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**SQO**

**Solves Jamming**

#### New NAVSOP technology solves jamming and spoofing

**InnovationNewsDaily 7/3**/12 (“New Hack-Proof GPS Could Be Huge for Military”, <http://mashable.com/2012/07/03/hack-proof-gps/>, CMR)

Military drones, ships, troops and missiles that rely upon GPS navigation to find and strike enemy targets can run into trouble if enemies jam the GPS signals. **A new navigation system can bypass the problem by plucking any electronic signal out of the air to figure out locations** — even using the signals from GPS jammers. **The technology** from defense company BAE Systems is not only able to use hundreds of different TV, Wi-Fi or cell phone signals to triangulate the location of a person or vehicle, but it **can** also **learn from previously unidentified signals. That could protect U.S. military drones from** both **jamming and** GPS “**spoofing**” that uses bogus signals to hack and take control of drones or other robots. “**This technology is a real game-changer** when it comes to navigation, which builds upon the rich heritage that both BAE Systems and the U.K. have in radio engineering,” said James Baker, managing director at BAE Systems Advanced Technology Centre. Scavenging signals from the air also allows BAE’s Navigation via Signals of Opportunity (NAVSOP) system to work indoors or deep underground — places where GPS has traditionally failed because satellite signals can’t reach them. NAVSOP can also work in remote locations far from civilization such as the deep jungle or in the Arctic. But the technology could do much more than just harden military weapons and vehicles against enemy jamming or hacking attempts — it could protect tomorrow’s self-driving robot cars from being hacked. **Trucks, ships and airplanes that use GPS could similarly benefit from having a jam-proof, reliable form of navigation**. Closer to home, NAVSOP could lead to the equivalent of indoor GPS for firefighters trying to rescue people inside smoke-filled buildings, miners working underground or cave explorers who don’t want to fall off the grid.

#### Military already has anti-jamming capabilities

**Strategy Page ’12** (“North Korea Jams GPS And Fails”, <http://www.strategypage.com/htmw/htecm/articles/20120508.aspx>, CMR)

Meanwhile, this is old news for **the** U.S. **Air Force**, which **has spent** most of **the last two decades developing anti-GPS jamming technology**. For years military aircraft have been equipped with complex and expensive GPS receivers that will work even if they are being jammed. **There are several ways you can defeat attempts to jam GPS signals**. **While some of the methods are well known, others are classified**. **No one has successfully used GPS jammers in combat yet** but the potential is there. Now the North Koreans are giving large scale demonstration of GPS jamming.

**Current system solves Jamming**

**Space News 10**

Space News; May 7, 2010 http://availabilitydigest.com/public\_articles/0506/gps\_upgrade.pdf

Built by Boeing, **the new GPS IIF** satellite system currently being deployed incorporates many advances over GPS IIA:It **has a design life of twelve years**. It **has a more accurate clock. Its positional accuracy is doubled. It has faster processors with more memory. it is more able to resist jamming.** GPS IIF will comprise twelve satellites. The first GPS IIF satellite was lifted into orbit by a Delta 4 rocket on May 28, 2010.

**Jamming is easily detected and overcome by precision strikes**

**Space News 10**

Space News; May 7, 2010 http://availabilitydigest.com/public\_articles/0506/gps\_upgrade.pdf

GPS has found wide use in both civilian and military circles. Civilian uses range from car navigation and cell-phone E911 services to trekking games such as geocaching. GPS usage by the military is far more widespread. The military uses GPS for air and sea navigation, bomb and artillery guidance, and armored vehicle and troop tracking**. Because GPS makes weapons more accurate, the military needs fewer warheads and fewer personnel**. However, **the leaner GPS-dependent military becomes more vulnerable if GPS services are lost**. This raises concerns that **an attack on GPS could wreck havoc** not only on the civilian population but also **on the military’s capabilities** as well. The Air Force says that to date there has never been a breach of the GPS system. With satellites 12,000 miles high in the sky, they are safe from attack (at least, with today’s technology). The GPS command center is backed up with a command center hundreds of miles away, both at heavily secured Air Force bases. GPS communications is heavily encrypted. **During the U.S. invasion of Iraq, the Iraqis tried to jam GPS signals**. However, **this took so much power that the positions of the jamming stations were easily pinpointed; and they were taken out by GPS-guided bombs**. It is felt that jamming is beyond the capabilities of groups like the Taliban and many third-world countries. However, jamming by a major foe is a concern. The military use of GPS is not foolproof. There is still a human element. In 2001, a GPS-guided bomb dropped by a Navy F-18 fighter jet fell into a residential neighborhood in Kabul, Afghanistan. Four civilians were killed. A subsequent investigation determined that wrong coordinates had been entered into the guidance system.

**SQO solves the impacts**

**CBO 11**

OCTOBER 2011 http://www.cbo.gov/sites/default/files/cbofiles/attachments/10-28-GPS.pdf

**The increased capabilities of GPS satellites and receivers under DoD’s plan would better enable military users to operate in the presence of radio frequency interference**— the main goal of the plan. Likewise, **improvements to the** satellite and **ground control capabilities that are included in that plan would allow military and civilian users to determine their position more accurately than they can today**. The planned improvements would enable military GPS receivers to pick up signals from satellites and to retain those signals in the presence of higher levels of electromagnetic interference. One way to characterize the magnitude of the improvement is to estimate the reduction in one type of jammer’s effectiveness. For example, if a 10 watt jammer can cause a Defense Advanced GPS Receiver (DAGR) to lose a GPS signal that it was tracking from a IIR-M or IIF satellite at a range of 55 miles, how much would that range be diminished after DoD has fielded the improvements that it plans for GPS? **The combined effects of all of DoD’s planned improvements would be to reduce the effective range of noise jammers by an estimated 96 percent**. 13 Each component of the system would contribute to that overall improvement. A new receiver, for example, that was capable of processing the M-code signals from the older-model satellites already in orbit would be able to maintain track of the GPS signals as close as 25 miles to the same 10-watt jammer (see Table 2-3). 14 In other words, fielding receivers capable of decoding the M-code signals would reduce the effective range of a noise jammer by an estimated 55 percent

**The Costs of DoD’s Plan to Modernize the GPS Satellites, Ground Control System, and Receivers**

**CBO 11**

OCTOBER 2011 http://www.cbo.gov/sites/default/files/cbofiles/attachments/10-28-GPS.pdf

**The Department of Defense plans to continue upgrading all three segments of the Global Positioning System, investing $7.3 billion from 2012 through 2016 and $15 billion over the subsequent nine years** (see Table 2-1). When fielded, all of **DoD’s fully modernized GPS components should improve the system’s ability to perform, even in a jamming environment**. But fully implementing all of DoD’s plans could take until 2030

**Squo solves-GPS Systems have already been backed up and replaced – eLORAN provides the same capabilities and MORE**

**PAPPALARDO 9**

[joe senior editor at Popular Mechanics and a former associate editor at Smithsonian's Air & Space magazine “ Inside the Government's Backup Plan for GPS Failure” <http://www.popularmechanics.com/technology/gadgets/news/4266972>

Satellite-based navigation has become a ubiquitous tool for business, military and personal use. The downside is that any disruption in the Global Positioning System could wreak havoc down on Earth. This year, the **D**epartment of **H**omeland **S**ecurity **decided that a 30-year-old navigation system** used by mariners **will be upgraded to back up GPS.** The decision **preserves the Long-Range Aids to Navigation (LORAN**) network, **which has been teetering on the verge of forced retirement** since the 1980s, according to the Coast Guard's Navigation Center. The **backbone of LORAN is a network of transmission stations**, many located in remote regions, **staffed with Coast Guard personnel, and equipped with antennas as tall as 900 ft**. The **2009 DHS budget allocates $34.5 million for the Coast Guard to start upgrading** the **LORAN** system **with modern electronics and solid-state transmitters. Users of the enhanced system**, called **eLORAN, will acquire and track signals from ground stations in much the same way they triangulate signals from** multiple **satellite feeds**. LORAN also adds a data channel that can handle more detailed information. The **system won't just wait for GPS to fail: eLORAN stations will continually transmit time-keeping data** needed for navigation and warnings about coming disruptions. Why GPS Needs a Backup Plan Intentional Jamming **Threat: GPS signals** use low-powered, high-frequency signals that **are easy to block. eLORAN** Fix: **Uses high-powered transmitters that send stronger signals requiring more power to disrupt**. Environmental Interference **Threat: Signals from GPS sats need to be in the line of sight of receivers and are blocked by metal, mountains and** reinforced **concrete. eLORAN Fix: Terrestrial signals bend around the Earth's curvature and can penetrate urban canyons and dense foliage**. Cosmic Radiation **Threat: Unusually large solar flares can produce radio bursts over the same frequency** bands **as GPS** satellite **transmissions. eLORAN Fix: Cosmic radio waves cannot penetrate the ionosphere, so LORAN signals are immune to interference.** Antisatellite Weapons **Threat: Future ground-based missiles could target and knock out GPS satellites. eLORAN Fix:Ground stations can be more easily guarded from attacks, including those by missiles.**

**Anti jamming tech already exists in squo and can solve**

Tony **Murfin**, Editor of GPS World’s professional OEM newsletter, previously vice president ar NovAtel. 15 June, 20**11** “Affordable Anti-Jam Technology” GPS World. http://www.gpsworld.com/professional-oem/affordable-anti-jam-technology-11790

**In a world where there is more and intentional and unintentional interference** with GNSS, **it’s a little comforting to hear that technology has been developed which can help us fight back.** The proliferation of affordable "Personal  Protection Devices (PPDs)" used to mask GPS location — for users who carry location capability but who really don’t want to be tracked — is already been felt at critical points in our GNSS infrastructure in North America. Well, if you can buy a catalog jammer over the Internet in the U.S., how readily available are these things for terrorists and people waging war against us overseas and at home? So now **NovAtel** (Calgary, Canada) **and QinetiQ** (UK) **have come up with a** potential **remedy for military land vehicles that are taking our forces into harm's way. The GPS Anti-Jam Technology** (GAJT or ‘Gadget’) **antenna was just released by NovAtel, and the company will be taking orders in the fall. It’s a fully integrated anti-jam solution in a single, robust package.** The price point has not been openly discussed, but **there is good possibility that it will be significantly more affordable that existing mil-spec systems, and that makes it possible that this integrated antenna/signal processing system will soon find applications in the civil field**, **in such applications as hazardous material transport or high-value cargo transportation.** The core of this receiver involves an integration of key technology from both NovAtel, and from QinetiQ. QinetiQ is a UK company few in the commercial world may know well — QinetiQ is better known in military circles for its close support role to the UK Ministry of Defense (MoD), and from the other side of an impenetrable "firewall" the rest of the business has been largely involved in complex R&D support tasks for the same customer. This complex arrangement came about as a result of continuing commercialization of UK government assets, as more activities are pushed down into private industry. More recently, the commercial side of QinetiQ has been looking for ways to bring its vast storehouse of military R&D technology to market, and the marriage with NovAtel for GAJT brought a heap of their radar signal processing IP to the table.

**Status quo solves better than aff**

**QinetiQ, 2011**. “GPS anti jamming technology revealed” QinetiQ and NovAtel. http://www.qinetiq.com/news/pressreleases/Pages/GPS-Anti-Jam-Technology-revealed.aspx

**QinetiQ and NovAtel Inc. have brought together their unique skills and technologies to launch GAJT** (pronounced “Gadget”), **the world’s first single-enclosure GPS anti-jam system which is a stand-alone, rugged enclosure** that mounts to the exterior of vehicles. **Intentional jamming and unintended interference of GPS can completely deny a position solution and timing over a wide area.** **GAJT is a seven element controlled reception pattern antenna (CRPA) that nulls jammers, ensuring GPS positioning capabilities are retained** during combat, training or other vehicle-based missions. **As an externally mounted single-unit enclosure, no additional electronics are necessary inside the vehicle; only power and a single RF cable are required to connect to legacy GPS receivers.** **The simplicity of its design results in faster installation, minimal vehicle downtime and training, and makes the antenna easier to integrate into new platforms, or retrofit onto existing platforms or fleets and works with standard military and civil GPS receivers.** Cathy Kane, QinetiQ Managed Services Director of Technology Insertion said, “We are delighted to be partnering with NovAtel to bring this much-needed and exciting force protection product to market. I have been particularly impressed at the way the people from NovAtel and QinetiQ have brought their different skills together to form an effective team.” Michael Rittter, President and CEO of NovAtel stated, “**GAJT is the first GPS anti-jam system that is small enough, and at a price point** that makes sense to use on land-based military vehicles such as LAVs (light armoured vehicles).” Mr. Ritter added, “We are extremely pleased to have developed a game-changing product that will protect the positioning and blue force tracking of troops on the ground, and potentially save the lives of personnel who encounter jammers while in theatre.” **GAJT is a commercial off-the-shelf (COTS) product, providing short order lead times and enabling quick deployment to the field**. Manufactured in Canada, and incorporating Canadian and UK technology, GAJT only requires Canadian and UK export approval, which means exporting to authorized customers in foreign countries is greatly simplified.

**Status Quo solves for Spoofing/Jamming**

**Raytheon Company ‘12**

Raytheon to Produce Anti-Jam GPS Systems for the U.S. Air Force C-130 Avionics Modernization Program **January 2012** http://www.prnewswire.com/news-releases/raytheon-to-produce-anti-jam-gps-systems-for-the-us-air-force-c-130-avionics-modernization-program-58921557.html accessed 7/3

**Raytheon Company** (NYSE: RTN) **has been awarded a** $7.6 million engineering and **manufacturing development contract to supply anti-jam** Global Positioning System **(GPS) receivers to the Air Force's C-130** Avionics Modernization Program (AMP). **Boeing Integrated Defense Systems selected the Raytheon Digital Anti-jam Receiver (DAR) to provide C-130 airlift and special mission aircraft with robust and highly accurate navigation components.** Under a follow-on production contract, 982 DAR systems at a cost of approximately $37.3 million may be required. **Raytheon's Space and Airborne Systems will adapt the DAR militarized GPS anti-jam sensor**, originally developed for high performance fighters such as the F-35 Joint Strike Fighter, **to the Boeing C-130 AMP architecture**. **Each DAR system will include a** 24 channel Selective Availability **Anti-Spoofing Module** (SAASM**) receiver, digital anti-jam electronics, and a multi-element antenna.** "The DAR system gives the C-130 the ultimate in military GPS technology," said James Hvizd, avionics technology manager for Raytheon's Precision Guidance Systems business area. "**By integrating** a 24-channel **GPS** SAASM **receiver and adaptive beam-steering anti-jam electronics into a single line replaceable unit, the DAR system is fully compatible with the existing GPS Antenna System-1 (GAS-1) antenna electronics.** The system includes provisions to incorporate emerging Joint Precision Approach and Landing System (JPALS) and GPS modernization requirements. And, by leveraging the common core technology from the JSF Anti-Jam GPS Sensor, the DAR system provides a dramatic savings in production and life cycle costs compared to legacy GPS receivers and anti-jam electronics." Raytheon Company's Space and Airborne Systems (SAS) designs, develops and manufactures advanced systems for precision engagement; missile defense; and intelligence, surveillance and reconnaissance. Headquartered in El Segundo, Calif., SAS has 11,000 employees and additional facilities in Goleta, Calif.; Forest, Miss.; Dallas, McKinney and Plano, Texas; and several international locations. Raytheon Company, with 2002 sales of $16.8 billion, is an industry leader in defense, government and commercial electronics, space, information technology, technical services, and business and special mission aircraft. With headquarters in Waltham, Mass., Raytheon employs more than 76,000 people worldwide.

#### Anti-jamming technology in Status Quo

[**QinetiQ Group**](http://www.defpro.com/index/profile/qinetiq/?SID=56592a932ee2d115fee37987b738045b) **‘11**

**GAJT** (GPS Anti-Jam Technology) optimizes battlefield performance by nullifying the effect of multiple GPS jammers June 9, **2011** http://www.defpro.com/news/details/25237/?SID=56592a932ee2d115fee37987b738045b accessed 7/3

**QinetiQ and NovAtel Inc. have brought together their** unique skills and **technologies to launch GAJT** (pronounced “Gadget”), **the world’s first single-enclosure GPS anti-jam system which is a stand-alone, rugged enclosure that mounts to the exterior of vehicles. Intentional jamming and unintended interference of GPS can completely deny a position solution and timing over a wide area.** GAJT is a seven element controlled reception pattern antenna (CRPA) that nulls jammers, ensuring **GPS positioning capabilities are retained during combat, training or other vehicle-based missions. As an externally mounted single-unit enclosure, no additional electronics are necessary inside the vehicle; only power and a single RF cable are required to connect to legacy GPS receivers.** The simplicity of its design results in faster installation, minimal vehicle downtime and training, and makes the antenna easier to integrate into new platforms, or retrofit onto existing platforms or fleets and works with standard military and civil GPS receivers. Cathy Kane, QinetiQ Managed Services Director of Technology Insertion said, “We are delighted to be partnering with NovAtel to bring this much-needed and exciting force protection product to market. I have been particularly impressed at the way the people from NovAtel and QinetiQ have brought their different skills together to form an effective team.” Michael Rittter, President and CEO of NovAtel stated, “GAJT is the first GPS anti-jam system that is small enough, and at a price point that makes sense to use on land-based military vehicles such as LAVs (light armoured vehicles).” Mr. Ritter added, “We are extremely pleased to have developed a game-changing product that will protect the positioning and blue force tracking of troops on the ground, and potentially save the lives of personnel who encounter jammers while in theatre.” **GAJT is a commercial off-the-shelf (COTS) product, providing short order lead times and enabling quick deployment to the field.** Manufactured in Canada, and incorporating Canadian and UK technology, GAJT

**We have back-up GPS assets that prevent failure**

**McGrath 9**

[THOMAS M. MCGRATH, B.S., Virginia Tech, M.S., Naval Postgraduate School “What Happens if the Stars Go Out? U.S. Army Dependence on the Global Positioning System” 2-2009 <http://dodreports.com/pdf/ada520135.pdf>] AK

While GAO report 09-325 stated that the GPS constellation could fall below 95 percent reliability (Government Accounting Office 2009, 20), the performance history of the system indicates otherwise. In his statement before the Congressional subcommittee on National Security and Foreign Affairs, General James, USAF, Joint Functional Component Commander for Space, stated that: **Although required to maintain 24 GPS satellites on orbit at 95 percent probability, we have exceeded requirements by currently maintaining 30 operational satellites and have achieved sub-three meter accuracy. We conduct ―residual operations as an on-going solution to mitigate any potential gap in GPS by retaining older, partially mission capable satellites in a back-up mode** that can potentially be returned to operations if a satellite in the constellation fails. **Currently three vehicles are held in residual status**, and thorough in depth analysis, residual satellites are returned to the constellation every six months to ensure PNT [Position, Navigation, and Timing] operational capability. (James 2009) The GAO report was also brought into question by the Air Force Times in an interview with Cristina Chaplain, the GAO representative who led the report team. ―In the wake of it all, the GAO’s Cristina Chaplain, who oversaw the investigation, now says she regrets the ―turmoil the report has caused for the Air Force. She says this while standing by her team’s findings, which she notes the Pentagon ―fundamentally concurred with in a letter attached to the report (Iannotta 2009).

### No Military Impact in the SQO

#### Jamming won’t affect military capabilities

**Strategy Page ’12** (“North Korea Jams GPS And Fails”, <http://www.strategypage.com/htmw/htecm/articles/20120508.aspx>, CMR)

**There are several approaches to defeating GPS jamming**, and knowing which one each American GPS guided weapon uses makes it easy to develop a way to jam the "jam-proof" GPS. So the U.S. Air Force is understandably reluctant to discuss what they are doing. **Given the cost of jam proofing all existing GPS weapons, it's more likely that jam-proof GPS weapons will only be used against targets where the GPS accuracy is vita**l. **Against most targets the accuracy provided by the inertial guidance system will do**. Also note that you can bomb GPS jammers with a bomb equipped with a guidance system that homes in on a GPS jamming signal. For that reason it's thought that any use of GPS jammers will involve dozens of jammers in each area so protected**. The GPS jamming has no effect on the even more accurate laser guided bombs**, and some countries buy smart bombs with both laser and GPS/INS systems.

### Other Countries Solve

**Russia and China’s own GPS systems moving forward quickly. Europe also developing Galileo**

**BBC 12’**

BBC News Technology , 4/30/12 , “China launches two more Beidou navigation satellites” <http://www.bbc.com/news/technology-17896353>, acc: 7/3/2012 WaruAHY

**China has moved** a step c**loser to completing its own navigation and positioning satellite network with the launch of two more** navigation **satellites.** It brings the Beidou system, which became operational with coverage of China last December, to 13 satellites. **To have global coverage, the country eventually aims to have 35 satellites in orbit by 2020.** **China hopes that Beidou will wean it off the US** Gl**obal** **P**ositioning **S**ystem. Just like GPS, the Chinese system is designed to let users determine their positions to within a few meters. **Beidou**, also known as Compass, **has been developed for both military and civilian use**s. The two satellites went up on Monday morning from the Xichang Satellite Launch Centre in southwest Sichuan province. They were carried on a Long March-3B rocket, according to the state-run Xinhua news agency. "**The two satellites will help improve the accuracy of the Beidou**, or Compass system," Xichang Satellite Launch Centre said in a statement carried by the agency. Now partially operational, **Beidou makes China only the third country in the world, after the US and Russia, to have its own navigation system**. **Russia's Glonass satellite network has 31 satellites in orbit,** but only **24 of them** are **operational.** Four more are in reserve, one undergoing trials, and two under maintenance. According to the Russian Space Agency, Roscosmos, **Russia plans to spend $694m (£427m) on its Glonass system this year**. At a recent annual Satellite Navigation Forum in Moscow, Russia's deputy prime minister Vladislav Surkov said that **more than 300 billion roubles (£6bn, $10.2bn) have been budgeted to further develop Glonass and bring 30 satellites into operation by 2020.** **Europe has also been building a navigation system**, called **Galileo, which has two satellites in orbit, launched in October last year. The next two are scheduled to follow later this year. The space project of the European Commission, the EU's executive arm, plans to have all 26 Galileo satellites in orbit by the end of 2015.**

### Inevitable

**Another GPS failure is inevitable**

**Coursey 9** (David, technology writer, broadcaster, and marketing consultant, “GPS System Could Begin to Fail Within a Year”, PC World Business Center, <http://www.pcworld.com/businesscenter/article/165126/gps_system_could_begin_to_fail_within_a_year.html>)

The **G**lobal **P**ositioning **S**ystem **faces the possibility of failures and blackouts**, a federal watchdog agency has warned the U.S. Congress. Mismanagement by and underinvestment by **the U.S. Air Force places the GPS at risk of failure in 2010 and beyond. The problem: Delays in launching replacement satellites, among other things.** According to the Government Accountability Office report, "In recent years, the **Air Force has struggled to successfully build GPS satellites within cost and schedule goals"** as part of a $2 billion modernization program. "**If the Air Force does not meet its schedule goals** for development of GPS IIIA satellites, there will be an increased likelihood that in 2010, as old satellites begin to fail, **the overall GPS constellation will fall below the number of satellites required to provide the level of GPS service that the U.S. government commits to.**" Considered by the GAO to be "essential to national security" the GPS is also widely used by business and consumers and is a driver for next-generation location-based mobile applications used with smartphones and other devices. "Such a gap in capability could have wide-ranging impacts on all GPS users," the GAO report states, "though there are measures the Air Force and others can take to plan for and minimize these impacts." **It is hard to imagine the U.S. government could allow this to happen. Actually, that's a lie, it's easy to imagine**, but there is also time for corrective action to be taken. The first replacement satellite is expected to be launched this November, some three years after the original launch date. Speeding up future launches can solve the problem, but is likely to come at a high price. The American GPS, though the pioneering consumer satnav system, is not alone. Russia, China, and India each have systems of their own, which are being expanded. The European Union's Galileo system, intended as a rival for GPS, is expected to begin its rollout later this year. **The delay and potential failure of GPS gives these other nations the potential to rival the U.S. in space, something the U.S. government is unlikely to accept.** The report is a black eye for the Air Force, which developed the GPS system during the 1980s and has maintained it since.

## Precision Ag

**Farmers Won’t Adopt**

**Farmers won’t adopt – multiple reasons**

**Schimmelpfennig ‘11**

[David; and Robert Ebel: Economic Research Service (USDA); *Economic Information Bulletin*, No. 80; August; p. iii]

**Adoption of** the main **precision information technologies**—yield monitors, variable-rate applicators, and GPS maps—**has been mixed among U.S. farmers. Recent data** from the Agricultural Resource Management Survey (ARMS) **show** that use of yield monitors, often a first step in utilization of precision technology for grain crop producers, has grown most rapidly, being used on 40-45 percent of corn and soybean acres in 2005-06. However, **farmers have mostly chosen not to** complement this yield information with the **use** of detailed Global Positioning System (**GPS**) **maps** or variable-rate input applicators that capitalize on the detailed yield information. Some of the **factors** that could be contributing to this adoption lag **include farm operator education, technical sophistication, and farm management acumen**. The report is not testing the impacts of precision agriculture on other farm practices like conservation tillage, but some associations between the various factors are noted.

**Cost and complexity prevent adoption of precision agriculture techniques**

**Ebel ‘11**

[Robert, Dept. of Agriculture Econ. Research Service; David Schimmelpfennig, USDA; “The Information Age and Adoption of Precision Agriculture,” *Amber Waves* (USDA bulletin), December]

**Despite the potential for improved production efficiency, farmers have been slow to adopt variable rate technologies**, and the expected impacts on farm structure, employment and environmental quality have not been fully realized. **Research suggests that low adoption rates may be due to uncertainty about the economic returns from large initial investments in precision equipment, the complexity of these technologies, and the need to make integrated use of several precision technologies to obtain cost savings**.

**Farmers won’t adopt technology – Mandate required**

**Woods ‘10**

[Jeremy, Porter Alliance, Center for Environmental Policy (London); *Philosophical Transactions of the Royal Society*, No. 365, p. 2999]

**While it is likely that farmers will readily adopt measures that will benefit their productivity and financial outcomes, adopting practices at a cost to farming businesses is more likely to require policy intervention**. Developing mechanisms to improve GHG abatement in the agricultural sector is complex, not least because policy mechanisms are often devised through different departmental policy-making regimes.

**Small Farms t/o**

**Zero chance of saving small farms - Precision agriculture only saves $22 per 100 acres**

**Bergtold ‘09**

[J.S., Professor in Dept. of Agricultural Economics @ Kansas State University; *Applied Engineering in Agriculture*; Vol. 25, No. 2; p. 133]

Automatic steering (**auto‐guidance) systems for tractors with GPS‐based guidance offers farmers the opportunity to reduce operating costs and improve profitability** of cropping enterprises. The economic benefits of auto‐guidance technology include: the reduction of overlap and skipping of fertilizer and pesticide applications, improved timeliness of operations (e.g. operating at night), accurate establishment of drip irrigation systems, and precision agricultural practices, such as variable rate application of inputs (Lewis, 2003). **Gan‐Mor and Clark (2001) suggest that using automatic steering systems with GPS guidance and centimeter accuracy to control traffic on farmers' fields can save farmers up to $22.00 ha**‐1. In addition, controlling vehicle traffic may reduce or eliminate the need for subsoiling on some soils by minimizing the re‐compaction of soils from vehicles crossing the fields (Potter and Chichester, 1993; Raper et al., 2005b).

**Only large farms would benefit from precision agriculture**

**Bergtold ‘09**

[J.S., Professor in Dept. of Agricultural Economics @ Kansas State University; Applied Engineering in Agriculture; Vol. 25, No. 2; p. 133]

**An economic analysis was conducted** based on the framework presented by Lewis (2003) **to examine if investing in an auto‐guidance system with GPS** for subsoiling **would be profitable**. **Lewis** (2003) **mentions** that **not all producers will benefit from adopting auto‐guidance systems**, but lower variable costs and higher revenue from additional output from use of the system may exceed the increase in fixed costs from purchasing the system for farms of sufficient size. **Thus, there may be a minimum cost‐effective acreage at which the auto‐guidance system becomes profitable**. As the cost and accuracy of auto‐guidance systems with GPS change, this base acreage will differ, as well. For the purpose of this study, the minimum cost‐effective acreage will be substituted with the minimum cost‐effective area of land in hectares (MCEH).

**SQuo Solves**

**Status Quo Solves: GPS-enabled Precision Agriculture will improve dramatically in the next few years**

**Andrade-Sanchez ‘12**

[Pedro, Professor of Agricultural and Biosystems Engineering @ University of Arizona & John T. Heun; *University of Arizona Cooperative Extension*, January, p. 1]

Global Positioning Systems (GPS) are satellite-based navigation systems that utilize a network of earth orbiting satellites. GPS operates well under any weather condition and does not require a subscription fee. **GPS is a crucial component of precision agriculture** by providing precise location information with very high repeatability.

**In recent years, GPS have improved** in their level of performance and functionality in part because new GPS receivers can track satellites not only from the 32 NAVSTAR satellites of the United States but also from the Russian GLONASS (approximately 24 satellites) systems. These high-accuracy navigation and positioning technologies are categorized as a GNSS (Global Navigation Satellite System). **We anticipate that even higher levels of performance will be achieved** when the Galileo satellite constellation (European Union) becomes available **in 2014 with an initial operating capacity of 18 satellites and expanding to 30 satellites by the year 2020**. The changing technology motivates the need for precise definitions.

**Privatization CP Solvency**

**Competition between manufacturers will lower GPS price points for consumers**

**Andrade-Sanchez ‘12**

[Pedro, Professor of Agricultural and Biosystems Engineering @ University of Arizona & John T. Heun; *University of Arizona Cooperative Extension*, January, p. 6]

The **integrated systems** described in this publication represent the newest development in advanced systems for enhanced functionality of machines in production agriculture. As expected, these systems **will keep evolving to improve their performance. Active competition between manufacturers will also result in affordable quality products that will benefit growers in their transition from conventional to more advanced systems**. Two operational elements of these computer-display systems that are worth analyzing are their portability, which can be a money-saving attribute when many power units can share at least part of the new components. The other element is that the use of these new displays requires computer skills and therefore workforce training is an essential element of modern farm management systems to enable full utilization of this technology.

**GPS fails to improve warning times – DAYS and WEEKS of advance notice are required to be effective**

**Harrison ‘08**

[Paul, Bristol Aerospace Ltd. (Magellan Aerospace Corporation); et al., “Earthquake Monitoring and Response from Space: The TREMOR Concept,” Conference Paper presented at ASTRO, p. 12-13]

**Earthquakes remain among the deadliest of natural disasters in part because of the lack of any reliable system to provide early warning**. In this paper, several possible earthquake precursors were examined. GPS and InSAR are both demonstrated and validated approaches for monitoring tectonic motion, the latter having the advantage of not requiring installation of ground receivers in tectonic regions. SAR is a relatively expensive technology, however, and to apply it on a global scale for continuous monitoring of seismically active regions will likely require a significant capital investment, unless enabling technologies arise that substantially reduce the cost of SAR payloads. The subject of electromagnetic and ionospheric precursors was also presented. EM activity has been observed prior to, during, and immediately after seismic events – both from the ground and from space – but turning this into a practical early warning system is another matter. The ionosphere is a highly dynamic environment, and in many ways still inadequately understood. Results from the first SEME satellite missions to date have been inconclusive, but have shown some interesting correlations that warrant further study. The payloads used in SEME research are also relatively simple and inexpensive, so these missions are typically much more affordable than SAR-based ones. It must be emphasized that the science of earthquake precursors is still very much in its infancy. **To be useful for an early warning system, an earthquake precursor must be observed and identified sufficiently in advance of the event (i.e. days or weeks, rather than hours or minutes), must indicate the geographic location of the event, and must be distinguishable from signals generated by non-seismic sources. To date, this has not been achieved using any approach**. A practical early warning system, if realizable, would take many years to develop and would very likely depend on data from multiple precursor sources to ensure as accurate an assessment as possible.

**Can’t solve earthquakes: Local solutions needed AND the best predictions only give populations one minute to respond**

**Grasso ‘11**

[Veronica F; Ashbindu Singh; “Early Warning Systems: State-of-Art Analysis and Future Directions,” United Nations Environment Programme, November 21, p. 21]

**Effective early warning technologies for earthquakes are much more challenging to develop than for other natural hazards because warning times range from only a few seconds in the area close to a rupturing fault to a minute or so** [Heaton (1985); Allen and Kanamori (2003); Kanamori (2005)]. Several local and regional applications exist worldwide but **no global system exists or could possibly exist for seismic early warning at global scale, due to timing constraints.** **Earthquake early warning systems applications must be designed at the local or regional level.** Although various early warning systems exist worldwide at the local or regional scale, there are still high seismic risk areas that lack of early warning applications, such as Peru, Chile, Iran, Pakistan, India.

**Solvency**

### Multi antenna systems

**Multi-antenna systems solve spoofing**

**Ledvina, Montgomery and Humphreys 9,** Brent Ledvina, director of new business and technology at Coherent Navigation, Paul Montgomery, principal engineer at Novariant, Inc. and Todd Humphreys, assistant professor in the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin, Inside GNSS, March/April 2009, “A Multi-Antenna Defense: Receiver-Autonomous GPS Spoofing Detection” http://www.insidegnss.com/node/1370

**Antenna diversity — employing either multiple separate receivers or a multi-antenna single-oscillator receiver — can be used to defend against intentional GPS spoofing by greatly increasing the technical difficulty required to mount a successful attack**. In general, **an additional spoofer transmitter is required for each additional GPS antenna.** Furthermore**, a spoofer would have to locate each transmit antenna in close physical proximity to the appropriate GPS antenna in the array. If the GPS antennas of static or dynamic installations are further protected by physical security, it is possible to create a robust defense against even a sophisticated spoofing attack.** In the case of a complicit user, the presence of **multiple antennas** **make**s **it difficult to intentionally defeat the system by direct injection of an artificial GPS signal**. In the spoofing defense implemented here, a one-time survey of a fixed antenna array was sufficient to enable receiver autonomous spoofing detection. A practical but slightly less robust defense that does not depend on knowledge of the attitude of the multi-antenna array can also be implemented. **The technology to enable multi-antenna spoofing detection is readily available using any of the numerous GPS receivers that produce L1 carrier phase observables.**

**Multi-antenna systems are effective countermeasures – communication between receivers**

**Tippenhauer et al 11** Nils Ol Tippenhauer, Department of Computer Science, ETH Zurich, Switzerland; Christina Pöpper, Department of Computer Science, ETH Zurich, Switzerland; Kasper B. Ramussen, Computer Science Dept. UCI Irvine, California; and Srdjan Capkun, Department of Computer Science, ETH Zurich, Switzerland; Zurich Information Security Center, “On the Requirements for Successful GPS Spooﬁng Attacks” October 17-21, 2011; http://www.syssec.ethz.ch/research/ccs139-tippenhauer.pdf

Spooﬁng detection based on lock loss has two disadvantages: (i) strong attackers can achieve a seamless satellite-lock takeover, and

(ii) lock loss can occur due to natural causes (e. g. signal loss in a tunnel). We propose **a countermeasure against GPS spooﬁng attacks that does not rely on the signal analysis or on the lock loss of signal**. Instead, our mechanism is based on our insights of Section 4 and **relies on the use of several GPS receivers**. These **GPS receivers can be deployed in a static, known formation**, e. g., they are ﬁxed on the deck of a cargo ship (see Figure 9). The basic idea of the countermeasure is the following: **If the GPS receivers can exchange their individual GPS locations, they can check if their calculated locations preserve their physical formation** (within certain error bounds). **In the case that the calculated GPS locations do not match the known formation, an attack must be suspected and there should be a warning message**. **Even if only two GPS receivers are used, this countermeasure can detect any attacker that is only using a single antenna.** As shown in Result 1, in case of a single-antenna attack both GPS receivers would report the same location (with small time offsets). As shown in Results 4–6, a strong attacker using multiple antennas could attempt to send signals such that the mutual distances between multiple receivers are preserved. Nevertheless, **each additional receiver of the victim makes these spooﬁng attacks exceedingly more difﬁcult because the space of possible antenna placements for the attacker gets reduced signiﬁcantly** (see Table 2). From Results 6 and 7 we know that there exists only one location per satellite where the attacker can place his antenna; this location is the rotated and translated satellite position of the GPS signal. **Conducting such an attack is very difﬁcult. It becomes even impossible if the victim can hide the exact positioning of at least one GPS receiver from the attacker** (e. g., by keeping it mobile on the vehicle) **such that the attacker cannot adapt to its position**. In summary, **our countermeasure requires no modiﬁcations of the GPS signal**, the satellite infrastructure, or the GPS receiver, it is resistant against a wide range of attackers, and **it can be deployed using multiple standard GPS receivers.** Outlook: Further possible applications are not restricted to mobile scenarios with a ﬁxed formation (such as in the cargo ship example above). **The countermeasure can also be applied** (i) **to ﬁxed and static** (i. e., immobile) settings where GPS is used for time synchronization and (ii) to mobile settings with varying formations (e. g., mobile formation of cars, robots, etc.). In the latter case, the devices can apply additional ranging techniques to identify their formation and use it in the sanity check with the calculated GPS locations (as long as the ranging techniques are secure [2,6,10,18,21]). We leave the elaboration of these ideas for future work.

**Multiple antennas makes spoofing extremely difficult**

**Ledvina, Montgomery and Humphreys NO DATE** Brent Ledvina, Asst professor at Bradley Department of Electrical and Computer Engineering at VTech, Paul Montgomery PhD in Aeronautics and Astronautics from Stanford U, and Todd Humphreys Research assistant professor in the department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin, “Receiver-Autonomous Spoofing Detection: Experimental results of a multi-antenna receiver defense against a portable civil GPS Spoofer” NO DATE, http://www.coherentnavigation.com/pub/rcvr\_auto\_spoofing\_detection.pdf

**The use of antenna diversity using either multiple separate receivers or a multi antenna single-oscillator receiver can be used to defend against intentional GPS spoofing**. This is because the use of **multiple antennas greatly increases the technical difficulty required to mount a successful spoofing attack.** In general, **an additional spoofer transmitter is required for each additional GPS antenna.** Furthermore**, a spoofer would have to locate each transmit antenna in close physical proximity to the appropriate GPS antenna in the array.** **If** the **GPS antennas** of a static installation **are further protected by physical security** **it is possible to create a robust defense against even a sophisticated spoofing attack**. One can broadly divide GPS applications into static and dynamic cases. In static cases it is feasible to construct and survey an antenna array and provide physical security to the antenna array. One time survey of the fixed array is sufficient to enable receiver autonomous spoofing detection (RASD).

### No Adoption

**GPS wont be taken up by enough farmers and macro level economic issues undermine its ability to solve food prices and farm productivity**

**Kahn ‘09**

(Dr. Bruce M Kahn PhD Senior Investment analyst DB Climate Change Advisors Deutsche Asset Management “Investing in Agriculture: Far-Reaching Challenge, Significant Opportunity” June 2009 http://www.sage.wisc.edu/pubs/articles/M-Z/Zaks/Investing\_in\_Agriculture\_July\_13\_2009.pdf Accessed: 6-28-2012)

The ability to measure, monitor, and verify components of the agricultural ecosystem will play an important role in the future of food production. Emerging markets for carbon, nutrients and water will need accurate data on the flows of these commodities across the agricultural landscape. Both on-farm and remote monitoring systems, that track crop productivity and constantly changing environmental variables, will need to be developed and integrated into the agribusiness economy. One way to get a grasp on our planetary goods and services is by leveraging the constellation of satellites already orbiting Earth. Global Positioning Systems (GPS) have become more common in developed agricultural economies and are designed to help minimize costs, maximize yields and enable farmers to apply inputs only where they are needed**.** Using GPS in conjunction with specialized satellite imagery can further the efficiency gains in crop production. While satellites are very good at detecting large scale changes, on-the-ground sensors can easily monitor changes to the farm ecosystem on a smaller scale. A global real-time distributed wireless network of sensors that monitors everything from water and air quality to carbon stocks and nutrient deficiencies is the trajectory that monitoring activities are taking. Examples of this type of wireless sensor network have been used in a few scientific studies, but further development and assimilation could give us a picture of the ebbs and flows of the agricultural system. **Precision agriculture technologies require a faster up-take rate by producers to utilize advanced information technology**. **Dependence on weather conditions, the risk of patent infringement and product liability issues, adverse foreign currency exchange rate fluctuations and uncertainty coupled with macro issues such as lower commodity prices and tightening credit are contributing to the industry’s weakness**.

**Tech advances in GPS technology solve signal drops**

**Duncan ‘09**

[Mitch J., Centre for Social Science Research, CQUniversity (Australia); Hannah Badland, W. Kerry Mummery; Science and Medicine in Sport, Vol. 12, p. 552]

**Increasing technological advances in GPS receiver chip technology will likely contribute to reducing** initialisation periods and **the likelihood of units to experience signal drop out**. Alternate location technology can be used to estimate position when GPS signal is not available, for example inside buildings or in very dense urban areas. This is performed using an inertial measurement unit combining data from multiple gyroscopes and three dimensional accelerometers or radio frequency tracking; however, this technology requires further development prior being widely used in the monitoring of TPA.

#### Multiple causes of accuracy errors – plan can’t ensure solvency

Zubinaite & Preiss ‘11

[Vilma, Vilnius Gediminas Technical University (Lithuania); George, Gjovik University College (Norway); *Aviation*; Vol. 15, No. 2; p. 45]

Since the beginning of global satellite positioning, it has been a challenge to eliminate and correct the error sources that affect positioning accuracy. Scientists have found mathematical solutions to reduce these errors as much as possible. Some of the errors can be totally eliminated, while others can be corrected to a certain degree. Some of the errors, like ionospheric errors, are still being examined and modelled. The goal of this paper is to examine whether the errors in a satellite’s orbital location, due to high solar activity, can affect the accuracy of ground receivers and, if so, how these errors can be controlled. When a ground receiver determines its position, there are many possible sources of errors: ––Ionospheric and tropospheric delays – signal delays due to the signal passing through various layers of the atmosphere; ––Orbital errors (ephemeris errors) – errors caused due to satellites transmitting inaccurate orbit parameters; ––Signal multipath – these errors can occur when the signal is reflected off objects before reaching the receiver; ––Receiver clock errors – the receiver clock is not as accurate as the atomic clocks on the satellites, which can lead to timing errors; ––The number of visible satellite – accuracy is better if the receiver observes more satellites; ––Geometry of the satellites – relative position of the satellites in the sky affects the accuracy, best if the satellites are spread widely. Researchers have been trying to find out ways to eliminate these errors. Some of the methods used are: ––Differencing; ––Using more signal frequencies; ––Modelling ionospheric errors. The first sources of errors, ionospheric and tropospheric delays and orbit errors, are affected by levels of solar radiation activity. It is generally assumed that satellites’ orbit errors are eliminated by differencing, in other words by using two or more receivers simultaneously (Būga 1999).

#### Can’t solve spoofing – models predicting success are unrealistic & robustness is a liability, not an advantage

Wesson ‘12

[Kyle, PhD candidate in Electrical & Computer Engineering @ University of Texas; Daniel Shepard, PhD candidate at the University of Texas & Todd Humphreys, Professor of Aerospace Engineering & Engineering Mechanics @ University of Texas; *GPS World*, January, p. 33-34]

Although our spoofer fooled all of the receivers tested in our laboratory, there are significant differences between receivers’ dynamic responses to spoofing attacks. It is important to understand the types of dynamics that a spoofer can induce in a target receiver to gain insight into the actual dangers that a spoofing attack poses rather than rely on unrealistic assumptions or models of a spoofing attack. For example, a recent paper on time-stamp manipulation of the U.S. power grid assumed that there was no limit to the rate of change that a spoofer could impose on a victim receiver’s position and timing solution, which led to unrealistic conclusions.

Experiments performed in our laboratory sought to answer three specific questions regarding spooferinduced dynamics: ◾ How quickly can a timing or position bias be introduced? ◾ What kinds of oscillations can a spoofer cause in a receiver’s position and timing? ◾ How different are receiver responses to spoofing? These questions were answered by determining the maximum spooferinduced pseudorange acceleration that can be used to reach a certain final velocity when starting from a velocity of zero, without raising any alarms or causing the target receiver to lose satellite lock. The curve in the velocity-acceleration plane created by connecting these points defines the upper bound of a region within which the spoofer can safely manipulate the target receiver. These data points can be obtained empirically and fit to an exponential curve. Alarms on the receiver may cause some deviations from this curve depending on the particular receiver. **FIGURE 1** shows an example of the velocity-acceleration curve for a high-quality handheld receiver, whose position and timing solution can be manipulated quite aggressively during a spoofing attack. These results suggest that the receiver’s robustness — its ability to provide navigation and timing solutions despite extreme signal dynamics — is actually a liability in regard to spoofing. The receiver’s ability to track high accelerations and velocities allows a spoofer to aggressively manipulate its navigation solution.

#### Can’t solve spoofing – No anti-spoofing technologies solve 100%

Wesson ‘12

[Kyle, PhD candidate in Electrical & Computer Engineering @ University of Texas; Daniel Shepard, PhD candidate at the University of Texas & Todd Humphreys, Professor of Aerospace Engineering & Engineering Mechanics @ University of Texas; *GPS World*, January, p. 33-34]

To avoid unrealistic expectations, it should be noted that no anti-spoofing technique is completely impervious to spoofing. GPS signal authentication is inherently probabilistic, even when rooted in cryptography. Many separate detectors and cross-checks, each with its own probability of false alarm, are involved in cryptographic spoofing detection. FIGURE 2 illustrates how the jammer-to-noise ratio detector, timing consistency check, security-code estimation and replay attack (SCER) detector, and cryptographic verification block all work together. This hybrid combination of statistical hypothesis tests and Boolean logic demonstrates the complexities and subtleties behind a comprehensive, probabilistic GPS signal authentication strategy for security-enhanced signals.

### A2 Non-Cryptographic Mechanism

#### Non-cryptographic anti-spoofing requires additional hardware – too expensive & too large

Wesson ‘12

[Kyle, PhD candidate in Electrical & Computer Engineering @ University of Texas; Daniel Shepard, PhD candidate at the University of Texas & Todd Humphreys, Professor of Aerospace Engineering & Engineering Mechanics @ University of Texas; *GPS World*, January, p. 62]

Non-cryptographic techniques are enticing because they can be made receiver-autonomous, requiring neither security-enhanced civil GPS signals nor a side-channel communication link. The literature contains a number of proposed non-cryptographic anti-spoofing techniques. Frequently, however, these techniques rely on additional hardware, such as accelerometers or inertial measurements units, which may exceed the cost, size, or weight requirements in many applications. This motivates research to develop software-based, receiver-autonomous anti-spoofing methods.

### A2 NMA Mechanism

#### NMA (Navigation Message Authentication) insufficient to solve spoofing

Wesson ‘12

[Kyle, PhD candidate in Electrical & Computer Engineering @ University of Texas; Daniel Shepard, PhD candidate at the University of Texas & Todd Humphreys, Professor of Aerospace Engineering & Engineering Mechanics @ University of Texas; *GPS World*, January, p. 60]

NMA is inherently less secure than SSSC. NMA security code chip interval (that is, 20 milliseconds) is longer than a SSSC chip interval, thereby allowing the spoofer more time to estimate the digital signature on-the-fly. That is not to say, however, that NMA is ineffective. In fact, tests with our laboratory’s spoofing testbed demonstrated the NMA-based signal authentication structure described earlier offered a receiver a better-than 95 percent probability of detecting a spoofing attack for a 0.01 percent probability of false alarm under a challenging spoofing-attack scenario. NMA is best viewed as a hedge. If the SSSC approach does not gain traction, then NMA might, since it only requires defining two new CNAV messages in the GPS IS — a relatively minor modification. CNAV-based NMA could defend receivers tracking L2C and L5. A new CNAV2 message will eventually be broadcast on L1 via L1C, so a repackaged CNAV2-based NMA technique could offer even single-frequency L1 receivers a signalside anti-spoofing defense.

## Industry Turn

#### **Jamming key to privacy**

NWI 4 National Workrights Institute, “On your tracks: GPS tracking in the workplace” 2004, http://epic.org/privacy/workplace/gps-traking.pdf

Regardless, employees can still find creative ways to protect their privacy. Self-help remedies include physically damaging the telephone, removing or disabling the chip, or using a GPS jammer. 103 Jammers can only the specific phone in question without disturbing other people’s phones. 104 Also, some nurses who are tracked have “feed their output directly into the phone’s receiving antenna or to its immediate vicinity, thus jamming accidentally” dropped their badges in patients’ bedpans, lost them in the toilet, or forgotten to wear them. 105 Undoubtedly, an employee would use such remedies at his or her own peril.

#### Geolocation Privacy is a Civil Liberties Imperative, and loss of privacy will cause us to lose trust in new technologies.

Black 12 Edward J. Black, president & CEO Computer & Communications Industry Association (CCIA), Before the Subcommittee on Crime, Terrorism, and Homeland Security U.S. House of Representatives Committee on the Judiciary, May 17, 2012 [http://www.ccianet.org/CCIA/files/ccLibraryFiles/Filename/000000000626/EBlack%20[CCIA]%20GPS%20Testimony%20[5-17-2012].pdf](http://www.ccianet.org/CCIA/files/ccLibraryFiles/Filename/000000000626/EBlack%20%5bCCIA%5d%20GPS%20Testimony%20%5b5-17-2012%5d.pdf)

My testimony makes five points: First, geolocation privacy is a civil liberties imperative. The privacy concerns and Constitutional beliefs of the nation strongly support warrant protection for location information. Where a person is located in relation to society – their interactions, their associations, their sense of being a free citizen – this information is the very essence of personhood. To cede to government the unchecked power to track you wherever you are is to lay the cornerstone of the surveillance state. As the D.C. Circuit noted in its opinion in United States v. Maynard, location data reveals information about a person that would shock the average American, and it can do it for numerous surveillance targets, from the comfort of an air conditioned office. There can be no question that, as the court in Maynard decided, Americans have a reasonable expectation of privacy in their whereabouts. 2 The law should close the loophole in ECPA that was inadvertently created by new geolocation technology. Otherwise the intent of the original law as well as this reasonable expectation of privacy in one’s whereabouts will be undermined. Second, there is also an important business interest in location privacy. Mobile telephony and mobile Internet access are some of the fastest growing sectors in our national economy. Mobile penetration itself has grown at an incredible rate, and smartphones in particular continue to grab new users all the time. Mobile technology promises to improve lives in many ways and geolocation-aware devices and apps in particular offer a renaissance for users. Third, many constituencies, from low-income and minority users, to many professionals, increasingly depend on mobile technology. For many, mobile devices are either the only means of accessing the In the workplace. Finally, decreasing the trust that people have in the devices they use will have a meaningful impact on how those people interact in society and in business in the future. Trust is the most essential question when looking at the uptake of a new technology, particularly where data is concerned. This is why the GPS Act as introduced by Representatives Goodlatte and Chaffetz is so vital. Today, many users are aware that their smartphones have the capability to track their movements and, thanks to press surrounding the U.S. v. Jones case from last year, know that, at least for the time being, cell-site location data may not have the protection of a warrant. That knowledge impedes trust, and the GPS Act would send a clear signal that geolocation information collected through the use of cell phones will be respected and protected against government intrusion at the highest level.

#### And this loss of trust leads to the hampering of innovation and expansion of geolocation business

Black 12 Edward J. Black, president & CEO Computer & Communications Industry Association (CCIA), Before the Subcommittee on Crime, Terrorism, and Homeland Security U.S. House of Representatives Committee on the Judiciary, May 17, 2012 [http://www.ccianet.org/CCIA/files/ccLibraryFiles/Filename/000000000626/EBlack%20[CCIA]%20GPS%20Testimony%20[5-17-2012].pdf](http://www.ccianet.org/CCIA/files/ccLibraryFiles/Filename/000000000626/EBlack%20%5bCCIA%5d%20GPS%20Testimony%20%5b5-17-2012%5d.pdf)

The situations described above hold true across the nation. As businesses across the Internet industry know, the trust of users is essential when collecting information from them, and geolocation information is no different. New geolocation services have the challenge of convincing potential users that they will treat information about their location with respect. In short, they must convince the users to trust them. There are many things that companies can do to enhance that trust. Among other practices, they can and should be transparent with their users about the information they gather and how it will be used, give those users as much control as possible over whether and when the information is collected, and protect the information once it is in their hands. It is vital for the health of their business to make this effort, and it is industry best practice. The one thing a company that collects location data cannot promise, however, is that they will protect that information against warrantless snooping by the government. The current state of Fourth Amendment law gives warrant protection against location information collected through a physical trespass (i.e., placing a device on a suspect’s car), but not through cell-site information or information collected directly from a device’s GPS receiver. 16 There is therefore quite a bit of uncertainty amongst companies about what the law is for each type of data, and what promises they can make to their users. That uncertainty itself hampers innovation and the expansion of businesses. Any company seeking start-up funding for a business plan that involves location information faces an uphill battle trying to overcome the stigma of legal uncertainty in a related area. The same is true when trying to form business partnerships or trying to sell a business that has achieved some success. The same uncertainty has an even more important effect on user trust. Users who are nervous about the privacy of their information will be turned off by finding out that the company collecting that data either cannot say for certain when they will have to turn it over to law enforcement or will affirmatively do so even when the government does not have a warrant.

## K Links

### Surveillance

#### GPS massively increases surveillance over populations

Granick 6/25

[ 2012 ;July 3rd, 2012; Directors of Civil Liberties @ The Center of Internet & Society; http://www.usnews.com/debate-club/should-probable-cause-be-required-for-police-to-use-cell-phone-location-data/without-regulation-gps-technology-easily-abused-by-authorities]

Police should be required to get authorization from a judge before they use technological gadgets to follow you 24/7. That's what the Geolocation Privacy and Surveillance Act would require. Here's a reason people feel creeped out when they think someone is tracking their movements. Being followed is scary and invasive. Curious officers can learn about your trips to the cancer screening clinic, the psychiatrist, the plastic surgeon, the AIDS treatment center, the strip club, the divorce attorney, the union meeting, the mosque, synagogue, or church from the safety of the precinct. Your personal, professional, religious, and sexual conduct is easy and inexpensive to track down. If I'm a bad cop, and some are, I can abuse this information to blackmail, to bolster an otherwise inadequate legal case, to harass, and to threaten. These abuses could have always taken place, but they were infinitely less likely just a few years ago. Then, innocent people were unlikely to be followed, because it wasn't worth the manpower. Mass surveillance was impossible. But modern GPS and cell phones have made it easy and cheap to follow anyone, or everyone, for any or no reason at all. The GPS Act is a great idea because a warrant requirement is the best tool our legal system has to restore the balance and ensure that only suspicious people are tracked. Also, the GPS Act allows officers to start tracking immediately in case of emergencies, so the concern that legal checks and balances may get in the way of legitimate police action does not apply here. With no warrant requirement, we give a green light to unwarranted police action. That means exactly what it sounds like. Officers could trail anyone (and everyone), without any reason, based on prejudice, corruption or whim. Police could engage in mass surveillance of groups of Americans based on race, religion, or political beliefs. Those surveyed get no notice, review, or remedy, and the entire enterprise would remain secret from courts and from the public. If we are to be a government of laws, not of men, then police use of unprecedented surveillance power should be exercised fairly, uniformly, and honestly. The GPS Act would ensure that police do not snoop into our most private affairs for arbitrary, discriminatory, or retaliatory reasons

### Capitalism

#### Satellites are intrinsic to capitalism Dickens 10(Peter, Professor of Sociology;University of Brighton and Cambridge, UK, July 3rd, 2012;, http://monthlyreview.org/2010/11/01/the-humanization-of-the-cosmos-to-what-end)

Yet among these plans and proposals, it is easy to forget that outer space is already being increasingly humanized. It has now been made an integral part of the way global capitalist society is organized and extended. Satellites, for example, are extremely important elements of contemporary communications systems. These have enabled an increasing number of people to become part of the labor market. Teleworking is the best known example. Satellite-based communications have also facilitated new forms of consumption such as teleshopping. Without satellite-based communications, the global economy in its present form would grind to a halt. Satellites have also been made central to modern warfare. Combined with pilotless Predator drones, they are now being used to observe and attack Taliban and Al-Qaida operatives in Afghanistan and elsewhere. This action is done by remote control from Creech Air Force Base at Indian Springs, Nevada. The 1980s Strategic Defense Initiative, or “Star Wars” program, aimed to intercept incoming missiles while facilitating devastating attacks on supposed enemies. A version of the program is still being developed, with the citizens of the Czech Republic and Poland now under pressure to accept parts of a U.S.-designed “missile defense shield.” This is part of a wider strategy of “Full Spectrum Dominance,” which has for some time been official U.S. Defense Policy.[4](http://monthlyreview.org/2010/11/01/the-humanization-of-the-cosmos-to-what-end#en82) Using surveillance and military equipment located in outer space is now seen as the prime means of protecting U.S. economic and military assets both on Earth and in outer space. Less dangerously, but still very expensively, a full-scale space-tourism industry has for some time been under active development. Dennis Tito, a multi-millionaire, made the first tourist trip into outer space in 2001. Richard Branson’s Virgin Galactic has now sold over three hundred seats at $200,000 apiece to its first tourists in outer space. The program is due to start in 2011, with spaceports for this novel form of travel now being built in Alaska, California, Florida, New Mexico, Virginia, Wisconsin, the United Arab Emirates, and Esrange in Sweden. Excursions circling the moon, likely to cost the galactic visitors around $100,000,000, are now under development

### Privacy

#### GPS technology ensures gov’t overreach & privacy violations p. 501-2

Karim ‘04

[Wassim, Attorney, former associate editor of Washington University Journal of Law and Policy; *Washington University Journal of Law and Policy*, Vol. 14; p. 501-2]

Up to this point, this Note has considered privacy concerns relating to the consumer data generated by personal tracking devices. However, another potential privacy problem involves the government’s possible use of the devices for surveillance and data collection. Given the enormous potential that these devices can have for law enforcement, it is certainly conceivable that law enforcement officials will attempt to use them. Recently, for example, police departments have used GPS systems in automobiles to track carjacking suspects.102 As history has shown, the government has tried to use surveillance—legally or illegally—when opportunities to do so are available, and a greater opportunity than the personal locator for the surveillance of people is scarcely imaginable.103 As such, we must consider the degree to which people who use GPS tracking devices are making themselves vulnerable to surveillance and profiling. Where corporations have the potential to collect data about individuals for their use, the government has the capability to consolidate the information and to create all-inclusive profiles on individuals.104 While the Privacy Act of 1974105 prohibits the government from maintaining profiles on individuals who are not the targets of investigation,106 the Act does not prohibit the government from purchasing information from private organizations.107 In fact, reports indicate that the Justice Department has an eight million dollar contract with Choicepoint, a data collection company, for access to their database of personal information.108

#### New technologies enable surveillance creep by the government

Karim ‘04

[Wassim, Attorney, former associate editor of Washington University Journal of Law and Policy; *Washington University Journal of Law and Policy*, Vol. 14; p. p. 509-510

Personal tracking devices will potentially present a significant threat to privacy with regard to government abuse in data collection and surveillance. With new technology such as the personal locator developing at a more rapid rate than that with which the law can keep pace, the potential for abuse intensifies.155 More importantly, the bigger threat, as identified by Jay Stanley and Barry Steinhardt of the ACLU, is the “Synergies of Surveillance”: the capability of the government to unify different technologies and data resulting in comprehensive surveillance and collection of data systems.156 The result of this comprehensive network could have an unprecedented chilling effect on society.157

#### GPS allows for unprecedented invasions of privacy

Gershman ‘10

[Bennett L., Professor of Law @ Pace University, *Pace Law Review*, Vol. 30, No. 3; p. 937-9]

The majority in Weaver conceded that Knotts appeared to be a formidable precedent that would seem to allow police investigators to use virtually any type of surveillance technology to track the progress of a vehicle on public roads.75 However, as the majority pointed out, there are significant differences between the “very primitive tracking device” in Knotts, and the “vastly different and exponentially more sophisticated and powerful technology” of a GPS device.76 The beeper in Knotts, the majority noted, was used for a limited and discrete purpose—to learn the destination of a particular item.77 The beeper merely served to enhance the sensory faculties of the police to enable them to follow the vehicle closely and maintain actual visual contact, which the Supreme Court compared to the agent‟s use of a searchlight, marine glass, or field glass.78 According to the Weaver majority, the GPS device is quantitatively and qualitatively different. GPS has a “remarkably precise tracking capability,”79 and can be cheaply and easily deployed to track a car “with uncanny accuracy to virtually any interior or exterior location, at any time and regardless of atmospheric conditions.”80 Such “constant” and “relentless” surveillance, according to the majority, is much more intrusive than “a mere enhancement of human sensory capacity.”81 Indeed, such tracking, the majority observed, “facilitates a new technological perception of the world in which the situation of any object may be followed and exhaustively recorded over, in most cases, a practically unlimited period.”82 For law enforcement to “see” and “capture” such information, the majority added, “would require, at a minimum, millions of additional police officers and cameras on every street lamp.”83 The implications to personal privacy of using a GPS device, the majority further argued, are staggering. They offered this stark portrayal: “[t]he whole of a person‟s progress through the world, into both public and private spatial spheres, can be charted and recorded over lengthy periods.”84 According to the majority, the police would be able to retrieve data that could instantaneously describe with “breathtaking quality and quantity . . . a highly detailed profile” of where we go, and in effect, who we are.85 Illustrative of the kinds of information that this technology potentially could reveal and record, the majority noted, are “trips to the psychiatrist, the plastic surgeon, the abortion clinic, the AIDS treatment center, the strip club, the criminal defense attorney, the by-the-hour motel, the union meeting, the mosque, synagogue or church, the gay bar and on and on.”86 The majority suggested that by using this technology, and by drawing easy inferences, the government would be able to assemble patterns of a person‟s professional and personal activities and could learn, with remarkable precision, his or her political, religious, amicable, and amorous associations.87

#### GPS monitoring of terrorist suspects would be extremely popular

Gershman ‘10

[Bennett L., Professor of Law @ Pace University, *Pace Law Review*, Vol. 30, No. 3; p.939-940]

In discussing whether Knotts should be the controlling doctrine on whether the use of a GPS device involves a constitutional search, the majority observed that the use of GPS “forces the issue.”88 Notwithstanding that round-the-clock GPS surveillance may be extremely popular and have many useful applications,89 as the majority acknowledged, this widespread use should not be taken as a “massive, undifferentiated concession of personal privacy to agents of the state.”90 Where there has been no voluntary utilization of this tracking technology, and when the GPS is surreptitiously installed by the police, there “exists no basis to find an expectation of privacy so diminished as to render constitutional concerns de minimis.”91 Moreover, the majority observed, the Supreme Court in Knotts acknowledged that the Fourth Amendment issue would be more directly presented if “twentyfour hour surveillance of any citizen of this country [were] possible, without judicial knowledge or supervision.”92

#### Warrants are essential to ensure ethical surveillance practices

Michael ‘06

[Katina; Andrew McNamee & MG Michael, Information Technology and Computer Science at the University of Wollongong (Australia), Presented at International Conference on Mobile Business (Denmark), July 25-27]

7.1.4. Do police need a warrant to track a suspected criminal or terrorist? Several cases have ruled that tracking a person with a GPS device is the same as following them on the street. However, GPS tracking is much more pervasive. First, a person is usually more aware of a person following them, than if a small tracking device were attached to their vehicle. Additionally, a GPS tracker can find a person’s location anywhere at anytime even when trailing is not possible. Furthermore, since a tracked person’s location is digitized it can be instantly analyzed to make inferences, in ways that simple observations cannot [57]. If the issuing of warrants is not compulsory there will be no barriers for police or security personnel to place tracking devices on any individual. Warrants are essential to ensure GPS tracking devices are used justly and ethically.

#### GPS monitoring sacrifices freedom at the altar of national security

Michael ‘06

[Katina; Andrew McNamee & MG Michael, Information Technology and Computer Science at the University of Wollongong (Australia), Presented at International Conference on Mobile Business (Denmark), July 25-27]

Molnar and Wagner [65] ask the definitive question “[i]s the cost of privacy and security ‘worth it’?” Stajano [10] answers by reminding us that, “[t]he benefits for consumers remain largely hypothetical, while the privacy-invading threats are real.” Indeed, when we add to privacy concerns the unknown longterm health impacts, the potential changes to cultural, social and political interactions, the circumvention of religious and philosophical ideals, and a potential mandatory deployment, then the disadvantages of the technology might seem almost burdensome. For the present, proponents of emerging LBS applications rebuke any negatives “under the aegis of personal and national security, enhanced working standards, reduced medical risks, protection of personal assets, and overall ease-of-living”[9]. Unless there are stringent ethical safeguards however, there is a potential for enhanced national security to come at the cost of freedom, or for enhanced working standards to devalue the importance of employee satisfaction. The innovative nature of the technology should not be cause to excuse it from the same “judicial or procedural constraints which limit the extent to which traditional surveillance technologies are permitted to infringe privacy” [56]. The aim of this present research is to understand the ethical implications of current LBS applications, with a view to emphasising the need for future innovators to ethically integrate these technologies into society.

#### Unfettered use of GPS surveillance ensures Orwellian overreach

Jallad ‘10

[Tarik, JD Candidate @ University of North Carolina; *North Carolina Journal of Law & Technology*, Vol. 11, Issue 2; Spring; p. ]

Have we, members of a free society, turned a blind eye to the government’s squandering of our constitutional liberties? Have our courts, the true guards protecting us from those veiled under the dark color of law, injudiciously watched as our intrinsic Fourth Amendment1 protections dissolved in plain sight? Consider the following assertions, reflecting on the unfettered use of Global Positioning System (“GPS”) surveillance: The sky is not falling—yet. But, if we continue to allow the Court’s Fourth Amendment law to be interpreted in a limited fashion that reads the amendment’s protections into oblivion, George Orwell’s 1984 will become a much more likely version of our future.2 The privacy violations arising from governmental abuse of GPS data from cellular phones and vehicle tracking systems are vast, thus legislative intervention is imperative.3 [T]he question becomes whether technology has eroded the protections provided by the Fourth Amendment, as interpreted by the U.S. Supreme Court. So far, the answer seems to be yes. . . .4 To some, this Orwellian future is no longer a sci-fi fantasy, but a prophetic reality knocking on our door—or more accurately, ringing the doorbell. This Recent Development, however, does not share this view.5 Rather, glancing only at the past few decades, this Recent Development seeks to explain how the precedent governing previous vehicle-tracking technologies still applies to the devices currently used by law enforcement officers.

#### GPS surveillance is the modern iteration of the Panopticon

Armstrong & Ruggles ‘05

[Marc P., Department of Geography @ University of Iowa; Amy J., Rand McNally & Co., *Cartographica*, Vol. 40, No. 4; Winter; p. 63-4]

Recent developments in geospatial information technologies have begun to generate rising levels of concern about privacy in the popular media. While researchers have initiated discussion about emerging interactions between geospatial technologies and in dividual-level privacy (Armstrong, Rushton, and Zimmerman 1999; Armstrong 2002; Curry 1997, 1998; Dobson 1998, 2000; Dobson and Fisher 2003; Goss 1995; Monmonier 2002; Onsrud, Johnson, and Lopez 1994; Waters 2000), the rapid pace of co evolutionary change requires further elucidation of emerging issues. The general purpose of this article, therefore, is to sketch out the role, both actual and potential, that geospatial technologies play in the negotiation of personal privacy. Particular emphasis is given to the surveillance capabilities of remote sensing systems (sateUite and terrestrial) and to how administrative records and other information, sometimes obtained as an adjunct of newly emerging location based services, can be mapped and cross-referenced to reveal the identities and characteristics of individuals from information that is often available on-line. Though writers such as Jeremy Bentham (1843) and Michel Foucault (1977), in their discussions of the panopticon, did not explicitly anticipate panoptic surveillance and the routine use of geospatial technologies to monitor the space-time activities of individuals, many scholars (see Elden 2003; Koskela 2003; Wood 2003) are increasingly concerned about such issues. In the case of remote sensing technologies, this role has already been explicitly acknowledged in the title of one of the first edited books on this topic: The Surveillant Science: Remote Sensing of the Environment (Holz 1973). While other geospatial technologies lack such a specific label, they clearly are being used, both individually and in combination, in surveillance. Moreover, as existing technologies develop, becoming smaller, lighter, and faster, and as their prices plummet, they will penetrate into most facets of our daily lives. Many individuals will complacently welcome these new technologies because of their real (or imagined) benefits. In other cases, however, awareness of the power of such technologies will encourage some to attempt to geospatially cloak themselves, living in the shadows of the panopticon.

#### GPS surveillance creep ensures the complete erosion of personal privacy

Armstrong & Ruggles ‘05

[Marc P., Department of Geography @ University of Iowa; Amy J., Rand McNally & Co., *Cartographica*, Vol. 40, No. 4; Winter; p. 71-2]

The pace of technological change in advanced societies is increasing, and we are now truly on the cusp of living under the continuous gaze of government and business interests; digitally encoded information about many routine activities is being collected and used, with and without consent. Our goal has been to elucidate some of the increasingly significant impacts of geospatial technologies on what were once thought to be private day-to-day activities. Remote sensing technologies are increasing in resolution to permit the identification of everyday objects and individuals fi-om space. Closer to home, effectively invisible technologies such as stealthy remotely piloted aircraft and closed-circuit television systems can now be used to conduct surveillance of individuals without their consent. Other geospatial operations can be applied to widely available digital maps to uncover the identities of the mapped and to monitor their proclivities. As the capabilities of geospatial technologies are not generally known and understood by the public, many individuals will find it difficult to guard against unwanted intrusions into their personal lives. Many will remain permanently unaware of the surveillant power of geospatial technologies, while others will remain complacent about their use, perhaps until they are confronted with a personal fact gleaned about them from the bitstream. Individuals can try to opt out of the panoptic surveillance of geospatial technologies, but this will be difficult to accomplish. As was widely reported through a variety of news outlets in 1999, Scott McNealy, CEO of Sun Microsystems, responded to a question about on line privacy in the following way: "You have zero privacy anyway. Get over it." It appears that we are headed to a similar place with respect to location privacy.

#### Warrants are key to checking privacy invasions of innocent parties – even the DOJ agrees

Shah ‘09

[Ramya, JD, University of Illinois; *Journal of Law, Technology & Policy*; Spring; p. 291]

Interestingly, even the Department of Justice‘s Electronic Surveillance Manual agrees and recommends securing a warrant because ―it often cannot be determined in advance whether a package containing a beeper will be taken inside a place where a person has a valid expectation of privacy, a search warrant should be obtained to cover that eventuality.‖115 Requiring a warrant before tracking a suspect would better serve the Fourth Amendment‘s purpose. True exigencies might arise ―[f]or example, during a bank robbery, [when] a bank teller acting as an agent for the police might slip a beeper into a money bag, thereby enabling the police to track the culprits.‖116 Even in such instances, ―the beeper would have to be attached at the scene of the crime or immediately thereafter, at a time when it would be impossible for police to obtain a warrant.‖117 Even in those cases, the safest policy would be for police ―to apply for a warrant as soon as possible after the tracking begins‖ in order to comply with the Fourth Amendment.118 State v. Campbell applied the concept of exigency announced in United States v. Karo.119 While Campbell reemphasized that in some cases, securing a warrant ―would be impracticable because of the ‗exigencies‘ surrounding their use and because of the need to satisfy the particularity requirements of the Fourth Amendment,‖120 the court nonetheless reasoned that because no exigency was present in this case, a warrant was required.121 Because a GPS device is attached to the vehicle, it has the potential to intrude upon the privacy of anyone who drives the vehicle or is a passenger in the vehicle. For instance, police could not only track the suspect but could also monitor a suspect‘s innocent friend or relative who uses the suspect‘s vehicle with the GPS attached to it. Unless the police are able to turn off the device or retrieve it when the vehicle is driven by someone else, the privacy rights of third parties may well be implicated.

#### Privacy rights are being invaded by GPS tracking GPS Tracker 2012(GPS Tracking Invades Privacy?, <http://www.gps-tracker.com/opinion/134-gps-tracking-invades-privacy>)

[GPS tracking](http://www.gps-tracker.com/index.php/gps-tracking) devices provide an incredible wealth of information that can be extremely beneficial to businesses interested in improving their fleet management programs, families looking for a way to monitor the driving habits of grandma or grandpa and [law enforcement](http://www.gps-tracker.com/index.php/law-enforcement) investigate potential law breakers. Although GPS tracking devices can leave a huge positive impact on a variety of businesses and people, **many everyday folks and privacy activists are asking whether we are going to far with the use of** [**GPS trackers**](http://gps-tracker.com/)**.** Okay, we have already established that GPS trackers are not bad technological tools. In fact, they are highly useful devices that can provide a wealth of informative data that can be used for a variety of applications.However, **the problem that many people have with GPS trackers is that they are sometimes seemingly over-used, and infringe on the** [**privacy rights**](https://www.privacyrights.org/) **of individuals.** **GPS trackers are now being used to track dogs, portable bathrooms and even bowling balls, making many believe the monitoring technology has gotten a little out of hand.** Basically, **GPS tracking technology can be used to monitor essentially any asset, item, person or thing**. Most people are using this new [technology](http://www.gps-tracker.com/index.php/technology) for positive applications such as protecting a car/recreational vehicle, monitoring a [teen driver](http://www.gps-tracker.com/index.php/teen-driving)/elderly driver, outdoor recreational activities/safety or one of the many other applications associated with vehicle tracking/GPS monitoring equipment. However, as the cost of highly accurate and sophisticated GPS monitoring units has fallen, more and more people are using GPS for any outside-of-the-box application a person could think of. "If a person wants to use a GPS tracker to monitor their cat, safe or some other silly thing that is their choice", explained a [fleet tracker](http://www.gps-tracker.com/index.php/fleet-tracker) expert at the [GPS Tracker Shop](http://www.gps-tracker.com/index.php/about-us). "Our only concern is the technology is not utilized in a way that is unlawful or irresponsible in a sense that it is used to invade the privacy rights of another human being." Right Of Privacy Invaded? GPS trackers have a stigma associated with them more than any other technological product. The reason is because most people automatically default assume that using a GPS tracker is in some how "creepy". The truth is all technological products can be used for positive applications as well as negative applications. A video camera can be used to capture family moments, but it can also be used for criminal purposes. A cell phone can be used to communicate with friends, but it can also be used to photograph others in peculiar and sometimes illegal situations. The truth is almost any technological product can be used to invade the right of privacy of another human being, and the technology should not be the scapegoat, but rather the individual.

**Supreme Court investigating privacy threats from GPS**

**Crump 2011** (Catherine, How GPS tracking threatens our privacy, <http://www.cnn.com/2011/11/07/opinion/crump-gps/index.html>, November 7, 2011)

(CNN) -- On Tuesday, the Supreme Court will confront the profound impact of new location-tracking technologies on Americans' privacy. The case, U.S. v. Jones, presents **the question of whether law enforcement needs a warrant before planting a GPS tracking device on a person's car**. The answer to this question is important in its own right, but the case is likely to have broader implications. **Attaching a GPS to a car isn't the only way the government can track people's movements. In fact, everyone with a cell phone is already carrying a device that the government can use to track his or her location. As a result, the principle at stake in this case may well shape our privacy rights in the years and decades to come.** The police in the current case suspected Antoine Jones of drug violations and tracked his movements continuously for one month by installing a GPS device on his car. Increasingly, though, **law enforcement agents are tracking our movements by tracking the cell phones that most people are already carrying around. It doesn't matter whether your phone is a smartphone or whether you use it to make calls; as long as your phone is turned on, it registers its location with cell phone networks several times a minute, and all U.S. cell phone companies hold on to that data, some of them for years. This kind of tracking is extremely invasive, because if the government knows where you are, it knows who you are.** As the Jones appellate court explained in its ruling that **the government violated the Fourth Amendment**, "A person who knows all of another's travels can deduce whether he is a weekly churchgoer, a heavy drinker, a regular at the gym, an unfaithful husband, an outpatient receiving medical treatment, an associate of particular individuals or political groups -- and not just one such fact about a person, but all such facts." Cell phone tracking can reveal our private associations and relationships with one another. The government could make note of whenever people being tracked crossed path or spent time together, showing who our friends, associates and lovers are. The Justice Department sometimes gets warrants to track location, and some local police departments make it a policy, which shows that it's not an unworkable requirement. But state and federal judges across the country have made conflicting rulings on what standards are required for the government to obtain tracking information from cell phone companies. New technology provides the government with a powerful and inexpensive tool to follow individuals as they travel through both public and private areas. Unless the court concludes that such tracking requires a warrant, anyone's movements could be subject to remote monitoring and permanent recording at the sole discretion of any curious police officer, without any judicial oversight. And **while it may not be realistic to think that the government will install a GPS device on every car, it's not at all implausible to think that the government will ask cell phone providers to turn over location-tracking information en masse -- and it may well be the case that the government is doing so already. It was** [**revealed last month**](http://www.guardian.co.uk/uk/2011/oct/30/metropolitan-police-mobile-phone-surveillance) **that the London police have a system that lets them track hundreds of phones in real time in a targeted geographic area, a technology that could easily enable the government to identify everyone at an Occupy protest, tea party rally or any other political gathering. The genius of the Constitution is that its limits on the government can still be applied in a modern world that the framers could scarcely have imagined. Anyone who values privacy should hope that the Court ensures the government cannot use technological advances to undermine the liberties this country was founded on.**

#### Police can track without a warrant; hurts privacy.

**Associated Press 2011** (New privacy fears as police could track your GPS without a warrant, <http://www.dailymail.co.uk/news/article-2059001/GPS-Privacy-Issues-Fears-police-track-GPS-warrant.html>, By [Associated Press](http://www.dailymail.co.uk/home/search.html?s=&authornamef=Associated+Press), 9 November 2011)

The U.S. Supreme Court is considering whether police use of GPS devices to track criminal suspects requires a judge's advance approval. The case being argued Tuesday could have implications for other high-tech surveillance techniques in the digital age. The Obama administration is appealing a ruling that threw out the drug conspiracy conviction of Antoine Jones of Washington because FBI agents and local police installed a GPS device on Jones' car and collected travel information without a search warrant. Tracking: The case will determine whether or not it is fair and legal for police officers to use a suspect's GPS device without issuing a warrant. **The government's point in favour of using the GPS device is that people have no expectation of privacy concerning their travel on public streets.** The GPS device helped authorities link Jones to a suburban house used to stash money and drugs. He was convicted and sentenced to life in prison before the federal appeals court in Washington overturned the conviction. The appellate judges said the authorities should have had a warrant and pointed to the length of the surveillance -- a month -- as a factor in their decision. An unusual array of interest groups backs Jones, including the Gun Owners of America, the Council on American-Islamic Relations, the American Civil Liberties Union and an association of truck drivers. The groups say GPS technology is much more powerful than the beeper technology police once employed in surveillance. A representative from the ACLU pushed the point that this case is not solely about Jones but about the future decisions of the Supreme Court, saying that **soon the issue of GPS on a car will be irrelevant as authorities move to simply track out cell phones without warrants since all cell devices have GPS capabilities already installed.** Highest level: The Supreme Court will hear the case starting Tuesday and it is likely to have major repercussions in the police and investigation fields But the Justice Department says the GPS device is no different from a beeper authorities used, with the high court's blessing in 1983, to help track a suspect to his drug lab. The court said then that people on public roads have no reasonable expectation of privacy. The Justice Department said GPS devices are especially useful in early stages of an investigation, when they can eliminate the use of time-consuming stakeouts as officers seek to gather evidence. Other appeals courts have ruled that search warrants aren't necessary for GPS tracking. The **justices will be considering two related issues, whether a warrant is needed before installing the device or using the GPS technology to track a vehicle.**

## Counterplan Ideas

### International

**International Co-op possible and solves - US and Europe prove**

**Lewis, 4**

Lewis, Senior fellow and director of the Technology and Public Policy Program CSIS, Center for Strategic and International Studies, June 2004, <http://csis.org/files/media/csis/pubs/040601_galileo_gps_competition_coop.pdf>, Galileo and GPS: From Competition to Cooperation acc: 6/28/2012 waru:AY

**A decision by European nations to move ahead with their own satellite navigation system, named Galileo, created a significant dispute with United States.** **As the outlines of the new system emerged, it was clear that it would compete with the U.S. Global Positioning System (GPS) rather than complement it.** **This engendered strong U.S. opposition** that, over **the course of four years of difficult negotiations, turned into an unexpected degree of compatibility. The successful framework agreement between the U.S. and Europe on the relationship between Galileo and GPS may suggest new models for cooperation** in space **for the provision of services and security**, **but also shows the limits of cooperation.** Understanding the concerns of the U.S. government and industry over the proposed for Galileo and how these concerns have been addressed helps us assess whether the positive outcome is a precedent. **Success in the negotiations was not preordained, as Galileo, almost by design, had become yet another irritant in the transatlantic relationship. The fundamental reason for creating Galileo was political and**, at some level, a **distrust of the** **U**nited **S**tates. A joint ESA/EC Report “A European Strategy for Space” (sometimes known as the Bildt report) had as a central conclusion that **Europe should not become dependent on an external ‘space infrastructure’ for strategic or commercial applications**.1 This follows from the notion that **space is an essential national infrastructure** (a more compelling idea, perhaps, in the 1990s, before the commerical satellite market fell on hard times), and that **it would be wrong to depend on foreign sources of supply.** **Satellite navigation services** **are** clearly **one such infrastructure, one that promises considerable commercial growth. France’s President** Jacques Chirac **went so far as to state that if Europe did not fund Galileo it would become an “American vassal.”2**

### eLorean/Private Actor CP

**eLorean is a PNT service capable of retaining services when GNSS/GPS is not available**

**Basker et. al. 7** Dr Sally Basker General Lighthouse Authorities (GLA) of the UK and Ireland Commander Joseph Chop US Coast Guard Colonel J Ron Davis (USAF, Ret.) Booz Allen Hamilton Captain G Thomas Gunther (USCG, Ret.) Booz Allen Hamilton Lieutenant Michael Herring US Coast Guard Mr Francis Hubert DCN Brest, France Professor David Last GLA Consultant Dr Sherman Lo Stanford University Commander John Merrill US Coast Guard Lieutenant Kirk Montgomery (USCG, Ret.) Symmetricom, Inc Mr Mitchell J Narins US Federal Aviation Administration Commander Christopher Nichols US Coast Guard Dr Gerard Offermans Reelektronika BV Dr Ben Peterson (Captain, USCG, Ret.) Peterson Integrated Geopositioning Captain Robert Wenzel (USCG, Ret.) Booz Allen Hamilton Lieutenant Ronald Wright US Coast Guard, “Enhanced Loran definition document” 16 October 2007, http://www.loran.org/ILAArchive/eLoran%20Definition%20Document/eLoran%20Definition%20Document-1.0.pdf

**eLoran**, **as an internationally standardized positioning, navigation, and timing (PNT) service**, **will be available for a wide range of applications and is an independent, dissimilar, complement to Global Navigation Satellite Systems** (GNSS). **PNT users will be capable of retaining the safety, security, and economic benefits of GNSS, even when their satellite services are disrupted or when using eLoran in areas where GNSS in not available**. **eLoran** is capable of providing this level of service by **meet**ing the **accuracy, availability, integrity, and continuity performance requirements for • aviation non-precision instrument approaches • maritime harbor entrance and approach maneuvers • land-mobile vehicle navigation • location-based services • precise time and frequency users**

**eLoran is the only system that can back up GPS in the event of a disruption**

**James 4/12** Callan James, Avionics today, “GPS Backup, is eLoran the answer?” Avionics Today, 4/12/12 http://www.aviationtoday.com/av/web-exclusives/GPS-Backup-Is-eLoran-the-Answer\_76148.html

According to researchers in the U.K., using its Sentinel GPS monitor network, between 50 and 450 jamming incidents were detected every day over a six month period last year. The Department of Homeland Security (DHS) in the coming years plans a similar monitoring scheme across the United States, called Patriot Watch. Unquestionably, such continuing investigations can only be an endless cat-and-mouse game between adversaries, during which time experts anticipate civil **GPS jamming will continue to escalate in intensity**, coupled with decreasing availability and integrity for users, while **underscoring the increasingly urgent need for an unjammable GPS backup** for aviation and all other critical national needs for positioning and timing. This has brought about the recent Federal Register request for public comment on the FAA plan to reduce the size of the national VOR network — while retaining DME — in readiness for NextGen’s Performance-Based Navigation (PBN) plan, and as a skeleton backup to GPS and Wide Area Augmentation System (WAAS), should jamming render them unusable. Under the plan, most ILS installations would be retained as backups for GPS Local Area Augmentation System (LAAS) for the same reason. But reducing VOR numbers down to FAA’s Minimum Operational Network (MON) has the unfortunate effect of raising the VOR’s nationwide reception “floor” to above 5,000 feet, due to line of sight limitations. Losing GPS at night while cruising at 3,000 feet sounds challenging Experts say eLoran, an enhanced version of the Loran-C long-range, **ground-based navigation system, could provide a backup to GPS from the ground up and the essential timing signals for the nation’s critical infrastructure**. **ELoran was not included in FAA’s plan**. (The U.S. Coast Guard terminated the transmission of all U.S. Loran-C signals in 2010.) “Today, **eLoran is the only system that can fully back up GPS, and all other GNSS systems planned or in use in other countries**,” said UrsaNav President and CEO Charles Schue. UrsaNav, a diversified technology company based in Chesapeake, Va., has assembled what could probably be described as one of the world’s leading centers of excellence in Loran-C and eLoran.

**eLORAN key to GPS accuracy**

by [**David Hambling**](http://www.newscientist.com/search?rbauthors=David+Hambling) **March 2011**

A new version, **eLORAN, uses more reliable transmitters and features improved** caesium atomic clocks. **With software modifications, it is accurate to about 10 metres**, as well as **providing a time signal of similar accuracy to GPS. It would be easy to modify future receivers to switch over to eLORAN without the user even noticing**, says Last.

### DOT says switch to eLorean

**DOT Recommends we Switch to eLoran to Back up our GPS for a Better Price**

**National PNT Advisory Board**-Jamming the Global Positioning System - A National Security Threat: Recent Events and Potential Cures-PDF- 20**10**

In December 2006, an Independent Assessment Team was appointed, reporting to **DOT and DHS**. It was under the administration of the Institute for Defense Analysis (IDA). After careful review over many weeks, they **unanimously recommended that the eLoran deployment be completed as a**

**backup for GPS. Yearly cost to maintain this in the US was about 20 $M. This is about 1/10th the cost of a single GPS satellite**. The DHS then made an announcement that eLoran was the official APNT system for the US. **The** Schlesinger-chaired **PNT Advisory Board has also unanimously recommended that eLoran be deployed and maintained as a GPS backup**. For these reasons, **the *international* navigation community has also strongly supported the upgrade and sustainment of the Loran system** in any number of forums. This recommendation has been heeded in Europe. Indeed, Figure 7 shows the faithful position track provided by enhanced Loran (e-Loran) as the ship traverses the jamming wedge generated by the General Lighthouse Authorities from Flamborough. Figure 7 provides a stark contrast to the GPS-based results in Figure 5**. unfortunately, DHS has not followed through with their announcement: the Loran system in the United States has been turned off.**

### eLorean Solves Terror

**The eLoran System Must be Implemented to Solve Terrorism**

**National PNT Advisory Board**-Jamming the Global Positioning System - A National Security Threat: Recent Events and Potential Cures-PDF- 20**10**

The new PFD **(Jammers) being sold on the web will** also **prevent use of** these **foreign GPS-like systems as well as cell phones**. Thus **these new foreign systems will not be helpful in operating during deliberate jamming radiated by the better devices currently available**. While a number of backup PNT systems have be considered, there are two major alternatives for APNT that have emerged as being particularly useful:1. e-Loran: **Loran is a ground-based radio-navigation system that preceded satellite navigation.** It finds its origins in World War II, and enjoyed wide spread adoption after the grounding of the Argo Merchant on Georges Bank. At that time, the U.S. Coast Guard began to require Loran carriage by ships over a certain tonnage in the Coastal Confluence Zone of the United States. Importantly**, Loran is based on the broadcast of *extremely high power signals* in the low frequency portion of the radio spectrum**. The 8/10frequency of transmission is 10,000 lower than the GPS frequencies in the microwave band, and the power of the transmission is 1000 times greater than the GPS transmission power. **An updated version of called eLoran has now been developed and tested. It is very robust, resistant to interference and has two dimensional accuracies of about 20 meters in critical areas.**