *See* FRP, *supra* note 38, at 1-1.

209 *See* Zicherman v. Korean Air Lines, Co., 116 S. Ct. 629 (1996).

by the navigation errors of the Boeing 747,[210] led to President Reagan's offering of the system for international civilian use.[211]

Planning for the implementation of free flight has been undertaken by numerous institutions in addition to the DOD. The Department of Transportation (DOT) and the FAA, for instance, have become involved as key players, with the DOT sharing much of the decision-making process through a joint effort with the DOD.[212] To make GPS available more widely, additional institutions become involved in attempting to plan, regulate, augment, or improve its use.[213] Complicating the issue somewhat is the continued operational control of the system exclusively by the DOD, including the purposeful degradation of the system for security purposes.

This fragmented approach to the implementation of GPS for civil uses leads to some potential conflicts in both domestic and international forums. In the end, the lack of clear policy surrounding GPS will be seen as the source of some difficulties. There is a strong need for a coherent policy to guide the numerous institutions involved.

A. DOMESTIC INSTITUTIONAL ISSUES

As noted above, the implementation of GPS and the transition to free flight involve the efforts and cooperation of many domestic institutions. The interplay between the various groups may lead to conflicts that pose problems to the implementation of free flight. Some of these issues parallel the issues raised by the attempt to adapt the limitless opportunities GPS offers to civil users, without compromising the military benefit that led to its genesis.

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[210] *Id.* at 631.

[211] Spradling, *supra* note 158, at 48.

[212] The "DOD and DOT have joint responsibility to avoid unnecessary overlap or gaps between military and civil radionavigation system and services." FRP, *supra* note 38, at 1-23.

[213] Currently, within the DOT the primary organizations responsible for navigation aids are the Coast Guard and the FAA, who are respectively responsible for maritime and aviation applications. *Id.* at 1-7. In addition to these key players, however, a plethora of other organizations become involved in the necessary complex planning. Examples include the Department of Commerce, see generally U.S. DEP'T OF COMMERCE, A TECHNICAL REPORT TO THE SECRETARY OF TRANSPORTATION ON A NATIONAL APPROACH TO AUGMENTED GPS SERVICES (DEC. 1994), as well as NASA and the National Oceanic and Atmospheric Administration (NOAA). *See* FRP, *supra* note 38, at 4-18 to 19.

Before examining the interplay between the DOD and the civil aviation users, we must first examine the involvement of a group that appears to be a strong advocate of the transition to free flight—the FAA. To some in the aviation industry, there is irony in looking to the FAA as the strongest ally in the push to implement technology.[214] In recent testimony, William G. Laynor, Chief Technical Advisor of the National Transportation Safety Board,[215] described the FAA's historical response to technological innovation by telling about an early industry suggestion for the concept of an airborne collision unit. He noted that the FAA initially claimed to support the concept of the airborne collision unit when suggested by industry in the late 1960s.[216] Despite this early support of an initiative that promised distinct safety benefits, the FAA did not proceed with full development of TCAS until after a 1978 collision between a Boeing 727 and a Cessna near San Diego.[217] Even then, the concept spent nearly twenty years in FAA research and development before approval for installation in transport aircraft.[218]

Despite criticism of the FAA's history of technological progress, there are many signs of a changed FAA. The involvement of RTCA is one clear example of an attempt by the FAA to gather a collection of experts representing the government and industry in an attempt to define future goals. It should be noted, however, that for all of RTCA's optimism and thorough planning, and despite the involvement of FAA personnel in the process, it is not RTCA who will make the decisions regarding free flight. It is yet to be seen whether the FAA will act on RTCA's recommendation of an expeditious transition to the free flight concept.[219] Hopefully, the remarks of David Hinson,

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214 *See, e.g.*, *Industry Perspective of FAA R&D Programs: Hearings Before the Subcomm. on Technology of the House Comm. on Science*, *supra* note 71 (testimony of William G. Laynor, Chief Technical Advisor, Nat'l Transp. Safety Board). ("The development of an airborne collision avoidance system, and finally the required installation of the TCAS system, may best exemplify some of the FAA problems in bringing an R&D program to fruition."); *see also id.* (statement of J. Roger Fleming) ("Most major system elements are scheduled for operation years after the airlines believe the capability should be available.").

215 *Id.* (testimony of William G. Laynor, Chief Technical Advisor, Nat'l Transp. Safety Board).

216 *Id.*

217 *Id.*

218 *Id.* Even then, the system was incorporated without adequate training of FAA personnel, including air traffic controllers. *Id.*

219 There are other signs that the FAA is seeking consensus support during the planning stages for technological progress. In addition to the use of RTCA to

during his tenure as FAA Administrator, to ATN Systems, Inc. bear the mark of truth:

> This collaborative effort is an example of government/industry cooperation at its best. . . . By establishing a clear need for and strong commitment to the network, and through finding a better way to work together, the FAA and the aviation industry expect to . . . deliver the operational benefits to the airspace users more quickly.[220]

Even if the FAA is a strong proponent of the transition to free flight, the story is not over. The entire concept depends on a system under the control of the DOD. GPS is a military innovation, and, even in its civil use it is still controlled by the DOD.

That is not to imply that the DOD has been entirely uncooperative. To make civil use of GPS feasible, the DOD has made certain availability guarantees.[221] Beyond this, much of the implementation planning is a joint effort between the DOD and DOT,[222] and both organizations usually characterize decisions as joint efforts. As one DOD official has said, the decisions are "made by the U.S. government, not the FAA and not the military."[223]

Nevertheless, these unified governmental decisions regarding GPS may sound like two preschool siblings reaching a unified "family" decision. There are occasional signs that the United States government is not entirely consistent in its policy with respect to GPS. One example occurred in a recent FAA reaction to a planned Army test evaluating the jamming of GPS signals to civil aviation users, where one FAA official noted: "If we, the

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gain a consensus regarding the overall transition to free flight, the FAA sought industry consensus in the development of some specifics aspects of technology. *See, e.g.*, *Industry Perspective of FAA R&D Programs: Hearings Before the Subcomm. on Technology of the House Comm. on Science*, *supra* note 71 (noting formation of ATN Systems, Inc. to facilitate consensus development of communications and surveillance systems).

220 Letter from David R. Hinson, Administrator, Fed. Aviation Admin., to Capt. William B. Cotton, President, ATN Systems, Inc. [hereinafter Hinson Letter to ATN], *in Industry Perspective of FAA R&D Programs: Hearings Before the Subcomm. on Technology of the House Comm. on Science*, *supra* note 72, at attachment B, addendum 2.

221 Including a minimum forty-eight hour notice for any planned disruption of the GPS signal in peacetime. FRP, *supra* note 38, at 3-31.

222 *See, e.g.*, FRP, *supra* note 38, at 1-1 to 3 (noting general joint responsibility for planning shared by the DOD and the DOT, and specific joint cooperation in GPS planning).

223 Hale Montgomery, *After GPS What?*, GPS WORLD, Jan. 1992, at 12 (quoting Air Force Col. Michael J. Ball, Chief of Airspace and Air Traffic Services).

FAA, are unable to prevent the disruption to the GPS, our previous promises to the ICAO community are certainly suspect."[224] Incidents like this give credence to the perception that the United States government is not always acting as a cohesive unit. Even the concept that one part of the government is spending vast amounts of money to augment a system that is purposefully degraded by another part of the government offers some fuel to this speculation. In a report released in 1995, the National Academy of Public Administration (NAPA) suggested the deactivation of the degraded GPS signal, noting that many augmentation systems provide accuracies better than the signal with the selective degradation turned on.[225]

The fractured governmental approach to GPS policy has raised the concerns of many.[226] The White House has taken several steps toward resolving this fractured governmental approach to GPS policy. In March 1996, President Clinton issued a Presidential Decision Directive on GPS.[227] That Directive not only promises to end the GPS selective availability within four to ten years, but also creates a "GPS Executive Board, jointly chaired by the DOT and DOD, to coordinate the development of the GPS system for both military and civilian uses."[228] This policy may go a long way towards unifying the perception of the U.S. government's approach to GPS policy.[229]

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224 *Clinton Says U.S. Is Committed to Civil Use of GPS*, AEROSPACE DAILY, Mar. 29, 1995, at 475. There are also reports that the FAA's efforts to implement WAAS have not always been well received by the DOD. *See, e.g.*, *GPS Experts Suggest Way to Avoid Terrorism*, AVIATION WK. & SPACE TECH., Oct. 9, 1995, at 57 (noting that an agreement was reached that allowed the DOD to selectively jam the WAAS signal for security concerns); *DOD Waffling on WAAS*, PROFESSIONAL PILOT, Dec. 1995, at 30.

225 *NAPA Study Calls for Phase Out of SA*, GLOBAL POSITIONING & NAVIGATION NEWS, June 1, 1995.

226 *See, e.g.*, *id.* (calling for adoption of "explicit" goals in GPS policy making); *Rand Report: U.S. Needs New, Clearer GPS Policy Statement*, SATELLITE WK., Feb. 5, 1996, *available in* 1996 WL 7054277 [hereinafter *Rand Report*] (noting the lack of clear U.S. GPS policy).

227 *Clinton Policy Opens GPS Accuracy to Civil Users*, AVIATION DAILY, Apr. 1, 1996, at 3.

228 *Id.*

229 *See, e.g.*, *Clinton Administration Making GPS Accuracy Available to Civil Users*, WEEKLY BUSINESS AVIATION, Apr. 8, 1996 (quoting Secretary of Transportation Péna as saying that the policy "gives everyone, including the global community, greater confidence that this is available and will be made available even further in the future"); Calvin Biesecker, *Clinton Policy Keeps GPS Service Free for All Users*, DEFENSE DAILY, Apr. 1, 1996 (quoting Randy Hoffman, president Magellan Sys-

B. International Institutional Issues

To fully implement free flight, the international aviation community will have to adopt unified operating standards. At this time, it is unknown what standards will be adopted or how they will be determined. The United States has offered GPS as the navigation signal of choice and is further seeking to take a leadership role in determining other standards to be used in implementing free flight. This raises two concerns in the international scene. First, the credibility of the United States is questioned when it puts its ambiguous GPS policy on display to the world. Second, even if the policy of the United States was clear, there are international doubts about the motives underlying the United States' offers.

Looking at the first issue, there is international concern over excessive dependance on a system, such as GPS, that is subject to the control of one government. This discomfort comes despite assurances from the U.S. government that the signals will be continuous and is based in part on the view that U.S. policy in this area is schizophrenic. The international community sees an intragovernmental dispute between different organizations of the U.S. government, with some, such as the FAA, promising continuity of the signal, while others, such as the DOD, offer less enthusiastic assurance. This concern is summarized by worries of overdependence on a system "owned and operated by the Pentagon."[230] Time will tell whether the recently issued presidential GPS policy will assuage these international concerns about the future availability of GPS.

The second issue concerns the international perception of the United States' motives for taking the leadership role in im-

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tems Corp. as saying that the new policy "provides a solid foundation for people to feel comfortable about using and investing in GPS for the long-term").

[230] *Editorial: Time for Action on Global Navsat*, AVIATION WK. & SPACE TECH., Aug. 2, 1993, at 70 (quoting John Beukers). The recently released *Final Report* of the Gore Commission noted that "[m]any other nations, . . . are reluctant to base their own airspace management on a GPS system which they perceive to be controlled by the U.S. military." FINAL REPORT OF THE WHITE HOUSE COMMISSION ON AVIATION SAFETY AND SECURITY 2.4 [hereinafter GORE COMMISSION FINAL REPORT]. Copies of the *Final Report of the White House Commission on Aviation Safety and Security* can be accessed on-line at www.aviationcommission.dot.gov. One of the report's recommendations was "that civilian leadership be strengthened by establishing a Civil GPS Users Advisory Council to report to the GPS Executive Board." *Id.* The commission was created by President Clinton to advise "the President on matters involving aviation safety and security, including air traffic control." Exec. Order No. 13,015 § 2(a), 61 Fed. Reg. 43,937 (1996).

plementing GPS and free flight. A review of the efforts of the United States to further the international effort is in order.

The United States' international commitment to GPS was first expressed in September 1991 by James B. Busey, then FAA Administrator, at the Air Navigation Conference (ANC) in Montreal "when he committed the United States to providing GPS standard positioning services free for 10 years past the system's operational date, or until about 2003."[231] This commitment was later reiterated to the ICAO by President Clinton, who said the United States "remains committed to provide Global Positioning System signals to the international civil aviation community and to other peaceful users of radio navigation and positioning systems."[232]

Just as the United States would like to set the standard for world navigation with GPS, the United States would also like to lead the way in setting international operational and equipment standards for implementation of free flight.[233] Such efforts are necessary for the major restructuring envisioned during the transition to satellite-based technology.[234] The FAA envisions development of the worldwide communications network's standards necessary for free flight,[235] and at the 1995 Paris Air Show, FAA Administrator David Hinson expressed the United States' desires for international agreement on setting these common standards.[236]

Despite these U.S. government assurances to provide the GPS signal and to cooperate in defining the future of free flight, much of the world is not convinced that the United States is acting altruistically. The fear is that the United States may be acting to "discourage foreign competition" and to keep the sat-

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231 Montgomery, *supra* note 223, at 12. In return, Glonass was offered by the "Soviets" until 2010. *Id.*

232 *Clinton Says U.S. Is Committed to Civil Use of GPS*, *supra* note 224, at 475 (quoting letter to ICAO).

233 Although RTCA's primary focus was domestic free flight, they recognized the value of worldwide acceptance of the concept. TASK FORCE 3 REPORT, *supra* note 1, at 133. One of the recommendations by RTCA was to encourage international participation in the steering committee that further examines free flight. Nordwall, *supra* note 2, at 34.

234 TASK FORCE 3 REPORT, *supra* note 1, at 133.

235 *Cf.* Hinson Letter to ATN, *supra* note 220.

236 *Hinson Calls for Worldwide ATC Structure*, AIR SAFETY WEEK, June 26, 1995. This echoes the recommendation of the *Rand Report*, *supra* note 226, advocating that U.S. policy promote the use of GPS as the global standard, to be provided free of user charges. *Id.*

ellite system under U.S. control.[237] Even the efforts of the United States to seek common standards is subject to a contrasting international view since the initial effort involved eleven U.S. airlines.[238] The view of the rest of the world may have been accurately summarized by European space officials who have expressed concerns that U.S. offers are "an attempt to thwart European initiative and undercut competing satellite, space and communications technologies."[239]

The United States has noted these international concerns[240] and is attempting to address them. The FAA characterizes its leadership towards free flight as support of the ICAO Communication, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) concept.[241] Indeed, there is evidence of U.S. solicitation of international support for advancement of technology in the field.[242]

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237 *Id.* (quoting recommendation of the *Rand Report, supra* note 226).

238 *Cf.* Hinson Letter to ATN, *supra* note 220. The airlines involved in ATN Systems, Inc. are Alaska Airlines, American Airlines, American Trans Air, Continental Airlines, Delta Airlines, Federal Express, Hawaiian Airlines, Northwest Airlines, United Airlines, United Parcel Service, and USAir. *Industry Perspective of FAA R&D Programs: Hearings Before the Subcomm. on Technology of the House Comm. on Science, supra* note 71, at attachment B.

239 Barry James, *Fliers Wary of U.S. Offer,* INT'L HERALD TRIB., June 13, 1995, at 15. George Donohue, FAA Associate Administrator, summarized European sentiment that FAA advocation of GPS as the international navigation instrument amounted to "technological imperialism." *FAA Pitch,* AVIATION WK. & SPACE TECH., July 10, 1995, at 21.

240 *See, e.g., FAA Blueprints Worldwide Airspace System; Expects WAAS Awarded This Month,* WKLY. BUS. AVIATION, July 17, 1995, at 26 (noting comments of George Donohue, FAA Associate Administrator for Research and Acquisitions, that some nations are apprehensive about the U.S. movement toward GPS and other satellite technologies, and that some foreign carriers are concerned about the potential for a U.S.-led technology providing advantages to U.S. carriers).

241 U.S. DEP'T OF TRANSP./FED. AVIATION ADMIN., ACCEPTING THE CHALLENGE: GLOBAL AVIATION FOR THE 21ST CENTURY INTRODUCTION (1993).

242 *See, e.g.,* John Martel, *Japanese MTSAT to be First WAAS Compatible System in Asia/Pacific Region,* SATNAV NEWS, Dec. 1995, at 1 (highlighting efforts to insure a seamless interface between FAA's WAAS and the Japanese Civil Aviation Bureau's Multi-Function Transport Satellite (MTSAT) Navigation Service); Amy Bellay, *U.S.—Iceland Agreement Nears Completion,* SATNAV NEWS, Dec. 1995, at 6 (highlighting imminent agreement for investigation of WAAS in northern latitudes).

Other signs of U.S. efforts to secure international cooperation are evident. For instance, the U.S. has encouraged Persian Gulf nations to establish a wide-area differential system through a cooperative effort. Paul Mann, *Gulf Nations Weigh Joint GPS Effort,* AVIATION WK. & SPACE TECH., Nov. 27, 1995, at 40. Additional international movement is evident by the planned installation of a local area differential GPS ground station at the Lugano airport in Switzerland. *Interstate Electronics Corp.,* AVIATION WK. & SPACE TECH., Oct. 16, 1995, at 56 (Bruce D.

One suggested solution to quell international fears would be to provide for ownership and operation of GNSS by the International Maritime Satellite Organization (Inmarsat).[243] This would be a very unlikely occurrence, at least as far as the United States GPS system is concerned. However, to offset some international concerns, Mr. Hinson has indicated that some systems could be administered by ICAO.[244]

Whether the United States is seeking to assert dominance over the technologies necessary for future air transportation, whether it is merely assuming the necessary leadership role by default, or whether it is acting as a reluctant partner in an industry-led drive remains to be seen. Whatever the role of the U.S., great economic and safety benefits will accrue from the implementation of such widespread changes.

VI. CONCLUSION

From a technological viewpoint, the transition to free flight is already underway. The chief obstacles will be institutional. To some extent, the political problems will stem from what appears to be a fragmented United States policy on the use of GPS. This, combined with international fears that may view U.S. leadership on the issue as being an attempt to "corner the market," may create impediments to free flight implementation. Despite this, the transition to free flight will be benefit driven.[245] Ultimately, the value of the system, to the airspace users as well as to the governments that provide the already overburdened conventional flight services, will outweigh any serious criticism of the system.

To avoid vindicated charges of trying to dominate the field, the transition will be largely guided by ICAO policies and should involve extensive international cooperation. Nevertheless, the leadership of the United States is still necessary to act as a driving force toward the economic and safety benefits that free flight may promise.

Nordwall, ed.). Several countries have already accepted GPS as a supplemental en route navigation aid. *FAA Region Examining GPS Direct Flights' Impact, Procedures*, AVIATION DAILY, July 30, 1996, at 161 (including Argentina, Australia, Brazil, Canada, Chile, Fiji, Germany, Iceland, Italy, New Zealand, Peru, South Africa, and Uruguay).

[243] *Air Transportation Defense Departments Reach Accord on GPS Use*, AVIATION WK. & SPACE TECH., Jan. 3, 1994, at 32.

[244] James, *supra* note 239, at 15.

[245] TASK FORCE 3 REPORT, *supra* note 1, at 20.

Will the transition to free flight be fast enough to take advantage of these economic and safety benefits? Maybe not. The just-issued Gore Commission Final Report notes the inadequacies of the current FAA goal of national airspace modernization by the year 2012.[246] The Commission recommends an accelerated deadline of 2005 for implementation of "all elements of the communication, navigation, and surveillance and air traffic management capabilities."[247] One major test of whether such a goal is feasible will begin in 1999. That is when the first "complete operational system evaluation" will be conducted during a two-year test of free flight for aircraft in Hawaii, Alaska, and in between.[248]

[246] GORE COMMISSION FINAL REPORT, *supra* note 230, at 2.1.

[247] *Id.*

[248] U.S. Dep't of Transp., *Fact Sheet Ha-Laska Free Flight Demonstration Project*, News Release, Jan. 15, 1997, *available in* WESTLAW, 1997 WL 38108. This will require a complete upgrade of the ground systems in both states and the equipping of about 2000 aircraft. *Id.*