

TENDLER Cellular

Robert K. Tandler, Chairman

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August 19, 1996

Office of Secretary
Federal Communications Commission
919 M Street, N.W.
Washington DC 20554

DOCKET FILE COPY ORIGINAL

RE: Comments to the Further Notice of Proposed Rulemaking
CC Docket No. 94-102; RM 8143

Dear Sir/Madame:

Enclosed herewith are comments to the Further Notice of Proposed Rulemaking adopted June 12, 1996 from Tandler Cellular, Inc.

It would be appreciated if the Commission would consider these comments.

Respectfully Submitted,


Robert K. Tandler
Chairman

RKT:lpc

enclosures, original and 9 copies

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

RECEIVED
AUG 20 1996
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In the Matter of)
)
Revision of the Commission's Rules) CC Docket No. 94-102
To Ensure Compatibility with) RM-8143
Enhanced 911 Emergency Calling Systems)

To: The Commission

REPLY COMMENTS BY TENDLER CELLULAR, INC.
TO THE FURTHER NOTICE OF PROPOSED RULE MAKING

INTRODUCTION

Prior to commenting on position accuracies and the speed with which automatic location information can be provided with present day technology, Tandler Cellular's role in the initial NPRM is now discussed. In response to the Notice and Order dated July 26, 1996 Tandler Cellular to notes that the requirements for ANI and ALI are now in place. In it's initial submission dated December 29, 1994 to the original NPRM concerning the location of E-911 cellular callers, Tandler Cellular commented favorably on the ability to meet the requirements for ALI (Automatic Location Identification) through the utilization of GPS Technology coupled with voice synthesis technology to verbally report in spoken language and in real time the latitude and longitude of a cellular telephone equipped with a GPS receiver and the synthesized speech

technology. The system also verbally reports the mobile identification or number or MIN, eg the cell phone number. The verbal communication of lat./lon. plus verbal communication of cell phone number satisfies the above identified Report and Order for new phones.

It is noted that the provision of such technology requires no infrastructure in order to report to the PSAP the latitude and location of the E911 caller. As a result, while the Report and Order is contingent upon cost effective technology, it is Tandler Cellular's position that presently-available cost-effective technology exists and will be available by year's end in a unitary hand held cellular phone and in a handsfree cradle version in which the GPS receiver and the synthesized voice technology is incorporated in the cradle.

ACCURACY

Attention is now turned to the main focus of the Further NPRM which, inter alia, seeks comments as to the technical feasibility of 10 meter accuracies for location of cellular E-911 callers. This accuracy can be achieved by the present GPS system if Selective Availability is turned off.

Selective Availability or S/A refers to the intentional degradation of position information obtained from GPS satellites obtained by dithering the pseudo range value transmitted by the GPS system such that the accuracy is no better than 100 meters with S/A turned on. The entity which

has control over the turning on or off of S/A is "The National Command Authority", eg. the President of the United States.

Positional accuracy of the GPS system as well as the Russian GLONASS system is regularly monitored. For instance, Lincoln Laboratories at MIT (See Exhibit A) regularly records a scatter pattern indicating the positional accuracy of both the GPS satellites, GLONASS satellites, and GLONASS satellites enhanced with the superior time clocks of the GPS satellites. The Internet web site for this information is as follows:

<http://satnav.atc.ll.mit.edu/>

Note that The Honorable Edward M. Kennedy was successful in cosponsoring an amendment to the Defense Authorization Act to require S/A to be turned off by May 1, 1996, unless the DOD put together a Research and Development program to address this issue. (See Exhibit B H.R. 1530). Just prior to this deadline the DOD promulgated an RFQ for the above-identified research, thus removing the May 1, 1996 deadline. (See Exhibit C PSA-1549)

Thereafter The White House issued a Presidential Decision Directive or PDD, announced March 29, 1996 by Vice-President Al Gore (See Exhibit D) which set as a goal the elimination of S/A "within a decade". Citing commercial applications, the Directive specified that the GPS system would be made available to the public and would be maintained by the DOD, as opposed to the Department of Transportation or Commerce.

Were Selective Availability to be turned off, the accuracy for the current GPS system would be in the ten meter

range, clearly meeting the ten meter requirement of the Further NPRM.

In support of a decision to turn off S/A, the undersigned has authored two articles, one in Cruising World Magazine and one in Defense Conversion Newsletter (Appended hereto as Exhibit E) in which it is argued that there is no military requirement for S/A in view of the GLONASS satellites which signals are not dithered. In view of the availability of GLONASS receivers both within the continental United States and the through Russian governmental agencies, and in view of the ready availability of so-called Beacon receivers which when in place near a target provide signals for correcting the dithered signals, any perceived assistance to the military of the dithering evaporates.

Note these Beacon receivers are available from the Leica Corporation, the successor in interest to the beacon technology developed by Magnavox Corporation and provided to the U.S. Coast Guard.

As mentioned in one of these articles, it is interesting to note that in the Gulf War the United States through the Department of Defense turned off S/A to permit troops and tank commanders to find their position in the desert, in direct opposition to the stated goal of the S/A, namely to protect troops from hostile use of the GPS system.

As one final comment, in an effort to persuade the National Command Authority to turn off S/A, it is noted that the original system produced by the Rockwell Corporation has cost

the tax payers twenty-six million dollars initially, with the full compliment of twenty-six satellites now having cost the taxpayers six to seven billion dollars. President Clinton has indicated the desire to turn off S/A as indicated by the above Directive so that the taxpayers can reap the benefits of a system, originally generated for Department of Defense use, now having major commercial and recreational spin off.

The Problem is WHEN?

With the support of the Federal Communications Commission, it is deemed that the National Command authority can be persuaded to turn off S/A, thereby meeting and ultimately exceeding the positional accuracy requirements of the Further NPRM.

LOCATION REPORTING SPEED

The Further NPRM requests comments on the speed by which it is possible to report E-911 cellular phone location to a PSAP. While triangulation systems have an inherent computation overhead or time before calculating and reporting position, present GPS receivers have location information available on average once a second. This permits real time tracking of the GPS receiver and thus the phone if it is co-located with the receiver. Tests with the precursor to the FoneFindertm System, namely the Mayday Miketm system for marine VHF radios provided verbal updates of the position as quickly as they could be spoken. Thus in one embodiment with an approximate time of 10 seconds to speak the entire position sentence,

verbal updates could be obtained every ten seconds. Digital automation does not significantly improve this real time report of position compared to the one to two minutes required for some triangulation systems.

CONCLUSION

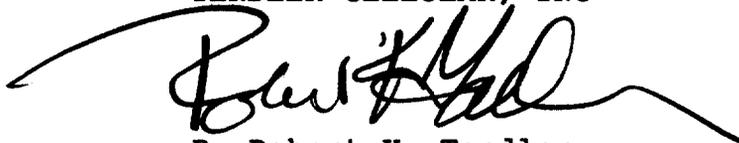
It is therefore Tandler Cellular's position that the technology presently exists for reporting the location of the E-911 cellular call to a PSAP in real time within the required ten meter range, should the National Command Authority turn off S/A. Alternatively, technology exists presently to acquire the GLONASS satellite signals, which signals have the requisite accuracy.

In summary, in view of the urgent public safety need for the location of cellular E911 callers, it is Tandler Cellular's position that the technology currently exists to meet the position accuracy and position reporting requirements of the Further NPRM, save only for the National Command Authority removing Selective Availibility. The removal of Selective Availability is appropriate insofar as there appears to be no military advantage view of the GLONASS satellites, GLONASS satellite receiver availability, and readily available Beacons.

Consideration of the above comments is respectfully solicited.

Respectfully submitted,

TENDLER CELLULAR, INC

A handwritten signature in black ink, appearing to read "Robert K. Tandler", with a long, sweeping horizontal line extending to the right.

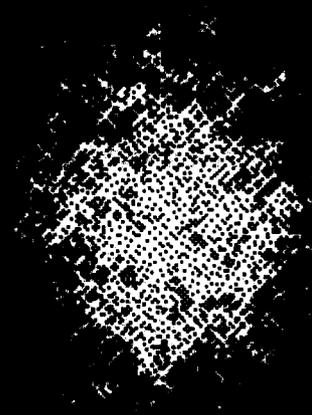
By Robert K. Tandler
Chairman

EXHIBIT A

GPS POSITION ESTIMATION

ANDREW S. HAYES AND JOHN J. KANE

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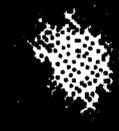
GPS

© Andrew S. Hayes and John J. Kane

GLONASS POSITION ES

EDITED BY V. V. KRYLOV

ISSN 1069-3513



GLONASS

(ISSN 1069-3513)

EXHIBIT B

THIS SEARCH

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H.R.1530

National Defense Authorization Act for Fiscal Year 1996 (Enrolled Bill (Sent to President))

SEC. 279. GLOBAL POSITIONING SYSTEM.

(a) **CONDITIONAL PROHIBITION ON USE OF SELECTIVE AVAILABILITY FEATURE-** Except as provided in subsection (b), after May 1, 1996, the Secretary of Defense may not (through use of the feature known as 'selective availability') deny access of non-Department of Defense users to the full capabilities of the Global Positioning System.

(b) **PLAN-** Subsection (a) shall cease to apply upon submission by the Secretary of Defense to the Committee on Armed Services of the Senate and the Committee on National Security of the House of Representatives of a plan for enhancement of the Global Positioning System that provides for--

(1) development and acquisition of effective capabilities to deny hostile military forces the ability to use the Global

Positioning System without hindering the ability of United States military forces and civil users to have access to and use of the system, together with a specific date by which those capabilities could be operational; and

(2) development and acquisition of receivers for the Global Positioning System and other techniques for weapons and weapon systems that provide substantially improved resistance to jamming and other forms of electronic interference or disruption, together with a specific date by which those receivers and other techniques could be operational with United States military forces.

SEC. 280. REVISION OF AUTHORITY FOR PROVIDING ARMY SUPPORT FOR THE NATIONAL SCIENCE CENTER FOR COMMUNICATIONS AND ELECTRONICS.

(a) PURPOSE- Subsection (b)(2) of section 1459 of the Department of Defense Authorization Act, 1986 (Public Law 99-145; 99 Stat. 763) is amended by striking out 'to make available' and all that follows and inserting in lieu thereof 'to provide for the management, operation, and maintenance of those areas in the national science center that are designated for use by the Army and to provide incidental support for the operation of those areas in the center that are designated for general use.'

(b) AUTHORITY FOR SUPPORT- Subsection (c) of such section is amended to read as follows:

'(c) NATIONAL SCIENCE CENTER- (1) The Secretary may manage, operate, and maintain facilities at the center under terms and conditions prescribed by the Secretary for the purpose of

EXHIBIT C

To: Bob Tendler, (617) 723-7186
From: Glen Gibbons, GPS World

COMMERCE BUSINESS DAILY

Issue No. PSA-1549

Date: 03/12/96

Services

Research and Development

Synopsis# 0011 - POTENTIAL SOURCES SOUGHT

HQ Space and Missile Systems Center (AFMC) SMC/CZK, 2435 Vela Way, Suite 1613, Los Angeles AFB, CA 90245-5500

A -- GPS SYSTEM LEVEL ARCHITECTURE SOL PRDA 96-34 POC Technical Contact Point: Ms Mary Guyse, (310)363-2619; Contracting Officer: Ms CC Coleman, (310)363-6360. The NAVSTAR Global Positioning System (GPS) Joint Program Office (JPO) is seeking potential offerors for the Navigation Warfare Program (NAVWAR) to develop a systems-level solution that will PROTECT the Department of Defense (DoD) and U.S. Allies operational use of GPS during times of conflict, while PREVENTING use of GPS by adversaries. The goals of this program are to implement acquisition streamlining initiatives, reduce system costs, stimulate competition, reduce Government oversight and solve emerging requirements by stimulating and encouraging technical innovation. The objective is to achieve these goals by selecting a prime contractor to design, develop, implement, and support an integrated NAVWAR architecture. The NAVWAR program is ultimately anticipated to include three phases: Evaluation, Engineering Manufacturing Development (EMD), and Production. Funding is only available for the Evaluation phase at this time. The objective of the Evaluation Phase is to create a system-level architecture, to be developed in 1998-2000 and implemented in the 2001-2006 time frame. The Evaluation phase objectives will be met when: 1) an integrated system level architecture involving the satellite signal in space, all DoD user equipment (to include munitions), and a prevention capability are defined, 2) performance requirement thresholds and objectives are recommended, and 3) a business strategy that identifies how the system-level architecture will be implemented is provided. At a minimum, the strategy must address how, throughout the life of the system, competition will be fostered, cost reduction will be pursued and controlled, emerging technologies will be pursued and incorporated, and user equipment and prevention assets will be economically and logistically supported. This Evaluation phase will be solicited using Program Research and Development Announcement (PRDA) procedures (published approximately Apr 96). The Government may award one or more contracts for this phase and cost-sharing may be considered. Contract award for the Evaluation phase is anticipated for Aug 96 with data deliveries in Aug 97. During the Evaluation phase, the

Government will formulate a detailed acquisition strategy for the remainder of the program, including competitive source selection. The objective of the EMD phase is to develop and demonstrate prevention and protection equipment. Contract award for the EMD phase is currently anticipated for Jan 98, with a period of performance concluding in FY 2000. This is anticipated to be followed by a production phase in FY 2000 based on firm requirements. Those offerors having applicable interest, qualifications, capability and background must submit clear and convincing documentation that demonstrates their ability to meet the objectives of the Evaluation phase. Qualified offerors should possess a Secret facility clearance and approved classified material storage container(s) in order to receive and store classified portions of Government-Furnished Information (GFI). This acquisition requires the prime contractor(s) to be U. S. owned and controlled and on-shore. Off-shore subcontractors are authorized for non-restricted portions of the acquisition. Offerors must indicate whether they are a Small Business concern, use Standard Industrial Classification Code 8731 (1,000 employees). The Government will host an Industry Day on 9 Apr 96 at the Aerospace Corporation, 2350 El Segundo Blvd., El Segundo, CA 90245 to provide potential offerors with a briefing describing the NAVWAR program objectives and the acquisition strategy. The meeting will begin at 0800 in building A8, Lower Level Conference Room. Seating is limited, therefore written advance requests for admittance are required. The briefing will be Secret and only U.S. citizens will be authorized. Submit visit requests to Hester Bing, Aerospace Corporation, telephone (310) 336-5038, fax (310) 336-6983. Requests should specify NAVWAR Industry Day. An Ombudsman has been appointed to hear concerns from offerors or potential offerors during the proposal development phase of this acquisition. The purpose of the Ombudsman is not to diminish the authority of the Program Director or the Contracting Officer, but to communicate contractor concerns, issues, disagreements and recommendations to the appropriate government personnel. When requested, the Ombudsman will maintain strict confidentiality as to the source of the concern. The Ombudsman does not participate in the evaluation of proposals nor in the source selection process. The Ombudsman, Mr. Leslie Bordelon, can be reached at (310) 363-3818. Direct technical questions to Mary Guyse, SMC/CZUN, at (310) 363-2619 and contractual questions to CC Coleman, SMC/CZK, at (310) 363-6360. Written responses shall be submitted to SMC/CZK, 2435 Vela Way, Suite 1613, Los Angeles AFB, CA 90245-5500, Attn: Capt Julie Wittkoff. This synopsis is for information and planning purposes only and does not constitute a solicitation, nor is it to be construed as a commitment by the Government. The Government will not pay for any effort expended in responding to this notice. (0068)

Provided by Federal Information & News Dispatch, Inc. 202-544-4800

EXHIBIT D

THE WHITE HOUSE

**Office of Science and Technology Policy
National Security Council**

FOR IMMEDIATE RELEASE

March 29, 1996

Contact: (202) 456-6020

FACT SHEET

U.S. GLOBAL POSITIONING SYSTEM POLICY

The President has approved a comprehensive national policy on the future management and use of the U.S. Global Positioning System (GPS) and related U.S. Government augmentations.

Background

The Global Positioning System (GPS) was designed as a dual-use system with the primary purpose of enhancing the effectiveness of U.S. and allied military forces. GPS provides a substantial military advantage and is now being integrated into virtually every facet of our military operations. GPS is also rapidly becoming an integral component of the emerging Global Information Infrastructure, with applications ranging from mapping and surveying to international air traffic management and global change research. The growing demand from military, civil, commercial, and scientific users has generated a U.S. commercial GPS equipment and service industry that leads the world. Augmentations to enhance basic GPS services could further expand these civil and commercial markets.

The basic GPS is defined as the constellation of satellites, the navigation payloads which produce the GPS signals, ground stations, data links, and associated command and control facilities which are operated and maintained by the Department of Defense; the Standard Positioning Service (SPS) as the civil and commercial service provided by the basic GPS; and augmentations as those systems based on the GPS that provide real-time accuracy greater than the SPS.

This policy presents a strategic vision for the future management and use of GPS, addressing a broad range of military, civil, commercial, and scientific interests, both national and international.

Policy Goals

In the management and use of GPS, we seek to support and enhance our economic competitiveness and productivity while protecting U.S. national security and foreign policy interests.

Our goals are to:

- (1) **Strengthen and maintain our national security.**
- (2) **Encourage acceptance and integration of GPS into peaceful civil, commercial and scientific applications worldwide.**
- (3) **Encourage private sector investment in and use of U.S. GPS technologies and services.**
- (4) **Promote safety and efficiency in transportation and other fields.**
- (5) **Promote international cooperation in using GPS for peaceful purposes.**
- (6) **Advance U.S. scientific and technical capabilities.**

Policy Guidelines

We will operate and manage GPS in accordance with the following guidelines:

- (1) **We will continue to provide the GPS Standard Positioning Service for peaceful civil, commercial and scientific use on a continuous, worldwide basis, free of direct user fees.**
- (2) **It is our intention to discontinue the use of GPS Selective Availability (SA) within a decade in a manner that allows adequate time and resources for our military forces to prepare fully for operations without SA. To support such a decision, affected departments and agencies will submit recommendations in accordance with the reporting requirements outlined in this policy.**
- (3) **The GPS and U.S. Government augmentations will remain responsive to the National Command Authorities.**
- (4) **We will cooperate with other governments and international organizations to ensure an appropriate balance between the requirements of international civil, commercial and scientific users and international security interests.**
- (5) **We will advocate the acceptance of GPS and U.S. Government augmentations as standards for international use.**
- (6) **To the fullest extent feasible, we will purchase commercially available GPS products and services that meet U.S. Government requirements and will not conduct activities that preclude or deter commercial GPS activities, except for national security or public safety reasons.**

- (7) A permanent interagency GPS Executive Board, jointly chaired by the Departments of Defense and Transportation, will manage the GPS and U.S. Government augmentations. Other departments and agencies will participate as appropriate. The GPS Executive Board will consult with U.S. Government agencies, U.S. industries and foreign governments involved in navigation and positioning system research, development, operation, and use.

This policy will be implemented within the overall resource and policy guidance provided by the President.

Agency Roles and Responsibilities

The Department of Defense will:

- (1) Continue to acquire, operate, and maintain the basic GPS.
- (2) Maintain a Standard Positioning Service (as defined in the Federal Radionavigation Plan and the GPS Standard Positioning Service Signal Specification) that will be available on a continuous, worldwide basis.
- (3) Maintain a Precise Positioning Service for use by the U.S. military and other authorized users.
- (4) Cooperate with the Director of Central Intelligence, the Department of State and other appropriate departments and agencies to assess the national security implications of the use of GPS, its augmentations, and alternative satellite-based positioning and navigation systems.
- (5) Develop measures to prevent the hostile use of GPS and its augmentations to ensure that the United States retains a military advantage without unduly disrupting or degrading civilian uses.

The Department of Transportation will:

- (1) Serve as the lead agency within the U.S. Government for all Federal civil GPS matters.
- (2) Develop and implement U.S. Government augmentations to the basic GPS for transportation applications.
- (3) In cooperation with the Departments of Commerce, Defense and State, take the lead in promoting commercial applications of GPS technologies and the acceptance of GPS and U.S. Government augmentations as standards in domestic and international transportation systems.
- (4) In cooperation with other departments and agencies, coordinate U.S. Government-provided GPS civil augmentation systems to minimize cost and duplication of effort.

The Department of State will:

- (1) In cooperation with appropriate departments and agencies, consult with foreign governments and other international organizations to assess the feasibility of developing bilateral or multilateral guidelines on the provision and use of GPS services.
- (2) Coordinate the interagency review of instructions to U.S. delegations to bilateral consultations and multilateral conferences related to the planning, operation, management, and use of GPS and related augmentation systems.
- (3) Coordinate the interagency review of international agreements with foreign governments and international organizations concerning international use of GPS and related augmentation systems.

Reporting Requirements

Beginning in 2000, the President will make an annual determination on continued use of GPS Selective Availability. To support this determination, the Secretary of Defense, in cooperation with the Secretary of Transportation, the Director of Central Intelligence, and heads of other appropriate departments and agencies, shall provide an assessment and recommendation on continued SA use. This recommendation shall be provided to the President through the Assistant to the President for National Security Affairs and the Assistant to the President for Science and Technology.

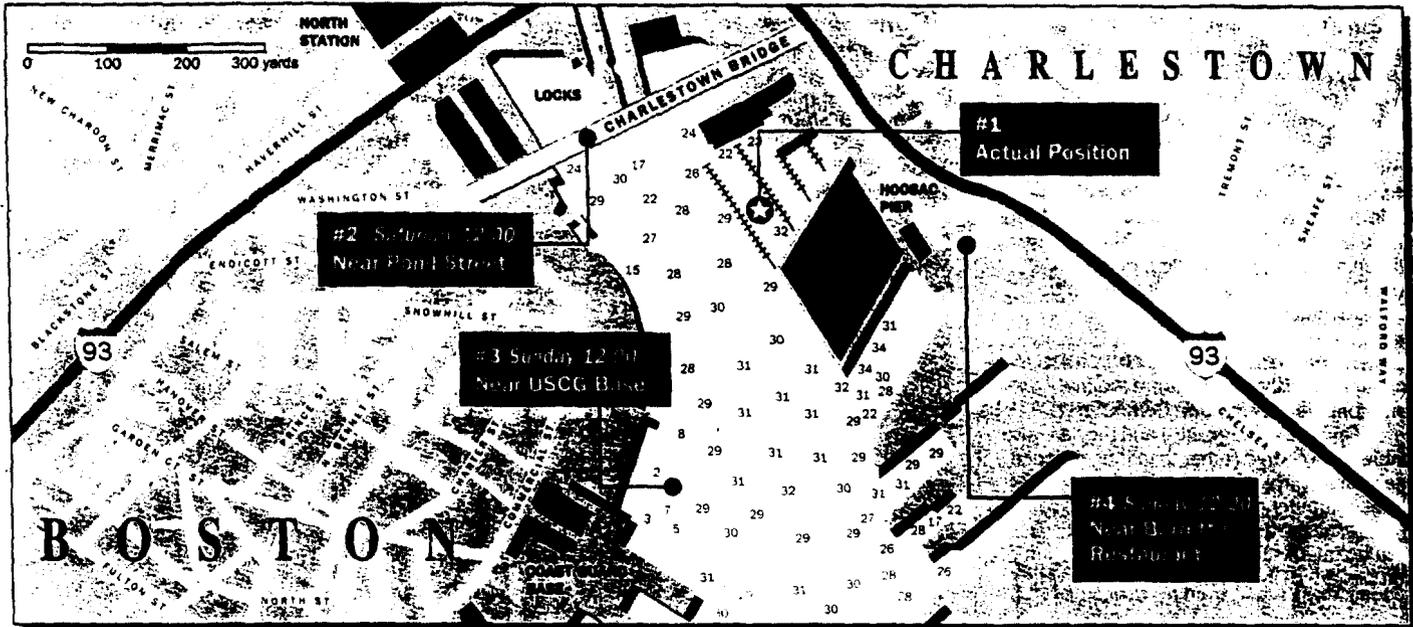
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EXHIBIT E

Opinion

by Bob Tendler

GPS: To Dither Or Not To Dither



The U.S. government may dither GPS signals as often as every two or three minutes. The positions above appeared on the author's electronic plotter over the course of a weekend at a dock near Boston, Massachusetts, demonstrating the danger of relying on dithered GPS signals when navigating in fog or near hazards.

Back in the old days of the Cold War, when Soviet intercontinental ballistic missiles were targeted on hardened missile silos in the United States, along came the Global Positioning System, or GPS. In an effort to help U.S. troops find themselves, Rockwell International and the U.S. Department of Defense decided on an ambitious program to place 24 satellites in orbit so that our country's military could conduct battles more precisely, anywhere on the face of the Earth.

The unintentional effect of providing an extensive GPS system was that it benefited not only the military, but also the citizenry at large, who had paid for the system. From cartographers to mariners to automobile drivers, GPS became a tool for the masses as much as a tool for the military.

However, with the implementation of GPS came the problem that enemies of the United States could use the system for their own purposes. Specifically, it was thought that with GPS, missiles targeted on the United States could be made so accurate as to come within 100 yards of a hardened missile silo, thereby destroying it. So in a countermeasure, the Department of Defense developed Selective Availability, in which the signals from the GPS satellites are dithered, limiting the accuracy to 300 yards as

opposed to the previous 100 yards. Selective Availability can be switched on or off at will so that U.S. forces can use the exceptional accuracy of GPS in time of battle.

Among the most influential advocates of Selective Availability were the architects of the Strategic Defense Initiative, known popularly as the Star Wars Project. Star Wars, initially conceived to intercept missiles in space, became an entity unto itself with justification based on the notion that there could be a 100-percent safety net to block an incoming missile onslaught.

Well, technology has proven to have some limitations and this was no more evident than in the Gulf War when even the best of American technology could not prevent the raining down of missiles fired by Saddam Hussein in the Middle East. So much for absolute certainty and, quite frankly, so much for Cold War logic.

Selective Availability became even more obsolete when the Russians implemented a duplicate GPS system called Glonass. Presently the Russians do not dither the signals from their satellites. Anyone who wants more accuracy than that available from dithered U.S. satellites needs only to tune a GPS receiver to the Russian GPS satellite and — voilà — 30-meter accuracy.

As for the U.S. system, it should be noted

that the GPS signal has both a fine- and a coarse-acquisition code. If civilians could get the fine-acquisition code for U.S. satellites, the error would drop to 21 meters, as opposed to 100 meters for the coarse signal. (Even that is too much error in and around harbors. Hence, differential GPS — explained below — may be the final answer.) In the meantime, 100-meter accuracy with Selective Availability presents some large problems, not only for position, but also because GPS-produced speed indications vary wildly and erratically when Selective Availability is on.

Why all the need for such accuracy in the marine environment? All one has to do is sit at the dock with an electronic plotter turned on and watch the apparent position of the boat shift rapidly in 1/5-mile jumps. As can be seen in the illustration, a boat moored at Constitution Marina in Charlestown, near Boston, Massachusetts, would find the vessel's position alternately at the Coast Guard Station across the channel, on an iron bridge that spans the outflow of the Charles River between Cambridge and Boston, or at Barrett's, the author's favorite restaurant — all of which are spaced from the vessel's real position by as much as 1/5 of a mile. If one relied on GPS to navigate when the Defense Department is dithering the signal, one

would be aground more often than not, albeit eating well.

While accuracy on the high seas may not be a problem, the general public believes that GPS can provide 10-meter accuracy. Not so with Selective Availability. Anyone who cruises in regions prone to fog would very much like to have the 10-meter accuracy. Problem is, one never knows when Selective Availability is turned on, so it is impossible to know when to rely on one's own instruments.

By way of remedy, the Department of Defense has imposed upon another govern-

where the only justification is to protect our hardened silos.

Some think that using Selective Availability will prevent cruise missiles from being able to navigate the streets of a target area. However, the Department of Defense does not use GPS position location for these missiles; rather, it relies on internal guidance systems that sense accelerations and provide the position to the cruise missile. GPS does not play a role in this guidance system.

In view of all this, it becomes increasingly clear that the federal government would be well served to give up on its dithering of the

"Dithering" is a term techies use to describe the U.S. government's policy of intentionally degrading GPS signals. This author argues that it is expensive, inefficient and in no one's clear interest

ment agency — namely, the Coast Guard — to undither the signals that it dithered. The result is a system called "Differential GPS," or DGPS. In order to do this, the Coast Guard has erected beacon stations (at a proposed cost of \$15 million) to broadcast corrective signals on a different frequency to vessels within 200 miles of the beacon. Magnavox and the Coast Guard developed GPS beacon transmitters that take the known position of the beacon and compare it with the calculated position from the GPS, thereby achieving an error between the calculated position and the known position. This error is calculated in terms of a "pseudo range number," which is then broadcast to a beacon receiver onboard the vessel. The beacon receiver corrects the pseudo range number so that the onboard GPS can accurately reflect position. Through use of a DGPS beacon, the system attains as much as a five- to 10-meter accuracy.

Another problem central to the GPS debate is that the world's charts are often inaccurate outside of the United States. For instance, some charts covering the Bahamas are based on very old surveys, the result being that charted latitudes and longitudes may differ from actual coordinates by as much as several miles. The situation is even more difficult in the Pacific, where sometimes the most accurate charts were prepared more than a century ago.

Were the Defense Department to make the fine-acquisition code available to cartographers, accuracies of +/- three meters would be possible. Even turning off Selective Availability for certain specified time periods to allow cartographers to rechart the world would help. Of course, the more rational solution would be to eliminate Selective Availability at all times there isn't a declared war going on. Oddly enough, Selective Availability was turned off during the Gulf War. It is puzzling that the Department of Defense removes Selective Availability in a wartime situation, yet insists on activating it

GPS signals. It simply costs the users too much money for a scenario that does not make geopolitical sense. Beyond the nautical realm, GPS is becoming more and more available for mobile land use; before long, all cars will have a street map display and vehicle position noted on the map. As that happens the general public will derive much more benefit from the removal of Selective Availability than the perceived military benefit of keeping it in place. From the mariner's point of view, the case for removing Selective Availability is eminently clear. Anyone who navigates in treacherous waters cannot rely on GPS in its present form. GPS receivers do not know when Selective Availability is in progress and therefore there is no way to know when to rely on one's instruments. Additionally, the world's charts lack accuracy in many places and by turning off Selective Availability for charting, one can improve navigation not only for the recreational sailor, but also for the military, which also requires more accurate charts. If this article does nothing else, it should once again indicate to sailors that one must utilize GPS with a large measure of caution if one does not equip one's boat with a differential GPS beacon receiver.

Whenever a government agency spends money on a large-scale project, the citizenry should expect an attached civilian benefit. This could not be truer than with GPS, which started out as a military project, but has an exceptionally useful civilian spinoff. For that reason, I strongly feel that Selective Availability should be used only when there is a perceived missile launch, that the Department Of Defense should make the fine-acquisition code available to the public and that the mariner should be free of dithering for dithering's sake.

Bob Tandler of Chestnut Hill, Massachusetts, is a patent lawyer and the inventor of such synthesized-voice electronic gear as the Depth Talker and the MAYDAY MIKE Rescue System. He avidly sails *Sahara Blue*, his Bristol 40, from her home port in Marblehead, Massachusetts.