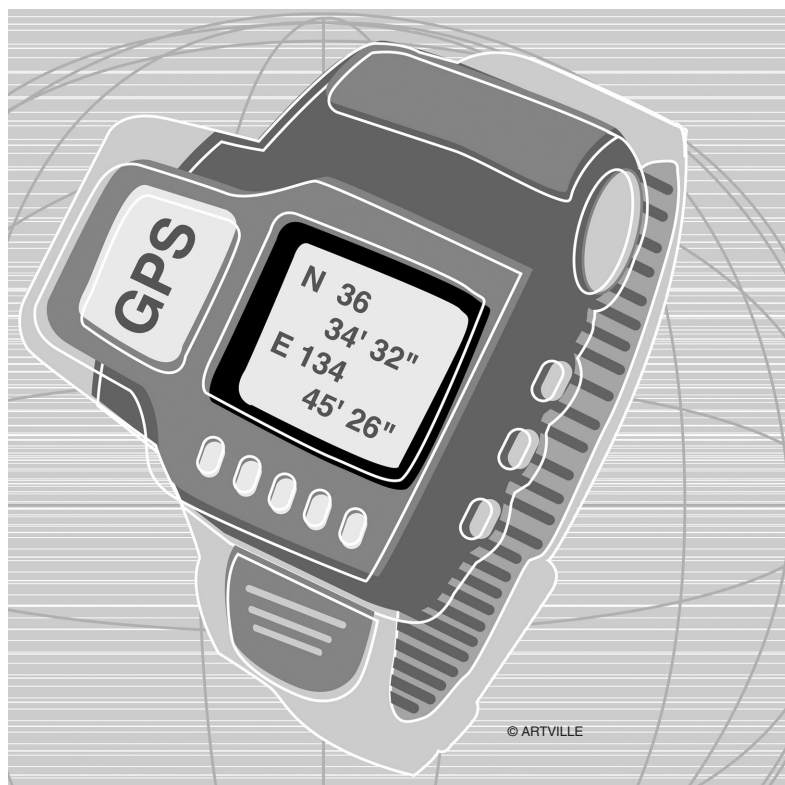


Geoslavery

Jerome E. Dobson and Peter F. Fisher



Geographic information systems (GIS) technologies, including Location Based Services (LBS) continuously fed by earth coordinate data streams derived from the Global Positioning System (GPS), recently have given rise to new consumer products advertised for tracking humans as well as animals. Heretofore, GIS has raised public concerns about information privacy, primarily due to its capacity for rapid integration of spatial information and personal information from diverse sources [1]-[3]. Human tracking devices, however, introduce a new potential for real-time control that extends far beyond privacy and surveillance, *per se*. As a result, society must contemplate a

Jerome Dobson is a Research Professor at the University of Kansas, Lawrence, KS; email dobson@ku.edu. Peter Fisher is a Professor of Geographical Information at the University of Leicester, United Kingdom; email: pff1@le.ac.uk.

new form of slavery characterized by location control [4]. Geoslavery now looms as a real, immediate, and global threat [5].

Commercial vendors of human tracking systems, naturally, tout benefits and diminish, dismiss, or deny any potential for abuse. Indeed, the benefits of LBS are myriad, and human tracking is not all bad. Mountaineers, for example, can have the assurance that, if they have an accident while climbing, one call will alert an emergency service and report almost precisely where they are. As with many other information technologies, however, there are tradeoffs between physical security and personal safety, on the one hand, and privacy and personal freedom on the other. Hence, the countless benefits of LBS are countered by social hazards unparalleled in human history. Here we explore possibilities for mis-use that many would consider unethical.

Our principal objectives are to forewarn the public, foster debate,

and propose remedies. We focus primarily on hazards, reasoning that benefits get more than their due from commercial advertising, while hazards are ignored by vendors and, all too often, by public officials, as well. We describe the technologies and cite current products to demonstrate that the dangers are real, not imaginary as some “Big Brother” bugaboos have been in the past. We illustrate the danger through realistic scenarios of potential enslavement applications. We advocate a rational response that acknowledges the benefits and inevitability of adoption along with an overwhelming need for safeguards. Finally, we propose a remedy that may prevent the most egregious abuses while, simultaneously, preserving most benefits.

DEFINITION

Geoslavery is defined here as a practice in which one entity, the master, coercively or surreptitiously monitors and exerts control over the physical location of another

individual, the slave. Inherent in this concept is the potential for a master to routinely control time, location, speed, and direction for each and every movement of the slave or, indeed, of many slaves simultaneously. Enhanced surveillance and control may be attained through complementary monitoring of functional indicators such as body temperature, heart rate, and perspiration.

It is possible to monitor people and exert behavioral control manually, as slavemasters have done for centuries, or visually, as George Orwell imagined in *1984* [6]. The

in or attached to a person can continuously record that person's location. A miniature radio transmitter can report that person's location to anyone else with a radio receiver tuned to the proper frequency. A GIS can accept the continuous stream of incoming geo-coordinates and plot the person's every movement in real time. The GIS can readily relate these individual movements to streets, roads, and buildings and to the movements of other individuals. Anyone operating the GIS can follow these movements in real time or retrospectively for as long as data are retained.

Inexpensive human tracking systems that combine these three technologies are now commercially available and widely marketed. Individual units currently sell for less than \$300.

In addition to geo-location through GPS, mobile phones already are capable of providing location information of variable precision depending on the density

of transmitters. Indeed, the next generation of mobile phones will be far more accurate due to Enhanced Observed Time Difference (E-OTD) as part of the G3 standard, or will be linked to GPS. In the United Kingdom location information from the current generation of mobile phones has achieved prominence in a recent high profile criminal case, when the accused in the Damilola Taylor murder trial were acquitted partly on the telling evidence that mobile phones associated with them were used 2.4 miles away within 3 minutes of the report of the murder. The Crown Prosecution Service seems to have been unprepared for this defense, and offered no refutation or contrary arguments. This evidence was available from completely standard mobile phones of the current generation.

Employed coercively or surreptitiously, LBS products clearly constitute an invasion of privacy, employing surveillance technologies well beyond those envisioned in *1984* [6]. As Orwell warned, however, surveillance can confer control. Anyone monitoring the tracking system can exert control over the person being tracked by reprimanding or otherwise punishing the person in near real time or retrospectively at the end of each day, week, or year.

Only one other technology is necessary to enforce real-time control. Simply add a transponder that receives a radio command from the master and instantaneously shocks, stings, burns, or otherwise punishes the slave. The technical feasibility of two-way LBS has been proven. One human-tracking device comes with a remote-control lock, and another commercial product (not advertised for human tracking) comes with a GPS receiver and two-way radio combined in a single hand-held unit.

Thus, the master could prescribe a path in the GIS, the slave's spatial location could be transmitted continuously to the GIS, and software could be set to recognize any instance in which the slave's coordinates depart from the prescribed path. If the slave were to transgress, a command could be transmitted instantaneously to the transponder, which would administer punishment. The result would be an electronic form of geoslavery, equivalent to a human robot. To our knowledge, no human-oriented product currently takes this fateful step, but a human version would pose no greater technical challenge than those of similar systems used on animals today.

This scenario is particularly chilling in the light of the news that rats have been trained to be remotely controlled for navigating mazes and other location-based activities. The control is achieved by direct electronic stimulation of the brain

Society must contemplate a new form of slavery, characterized by location control.

key to widespread adoption, universal coverage, and exceptional precision, today, lies in recent advances of electronic information systems.

Human tracking systems, currently sold commercially without restriction, already empower those who would be masters, and safeguards have not yet evolved to protect those destined to become slaves. Current products freely exploit the GPS and other digital information offered as a public good, but no government has yet established any specific statutes or regulations restricting their use.

TECHNOLOGY

Three current technologies can be combined to enable one person to monitor and control the actions of one or many other individuals. A miniature GPS receiver implanted

from up to 500 m [7]. Linking this to a GIS with a digital map of the maze and GPS location information is almost trivial, technically.

CURRENT COMMERCIAL PRODUCTS

Products currently for sale can be used to enforce almost any spatial or temporal constraint that the master is willing to impose on the slave. A master can prescribe a route and force a slave to follow it to a precision measured in centimeters. Or, a master may grant a slave free rein except for certain areas defined as taboo. Or, a master may limit a slave's visits to specified places, times, and durations. Or, a master may prohibit intersections between a slave's track and that of any other specified slave or group of slaves.

Some current products (a short search on the WWW will reveal more) that offer the ability to monitor the positions of people or vehicles are shown in Table I.

Although not the stated intention of these vendors, it is quite possible for an abusive husband, for example, to purchase an inexpensive device or service that will enable him to follow his wife's every step, monitor her daily travels, report her whereabouts, identify whether she visits a specified friend, and time her stay on any

given visit. If she still loves him after all this, she cannot purchase his birthday gift without revealing which shop or shops she visited.

Such systems are already in use to incarcerate convicted criminals in Britain and the U.S. Prisoners are allowed to be in certain places at certain times, and not to range outside a prescribed polygon. These people have been found guilty in a recognized judicial system and are having their liberty curtailed as part of the criminal justice system. Others, however, may be subject to the same technology without due process.

HUMAN RIGHTS

Geoslavery is a global human rights issue. In the United States, United Kingdom, and other countries with long traditions of personal freedom, the most severe abuses may be avoided through cultural constraints and future legislation. In most of the world, however, abuses will be inevitable. In some countries geoslavery may be the principle LBS use and will spell the end of any semblance of freedom.

Traditional societies, especially, will face threats from inside and out. Lacking technical know-how and capital of their own, indigenous peoples may face intrusive threats from unscrupulous outsiders who coerce or trick them

into geoslavery. Glittering bracelet-style tracking devices may be given freely or sold at far below actual cost. Once deployed the devices can be used in any number of ways to enslave laborers and extract a financial return. Forced laborers on plantations, for example, may never be able to hide or escape their bondage; giving a new means for unscrupulous masters to abuse workers. Child slaves may be forced to beg or steal on specified streets for specified hours with no chance of hiding away for a little rest, much less escaping for good. Sex slaves may be confined to brothels, street corners, and specified trysts with little possibility of seeking other employment or escaping to their home villages.

Recognized as a new form of slavery, geoslavery will contravene Article 4 of the *Universal Declaration of Human Rights* passed as Resolution 217A(III) of 10 December 1948, "No one shall be held in slavery or servitude; slavery and the slave trade shall be prohibited in all their forms." Real-time punishment via transponders may be considered as cruel, inhuman or degrading treatment or punishment, and thus contrary to Article 5. Furthermore, restricting individual movements is contrary to Article 13 (1): "Everyone has the right to freedom of movement and resi-

TABLE I
SOME CURRENT COMMERCIAL PRODUCTS

Digital Angel	Http://www.digitalangel.net/	A wristband to be locked to the individual enabling tracking of all movements, marked for use with children and senior citizens.
Whereify Wireless	Http://www.wherifywireless.com/corp_home.htm	Marketing devices for monitoring locations of vehicles, children, or senior citizens
Travel Eyes	Http://www.traveleyes.com/	Vehicle tracking system for fleet management and tax deductible mileage calculation

dence within the borders of each state". The same restrictions are not specifically stated in the *Declaration of the Rights of the Child* passed as Resolution 1386(XIV) of 20 November 1959, but are implied in many parts.

When public concerns become acute, existing laws in many nations and states may be extended to cover certain aspects of geoslavery. For example, laws against stalking conceivably can be interpreted to address electronic tracking, and laws against human branding can be interpreted to address the implantation of tracking devices.

WOMEN'S RIGHTS

Geoslavery is, perhaps first and foremost, a women's rights issue. To illustrate, consider the ultimate sanction used to control women in certain cultures. "Honor murders" occur when a father, brother, or husband kills a female family member accused of "disgracing" the family. Often the issue is location as well as behavior.

One "honor murder" case currently galvanizing the international women's movement is the death of a teenage girl, Sevda Gok, whose family held a council and voted to execute her in violation of their own country's laws (http://www.state.gov/www/global/human_rights/1996_hrp_report/turkey.html). A young cousin was assigned to kill her, and he did so by slitting her throat in the middle of a street while other family members restrained her. How did Sevda Gok disgrace her family? She went to a movie without permission. No tracking device was employed in her case, but surely any culture that exerts such extreme location control over its youth will feel no compunction against electronic geoslavery. If the devices aren't widely adopted, it will be due to other factors such as cost or technical complexity. Of course, with positional accuracies of GPS and

digital maps being as they are, some girls may die for pausing near a movie or a sweetheart's home rather than actually going inside.

Soon, an enterprising businessman in Sevda Gok's village may be able to purchase a central monitoring system (personal computer with GIS, radio receiver, and optional transmitter) for less than \$2000 and individual tracking devices (GPS, radio transmitter, and optional transponder) for less than \$100 per unit which can be locked onto the wrists of every member of the village (women, children, and men). Most likely, he will be able to offer a service to village parents at an affordable price that will cover his investment and a tidy profit. If, say, 100 families sign up and capital equipment is amortized over ten years, the cost to each family may be somewhat less than 1 per cent of the median family income in that country.

Further information on Honor Killings can be found on the Amnesty International Web site (<http://www.amnesty.org.uk/cgi-bin/eatsoup.cgi?id= PL2BtdR DxIcAAB2MgoQ>).

SOCIAL RESPONSIBILITY

Technology *per se* is neither good nor evil, and it certainly cannot be held responsible for the sins of society. But technology can empower those who choose to engage in good or bad behavior. In this case, LBS will support and amplify some of the more extreme tendencies of human nature. Parents who choose to protect their children through surveillance and location control now may do so in the extreme. Tyrants who choose to dominate their subjects, husbands and wives who choose to dominate their spouses, and employers who choose to dominate their employees now may do so in the extreme. Many of these choices will be considered legitimate in one culture and not in another.

The perception of good and evil,

of course, may change over time. In 1967, for example, during early development of GIS to support computerization of the 1970 census, a Yale University administrator declared the efforts a threat to individual privacy and closed the project's computer accounts [8]. Yet, far more invasive measures, such as citywide video surveillance, are routinely tolerated today. Surely, the current generation of children growing up with video cameras on their school buses will view surveillance differently than their predecessors.

Wars traditionally tilt the balance in favor of sacrificing personal freedom for the sake of public safety and security. In the current War on Terrorism, strong positions have been expressed on both sides regarding increased U. S. government access to information about personal transactions (including their geographic coordinates) following the terrorist attack of September 11, 2001. In the climate of fear that currently exists around the globe, one might readily imagine the citizens of any nation demanding that all suspicious foreigners be tagged with human-tracking devices for the duration of their stay. Or, they might take it further and demand that all foreigners be tagged. Or, they might include their fellow citizens as well. Who knows how far hysteria may take us?

We, as geographers, are acutely aware of cultural diversity around the globe and changes within each culture over time. We do suggest, however, that certain shared values are nearly universal. Over the past two centuries, the vast majority of nations have agreed that slavery is wrong, and slavery is prohibited, accordingly, by most nations and by the international conventions cited above. Developers, marketers, and sellers of LBS technology have a professional responsibility to familiarize themselves with likely outcomes and with the laws and norms that may apply.

They have a social responsibility to recuse themselves from any development or application that overtly and directly aims to enslave individuals who have committed no crime and pose no threat to the safety and security of others.

GEOSLAVERY VERSUS “BIG BROTHER”

In one sense geoslavery is the ultimate fulfillment of George Orwell’s “Big Brother” nightmare, but geoslavery differs in two major ways from what he imagined in 1984 [6].

First, LBS makes Orwell’s television-based surveillance technology look amateurish. His technology relied on human observers watching other human subjects and initiating actions to control their behavior. Being digital, LBS can be programmed so that it watches each and every subject, evaluates myriad pathways based on models or sets of rules, and automatically issues instructions and punishments. With his visual system, one human observer might reasonably monitor 20 or at most, say, 50 other humans. With LBS, one human operator could monitor 1,000, . . . 10,000, . . . 100,000, . . . 1,000,000 fellow humans and yet know if any one of them steps off the path by more than a few centimeters.

Second, Orwell’s warning was that governments someday may use technology to control individuals. Governments may employ geoslavery as well, but our principal warning is that individuals can use current technology to control other individuals or groups of individuals. The institution of slavery again serves as a sobering example. Throughout history, the vast majority of slaves were owned, not by governments, but by individuals.

A RATIONAL RESPONSE

LBS technology is the quintessential double-edged sword. Hardware and software for monitoring

vehicle fleets are sold, for the best of reasons, to reduce costs and improve efficiency. New issues are raised, however, if those same vehicles are monitored outside of work hours when used for private activities. Caring parents may use LBS solely to protect their children, but domineering parents may do so to exert obsessive control even into adulthood. Conversely, caring children may use LBS to monitor parents suffering from Alzheimer’s disease, but who will decide when you personally are sufficiently impaired to warrant such control? Physical incarceration generally would require some type of legal or medical review, but similar protections have not yet developed for electronic forms of incarceration. The challenge is to develop safeguards that simultaneously permit legitimate uses while preventing mis-uses.

One answer may lie in encryption and licensing of GPS signals, but the solution will be expensive and will require an enormous institutional apparatus worldwide. In this approach, access to the locator signal might be degraded far more than the previous degradation, called Selective Availability, that was ended by the Clinton administration in 2000. Access to the undegraded signal would then be subject to review and approval based on national and international guidelines.

Encryption and licensed access is exactly what the European Union is planning for access to signals from the Galileo GPS satellites. The higher precision of this system over the Navsat of the United States’ GPS is supposed to be the selling point for this system for aircraft navigation and LBS. The geoslavery issues raised here should be part of the consideration

for releasing that encryption key.

Controlling user access by signal encryption will fail unless accompanied by strict controls over manufacturers, as well. This approach would render the current generation of GPS receivers unusable without additional decryption technology, thus suggesting a phased approach to allow manufacturers time to redesign the next generation of receivers. Care then must be taken to ensure that new devices do not circumvent the purpose, for example by manufacturers acquiring

Hazards are ignored by vendors, and all too often, by public officials as well.

codes for legitimate purposes and installing them in geoslavery devices, as well. Therefore, licensing and monitoring of the LBS industry may be required to ensure that products are not designed to serve unethical purposes.

Yet, this solution only addresses the risk from GPS. The risk from other mobile location-aware devices such as mobile phones remains.

Do we need licensing organizations at the national level which control the production and services of all such industries? Are the Federal Communications Commission or OfTel ready for this role in the U.S. and U.K. respectively? Are national and global human rights organizations prepared to address geoslavery? No, not at all.

A WARNING FROM INSIDE THE GIS COMMUNITY

Both authors are long-term insiders of the GIS community.

Dobson published his first GIS article in 1979, served as President of the University Consortium for Geographic Information Science, and currently serves as President of the American Geographical Society. Fisher has been a university lecturer and, later, professor specializing in geographical information science for more than 20 years, and is currently editor of the *International Journal of Geographical Information Science*. Our predicament reminds us of the ethical dilemma faced by pioneers of nuclear science when they first realized the societal risk associated with the technology they had helped to create—a realization that prompted Robert Oppenheimer

to say, “Now, we’re the SOB’s.” Like nuclear energy, LBS offers major benefits on the one hand and horrendous risks on the other. As with nuclear energy, responsible governments and industries must develop LBS safeguards, possibly at levels of effort rivaling those devoted to advancement of the technology itself. Once, when a colleague at Oak Ridge National Laboratory complained about the funding and perks going to nuclear engineers to fix a broken reactor, Dobson told him, “Invent something dangerous enough, and screw it up badly enough, and you’ll have a job forever.” Now, unfortunately, it appears we ourselves may have done just that. Now we, too, are the SOB’s.

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