

IISL-96-IISL.4.05

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) INTERFERENCE TESTING: LEGAL ISSUES

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I. Introduction

On March 29, 1996 the White House issued a Presidential Decision Document which established "comprehensive national policy on the future management and use of the U.S. Global Positioning System (GPS) and related U.S.

Government augmentations." The Decision Document described GPS as a dual-use system, the primary purpose of which is the military use. However, the civilian use of GPS is growing rapidly and becoming an essential element of the Global Information Infrastructure; civilian use includes such diverse activities as air traffic control, mapping and surveying, and global change research. GPS augmentation is an important expansion of GPS capability. 1/

While this paper refers to GPS, it is assumed that the reader will know that the kind of issues that apply to GPS also apply to other Global Navigation Satellite Systems (GNSS). The analysis will consider the entire basic GPS system including the GPS satellites, their navigation payloads, the ground stations, and their control stations, as well as augmentations systems.

II. Background

Disruption of the GPS navigational signals is cause for great concern because there are no plans for a back-up navigational system. Back-up systems are considered redundant. Users will have to be prepared for the GPS to be interrupted during testing for interference and for maintenance. These activities are necessary to maintain and promote the over-all safety and efficiency of the GPS system.

The Presidential Decision Document states that the U.S. Government (the Department of Defense) will take "measures to prevent the hostile use of GPS and its augmentations." 2/ This

appears to refer to Governmental measures to prevent terrorists and unfriendly forces either to interfere with the GPS signals or to use the GPS for their own purposes. Such measures will require testing the system for possible illegal uses. Such testing could interfere both with military and civilian uses of GPS. Consequently interference testing will be conducted by the operator of the GPS system, the Department of Defense. Clearly such testing will have to be coordinated with all civilian as well as military users. Failure to communicate with all reasonably foreseeable users could have legal consequences. The same notification issues exist for shutdown that is part of technical maintenance. Technical maintenance is to occur to preserve GPS accuracy, integrity, and availability. 3/ The 1995 NAPA/NRC report defines these three terms as follows:

- (1) Accuracy is the degree of conformity between the estimated or measured position or velocity of a platform at a given time and its true position and velocity.
- (2) Integrity is the ability of a system to provide timely warnings to users when the system should not be used for navigation.
- (3) Availability of a navigation system is the percentage of time that the services are usable, for example, an indication of the ability of the system to provide usable service within the specified coverage area. 4/

The Presidential Decision Document makes the following assignment of responsibilities for GPS: The Department of Defense will maintain the GPS system and will operate the navigation service, including the testing of the GPS signals. The

Department of Transportation (DOT) is responsible for non-military uses of GPS including development of the GPS augmentations. 5/

The President assigned responsibility for civilian coordination and communication of GPS testing to DOT. This assignment is consistent with the NAPA /NRC Report which holds DOT responsible for monitoring the civil GPS signal and for cooperating with DOD to insure its integrity, accuracy and availability and concludes "that the most important Government action required is to improve the performance of the basic GPS satellite system to provide the highest levels of position accuracy, signal integrity and signal availability that can be technologically achieved at reasonable cost without negatively impacting national security." 6/

Therefore it is within the mandate of the Presidential Decision Document to place a high priority on resolving testing interference issues in order to provide GPS standard service " for peaceful civil, commercial and scientific service on a continuous, worldwide basis." 7/ It probably does not need to be pointed out that a continuously operating GPS system is one in which service is not interrupted .

It is critical for the rapid growth and development of the GPS system that the capability of "continuous operation in all foreseeable contingencies" be maintained. For that purpose the NAPA/NRC Report recommends that more GPS monitoring stations be added to the existing operational

control segments of the GPS system. 8/

The International Civil Aviation Organization (ICAO) defines continuity of service (also referred to as reliability) as the ability of a navigation system to provide required service over a stated uninterrupted period of time. The continuity level is stated in terms of the probability of maintaining the radiated signals. 9/ The average navigational reliability of GPS is stated as being 99,97% . 10/

Finally, it is possible that GPS navigational accuracy may experience unintentional, unwanted interference from terrestrial and other sources so that the GPS receiver cannot accept navigational or positioning information. Unintentional unwanted interference may come from UHF transmitters. 11/

III. Effects of GNSS Testing

Interruptions to military navigation may be small since GPS is virtually controlled by the Department of Defense. For civilian users it is possible to reduce the magnitude of intentional GPS interference by testing at remote areas where the navigational needs are small. Testing, like maintenance of streets and roads, may also be done at times and during seasons when the traffic requirements are the lowest.

The Department of Transportation is responsible for notifying civilian users. The Federal Aviation Administration and other air traffic control authorities can be expected to know about GPS interference testing and to pass

information on to aircraft users. Likewise the Coast Guard and other maritime navigation authorities can be expected to inform mariners. DOT regularly issues NOTAMS to pilots and notices to mariners. However, non-transportation users may suffer because they are not naturally in the chain of information from the DOT. Surveyors, and even more so farmers and recreational users, will be difficult to notify of interruptions..

Legal Issues

A. Regulatory

A number of international treaties have some authority over navigation afforded by GPS. Consequently these treaties and their institutions also have some authority over interruptions of the supply of navigation. A number of national laws and institutions also have authority and therefore responsibility for interruptions. Both kinds of regulatory authorities will be discussed here. 12/

1. International Regulation.

The international treaties with relevant authority over GPS, and in turn authority over interruptions of GPS, are:

1. The U.N. Charter which applies in outer space. Article 2 of the Charter obligates States to resolve their differences by peaceful means. Thus GPS interruptions which amount to acts of aggression are prohibited. Furthermore, under the 1967 Outer Space Treaty, Article VI, 13/ States have assumed responsibility for national activities in outer

space. The United Nations through the United Nations Committee for Peaceful Uses of Outer Space exercises an active role in all space issues. 14/

2. International conventions on liability, registration and aid to astronauts are relevant to GPS navigation and will be further discussed below. 15/ These treaties do not establish regulatory institutions. 16/

3. The International Telecommunications Convention 17/ governs the use of radiofrequencies through the institution of the International Telecommunications Union (ITU). Thus ITU is concerned with disruptions of and interference with the GPS radio signals

4. The 1944 Convention on the International Civil Aviation (Chicago Convention) 18/ governs navigation of aircraft. The Convention has established the International Civil Aviation Organization (ICAO) as the competent body to establish international minimum air navigation standards (article 44) As described above 19/ ICAO Annex 10 defines the concept of continuity of air navigation services.

5. The Convention on the Intergovernmental Maritime Organization (IMO) 20/ establishes international maritime navigation standards. IMO is concerned with interruption of maritime GPS navigation signals that constitute dangers to maritime navigation .

6. Under the aegis of the Treaty of Rome 21/ the European Union also is exercising authority over Global Navigation Satellite Systems. In the 1995 Madrid Agreement between the United States and the European Union the two parties decided to establish a working group to coordinate and

cooperate on all GPS issues. Any interruption of or interference with the GPS navigation system may be an issue for coordination.

2. U.S. Domestic Regulation

Use of radio frequencies are regulated by the Communications Act of 1934 22/ . The Act establishes the Federal Communications Commission (FCC) to regulate the use of radio frequencies, including interference with the use of radio frequencies. While the FCC would not regulate military uses of GPS it would have concerns with civilian interruptions.

The Federal Aviation Act 23/ establishes the Federal Aviation Administration (FAA) which regulates GPS navigation by aircraft . The FAA regulates the use of GPS, including its augmentation, in the United States . The FAA is directly involved in regulation of interruptions and interferences with GPS, because of potential adverse effects on aviation safety.

U.S. maritime laws 24/ establish controls over maritime navigation by the U.S. Coast Guard. Like the FAA the Coast Guard is involved in the regulation of interruptions and interferences with GPS signals because of potential adverse effect on maritime safety.

Operation of the Intelligent Vehicle System (IVS) will also be affected by interruptions and interferences with the GPS signal. The IVS system is under the oversight of the Department of Transportation's Federal Highway Administration. Likewise, the use of GPS by trains is of

concern to the Department of Transportation (Federal Railroad Administration)

Non-Transportation GPS users may look to the Department of Transportation for resolution of their concerns with GPS interruptions and interferences because the Presidential Decision Document assigned DOT to "serve as the lead agency within the U.S. Government for Federal civil GPS matters," and in cooperation with other U.S. agencies to "coordinate U.S. Government-provided GPS civil augmentation systems." 25/

B. Liability Issues

1. International Liability

Virtually all states are parties to the 1967 Outer Space Treaty 26/. Under its Article VII contracting States are internationally liable for damage done by space objects whether such damage happens in outer space, air space on the surface of the earth. Furthermore, under the 1972 Liability Convention, Article II, States have agreed that: "A launching state shall be absolutely liable to pay compensation for damage caused by its space objects on the surface of the earth or to aircraft in flight." 27/

Claims for damages are more likely to be brought under national law. Many countries have now removed legal barriers to direct law suits against governments for their torts. In the United States claims may be brought against the U.S. Government under the Federal Tort Claims Act 28/. A claim against the U.S. Government is barred if the Governmental activity is discretionary.

However, U.S. case law has held the U.S. Government liable for negligently provided air traffic control service. It appears that the Presidential Decision Document's assignment of responsibility to the Department of Defense to "Develop measures to prevent the hostile use of GPS and its augmentation" would be a discretionary decision made at a high decision-making level. 29/ Whether failure of the DOT to inform known GPS users of known disruptions and interferences resulting in injuries would also be discretionary, is a different matter. In the Supreme Court case of *Indian Towing v. United States*, 350 U.S. 61 (1955) the Court decided that the discretionary exception to governmental liability would not apply in cases in which "one who undertakes to warn the public of danger and thereby induces reliance must perform his 'good Samaritan task' in a careful manner."

In *Indian Towing* the Supreme Court concluded that once the Government had undertaken to operate the navigation aid (the lighthouse) "it was obligated to use due care to make certain that the light was kept in good working order; and, if the light became extinguished, then the Coast Guard was further obligated to use due care to discover this fact and to repair the light or give warning that it was not functioning. If the Coast Guard failed in its duty and damage was thereby caused to petitioners, the United States is liable under the Tort Claims Act." 30/ The application of the Supreme Court's line of reasoning is directly relevant to the duty to inform known GPS users of known disruptions.

The next issue then becomes the Government's liability to the GPS users who are not identified and known. Here the liability issue becomes one of foreseeability. The question is: could the Government reasonably foresee that claimants would suffer if not informed? If claimants' damages were not foreseeable then they would not come within the Government's duty of care.

V. Recommendations

Clearly a continuously performing system is required if a reliable satellite navigation system is to exist and function without a back-up system. The system would have to meet the ICAO Annex 10 minimum test for continuity, specified by the GPS operator, DOD, as a reliability of 99,97%. 31/ That means that the system would have to be up and functioning virtually 100% of the time. To achieve this high level of performance:

1. Interruptions should be limited as much as possible and should be scheduled for remote locations, at low traffic times and seasons.
2. An effective communication tree should be established to distribute information about known disruptions to the extent possible
 - a. For that purpose the military and civilian authorities should work closely together
 - b. The civilian authorities should create both international and national coordination systems that include all civilian users
3. Liability for failure to perform would act as a hammer to

compel a virtually 100% GPS system.

VI. Summary

On March 29, 1996 President Clinton announced U.S. policy on management of the Global Positioning System. While GPS will continue as a dual use system, the integration of GPS into peaceful civil, commercial and scientific applications is assured. The decision document clarified the roles and responsibilities of the Departments of Defense and Transportation.

This Presidential Decision Document announced that the Department of Defense will take measures to prevent the hostile uses of GPS and its augmentations. Thus the focus of this paper is on the legal consequences of intentional interference with GPS and also with technical testing to assure accuracy, integrity and availability of the GPS system.

ICAO Annex 10 sets as a goal that the navigational system should be continuously operational and DOD has specified the global average reliability of GPS to be 99,97%, in other words the systems should be continuously operational virtually all the time. Thus there is almost no space for interruption of the GPS system whether for intentional interference testing nor for unintentional interference testing.

When there must be interruptions the main GPS users may be fairly easily reached for information. The greater adverse effects of interference testing may well be on the more remote civilian users

such as surveyors, farmers and recreational users.

A number of international and national institutions have some responsibility for the consequences of interruptions to the GPS system. These institutions range from international institutions such as ICAO and IMO and the E.U. to national institutions such as the DOT, the FAA, and the U.S. Coast Guard.

Potential liability for negligent GPS operation and negligence in informing GPS users acts as a pressure for the GPS system to perform virtually 100% of the time.

For that purpose, the paper makes three recommendations:

1. Schedule intentional interruptions so that they cause as little interference as possible
2. Establish an effective communication tree to inform virtually all users of interruptions that may affect them
3. Let potential liability act as a hammer to keep the GPS system operational virtually 100% of the time.

*) Currently at the Max Planck Institute for Private International Law, Hamburg. None of this paper should in any way be attributed to any organization or agency with which the author is associated.

1. White House Press Release, March 29, 1996
2. Id.
3. National Academy of Public Administration/ National Research Council, The Global Positioning System, Charting the Future, Summary Report, at 7.
4. Id. at 23. The NAPA/NRC Report describes these three as the most important needs for commercial and civil GPS users.
5. Supra n. 1.
6. NAPA/NRC Report supra n. 3 at 17, and 27.
7. Supra n. 1
8. NAPA/NRC Report supra n. 3 at 24 - 27.
9. ICAO Annex 10, Vol. 1, 22 (1987).
10. Assistant Secretary of Defense for Command, Control, Communications and Intelligence, Global Positioning Service Signal Specification, Section 4.0 at B-11 to B-14; also see NRC Report, The Global Positioning System at 163, National Academy Press (1995).
11. NRC Report supra n. 10 at 163.
12. For extensive discussion of regulatory institutions, see Larsen, Positioning Satellites:

FOOTNOTES

Current Institutional Issues,
1994 Coll. on the Law of Outer
Space.

13. Treaty on Principles
Governing the Activities of
States in the Exploration and
Use of Outer Space, Including the
Moon and other Celestial Bodies,
18 UST 2310, TIAS 6347, (1967);
Jasentuliyana and Lee, Manual on
Space law, at 851.

14. Larsen, supra n. 12

15. Convention on International
Liability for Damage caused by
Space Objects, 24 UST 2389, TIAS
6347 (1972); Agreement on the
Rescue of Astronauts, the Return
of Astronauts and the Return of
Objects Launched into Outer
Space, 19 UST 7570, TIAS 6599,
672 UNTS 121 (1969); Convention
on Registration of Objects
Launched into Outer Space, 28 UST
695, TIAS 8480, Manual on Space
Law, at 23.

16. Larsen, supra n. 12

17. 1932 Telecommunication
Convention, 151 LNTS 4, as
amended; latest amendment was in
1992. For discussion see Lyall,
The International
Telecommunication Union
Reconstructed, Proceedings of the
Thirty-Sixth Coll. on the Law of
Outer Space, at 78.

18. 51 UNTS 295, 51 Stat. 1180,
TIAS 295.

19. At n. 9.

20 Convention on the
Intergovernmental Maritime
Organization, 9 UST 621, TIAS
4044

21. Rudden/Wyatt, Basic
Community Laws at 20.

22. 47 U.S.C. 151.

23. 49 U.S.C. 40101

24. 14 U.S.C. 2, 81 - 90.

25. Supra n. 1.

26. Supra n. 15.

28. 28 U.S.C. 2671 et seq..

29. Dalehite v. U.S., 346 U.S.
15 (1952).

30. Indian Towing v. United
States, 350 U.S. 61 (1955), at
69.

31. Supra notes 9 and 10.