

# **THE GNSS SAFETY AND SOVEREIGNTY CONVENTION OF 2000 AD**

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## I. UNDERSTANDING THE REALITY

The United States established the Global Positioning System (GPS) satellite system in the 1970's. GPS is the first Global Navigation Satellite System (GNSS as they are generically called). The Russians have put up a partial array of birds, GLONASS, and the European Community is almost certain to send up its own system, Galileo, in the near future. In the longer term, other developed nations, or groups of nations, are likely to send up their systems as well.

These GNSS systems have profoundly altered the military and civilian power relationships among the nations of the world. These systems can be immensely beneficial to mankind. They are also capable of military and civilian destruction on an unprecedented scale. The world is only now coming to understand the good and the evil aspects of GNSS, and is seeking to create a framework within which the benefits can be exploited while protecting the interests of the user nations.

At present the only fully operational worldwide system is GPS, put up and controlled by the US. GPS was originally meant only for military purposes. GPS is still of immense military significance and is now built into all US Department of Defense aircraft, cruise missiles, stand off munitions, and even some artillery shells. GPS was used in recent counter-terrorist actions in the Middle East and in Operation Desert Fox. GPS is also now installed in the military vehicles of other nations, including those aligned with US and otherwise. We Americans now know that GPS can be used by our forces—and against them. Someone once said: “Be careful what you ask for: you may get it.”

To the consternation of the US military, however, GPS's remarkable technology has been adopted for civilian uses worldwide. GPS is approved and used for aircraft and marine navigation, railway train control, truck and

container following, surveying, and agriculture, to name a few. And there is another role less discussed: timing. GPS birds transmit an atomic clock timing signal that can be used, and is being used, to control telecommunications networks, bank transfers, power distribution grids, among others.

But there are problems.

The first problem is that the GPS signal is so weak that it is regularly wiped out by natural phenomena and by other radio transmissions. And anyone with \$50 and a soldering iron can buy parts from a radio store and make a jammer to destroy the GPS signal for a hundred miles. The world's terrorists, as well as the world's military, are well aware of this.

The second problem is that the US controls the GPS birds and can turn them off at any time.

Vulnerability and sovereignty are the two great unresolved issues for GPS and, indeed, all GNSS systems.

What to do?

## II. CHARTING THE WAY WITH PDD

The US put up GPS and controls the birds via a coded uplink. A DOD control station in Colorado can move the birds to different orbits, degrade the accuracy of the signal, and turn off the signal for part, or all, of the orbit. And regularly does so. Naturally, the rest-of-the-world (ROW) wants to know how the US will exercise this control.

The answer is found in the famous Presidential Decision Directive (PDD), a White House press release that is the first public statement of GNSS operating policy.

The PDD deserves careful reading because the language is not crystal clear. There are two critical clauses.

The first says that GPS will be provided continuously, without charge, for civil purposes.

The second says that GPS will remain responsive to the National Command Authority, i.e., the President of the United States. So the PDD reserves to the US the right to turn off, degrade, or spoof GPS whenever, and wherever it wants without prior notice or explanation.

Given the military significance of GPS, including both benefit and risk to my country and its allies, I approve of this policy. It is obvious that the US is not going to give up or share control of GPS. GPS will not be internationalized, as the US has recently confirmed and as Commissioner Neil Kinnock of the EC noted in Toulouse.

And I further predict that the inevitable new GNSS arrays, by the EU or others, will reserve the same controls to the owners.

### III. THE CIVIL WORLD AT RISK

These terms make perfect military sense. But they pose a terrible dilemma to civil users in ROW. Because the economies of many nations, perhaps every nation, will become increasingly dependent on GNSS for navigation and timing services. And GNSS can be suddenly turned off by the owner, or disrupted by a terrorist! The consequences to a GNSS-dependent economy would be catastrophic. Now we face the modern era's best example of the law of unintended consequences.

I guarantee you that the US DOD did not foresee that its GPS would be hijacked by the civilian economy. But it happened, and the world's politicians and diplomats need to solve this problem now.

To date the response to this problem, or perhaps the awareness of it, has been disappointing. The US has understandably resisted attempts to share control of GPS and to impose an impractical liability regime.

There is an ongoing debate within ICAO, which is a good forum for the issue. Recently the US and others have argued that existing laws are adequate because existing radio navigation signals cross borders and current laws serve well enough. But is this like GPS? No. This is an argument only a lawyer could love.

In October, ICAO set up a study group to consider a multi-lateral treaty to set out the rights and obligations of GNSS providers and users. This process deserves the highest level of attention, especially from the US, because a new legal framework is needed.

#### IV. THE POST WAR WORLD AND THE MARSHALL PLAN

The principles that have structured the post-war world for America and its allies were articulated by General Marshall at Harvard in 1948. Rejecting the notion that the allies should control much of the world, the Marshall Plan endorsed the principle that world peace and prosperity were best assured by free and independent nations joining in voluntary associations. The UN and a host of other groupings reflect this successful precept.

Nowhere was it contemplated that one nation, or group of nations, could throw a switch and wreck the economies of other nations. GNSS systems, including GPS, raise this specter. No one contemplated this possibility, of course, when GPS was set up. There are no villains of this piece. But modern technology outran our vision and the world must find a solution.

#### V. A TWO PART SOLUTION

As I noted, there are two issues to be addressed: GNSS vulnerability and sovereignty.

#### A. VULNERABILITY

The GPS signal is extremely weak: one ten quadrillionth of a watt ( $10^{-16}$  watt). Modern receivers work fine with this ultra faint signal. But the signal is regularly lost to unintended causes, such as natural phenomena and other electronic transmissions. Careful technical work, and a second civil frequency, can probably control this problem. But the more vexing issue is intentional interference, such as jamming. Simple, low cost noise jammers can kill GPS for a hundred miles. Multiple jammers, or jammers sent up in a balloon, can wipe out GPS over an entire region. Spoofing jammers, which imitate the GPS signal, are more complicated and expensive. A one watt spoofing jammer can kill GPS for 350 miles.

The US DOD and other military forces have been aware of these problems for years and worked in secret for a cure. The conclusion: there is no assured cure. As Mike Shaw of the DOD's C<sup>3</sup>I office was quoted as saying, "There is very little we can do to prevent intentional jamming" (Aviation Daily, 2 Apr 98). All US DOD vehicles carry a second, dissimilar navigation system, such as inertial systems, LORAN, or VOR/DME, in case GPS is lost.

This issue is now well understood in the civil technical world, even though the military defenses against jamming are, for good reasons, secret.

The US civil authorities are still studying this problem. Soon the US DOT will formally adopt the same conclusion as the US DOD: relying on GPS alone for navigation carries a significant risk and a secure, alternate system must be carried.

The ROW needs to hear this from the US DOT, and the sooner the better. Because this addresses, and largely solves, the liability issue. Other nations then will understand that they rely solely on GPS at their own risk.

And if they install or retain back-up systems, they are protected against loss of GNSS by any cause.

## B. SOVEREIGNTY

It is now clear that no GNSS provider will voluntarily give up the power to turn off its own GNSS systems. The defense imperatives are just too great.

But the GNSS providers can, and should, state the conditions under which they provide the signal to other nations. This can be done while fully protecting the providers interests.

Attorney General Rattray of Jamaica called for “bankable guarantees” of the GNSS service. He has a point: it can be done.

The solution is a multi-lateral treaty.

## VI. THE GNSS SAFETY AND SOVEREIGNTY CONVENTION OF 2000

### A. GUARANTEE OF CONTINUITY

The treaty should require the ratifiers to promise to provide the civil signal continuously to all, with specified exceptions.

### B. EXCEPTIONS

The treaty should list the specific causes for which the provider is entitled to withdraw or alter the signal.

This provision will be the subject of hard bargaining. Military causes, including terrorism, are a minimum. The US, the EU, Russia, and other potential providers have a common interest in insisting on a broad definition of the military triggers for withdrawal of the signal. And the providers can probably get the terms they seek: what good is a treaty that is not ratified by the provider?

An exception for economic sanctions will be controversial. Most of the world abhors economic sanctions. The US employs them because they are preferable to warfare. This point may be resolved technically: the birds can be turned on and off but the imprint would be over a large area. The GPS signal is



not a pencil beam and cannot be focused on, or withdrawn, along national boundary lines.

There should also be a requirement for notification to the ROW, though this would be instantly obvious.

### C. USER CHARGES

The US PDD states that the GPS signal will be provided free of charge. This statement can be relied on for reasons unique to the US. Domestically the US does not assess user charges for CNS/ATM services as a matter of national policy. Outside the US, no one could figure out how to assess and collect charges for GPS.

Other providers, specifically the EU, have a different practice. Virtually all other countries charge for CNS/ATM services. Even so, GNSS may be hard to charge for since everyone agrees that all GNSS signals should have the same format and be interoperable – a seamless system. How can you charge for a service, most of which is provided for free by the US?

On balance, the issue of user fees should probably be determined outside the treaty.

### D. LIABILITY

The treaty should find that GNSS signals are subject to interruptions that cannot all be controlled by the users, user nations, or provider nations. All stakeholders must therefore provide an alternate, dissimilar source for positioning and timing where loss of the GNSS signal would cause significant harm. And all GNSS users assume the full risk of loss in respect to the provider.

### E. INTEROPERABILITY

The treaty should direct ICAO to adopt Standards and Recommended Practices (SARPS) for the signal format and for receivers so that all GNSS aviation users can operate worldwide with the same receiver – a seamless system. The International Maritime Organization should undertake the same task for marine users.

## VII. GNSS – FUTURE POTENTIAL

This paper has necessarily dwelt on the darker aspects of satellite positioning and timing because the issues of vulnerability, liability, and sovereignty/continuity are acute and are on the table now. Unless they are addressed and resolved they will destabilize world peace and limit universal use. But there is a way out of the dilemma, and it lies in stating and accepting the inherent limitations of GNSS, and in clearly establishing the terms upon which the signal is provided.

The good news is that satellite positioning and timing is a stunning technology with potential to create jobs, provide desperately needed infrastructure, and advance the developing world. The technology is splendid. We just need to manage it properly.

END

### **AUTHOR'S NOTE**

"The GNSS Safety & Sovereignty Convention of 2000 AD" is a policy paper and draws heavily on my experience as a government official. Its purpose is to translate technical risk into a broadly acceptable multilateral treaty.