No. 10-1259

In the Supreme Court of the United States

UNITED STATES OF AMERICA,

Petitioner,

v.

ANTOINE JONES,

Respondent.

On Writ of Certiorari to the United States Court of Appeals for the District of Columbia Circuit

BRIEF OF CENTER FOR DEMOCRACY & TECHNOLOGY, ELECTRONIC FRONTIER FOUNDATION, MATT BLAZE, ANDREW J. BLUMBERG, ROGER L. EASTON, AND NORMAN M. SADEH AS *AMICI CURIAE* IN SUPPORT OF RESPONDENT

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QUESTION PRESENTED

Amici curiae will address the following question:

Whether the warrantless use of a GPS tracking device on a vehicle to monitor its movements on public streets violates the Fourth Amendment.

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INTEREST OF THE *AMICI CURIAE*[1]

This case brings before the Court important issues regarding the application of the Fourth Amendment's protection against unreasonable searches in the context of Global Positioning System (GPS) tracking technology. *Amici* consist of nationwide organizations and individuals with expertise regarding the technical operation of GPS and other technologies and the application of the Fourth Amendment to new and emerging technologies:

The Center for Democracy & Technology (CDT) is a non-profit public interest organization focused on privacy and other civil liberties issues affecting the Internet, other communications networks, and associated technologies. CDT represents the public's interest in an open Internet and promotes the constitutional and democratic values of free expression, privacy, and individual liberty.

The Electronic Frontier Foundation (EFF) is a non-profit, member-supported organization based in San Francisco, California, that works to protect free speech and privacy rights in an age of increasingly sophisticated technology. As part of that mission, EFF has served as counsel or *amicus curiae* in many cases addressing civil liberties issues raised by emerging technologies, including location-based tracking techniques such as GPS.

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[1] Pursuant to Rule 37.6, *amici* affirm that no counsel for a party authored this brief in whole or in part and that no person other than *amici* or their counsel made a monetary contribution to its preparation or submission. The parties' letters consenting to the filing of this brief have been filed with the Clerk's office.

Matt Blaze is associate professor of computer and information science at the University of Pennsylvania and director of the Distributed Computing Laboratory. He conducts research on security, networks, and surveillance technology.

Andrew J. Blumberg is an assistant professor of mathematics at the University of Texas at Austin. He has worked on the design and implementation of systems that use modern cryptography to provide location-based services while preserving user anonymity and privacy.

Roger L. Easton is the father of the GPS. He was the principal inventor and developer of the Timation Satellite Navigation System at the Naval Research Laboratory, where he worked from 1943 until his retirement in 1980. Today's GPS is based on Timation, and its principles of operation are fundamentally identical. Mr. Easton was inducted into the GPS Hall of Fame in 2006 and the National Inventors Hall of Fame in 2010. His awards include the National Medal of Technology, Navy Distinguished Civilian Service Award, Institute of Navigation Thurlow Award, and Sigma Xi Applied Science Award.

Norman M. Sadeh is a professor in the School of Computer Science at Carnegie Mellon University, where he directs the Mobile Commerce Laboratory. Dr. Sadeh's research focus has been in the area of mobile and pervasive computing, web privacy, and security. Products based on his research have been deployed and commercialized by IBM, Raytheon, Mitsubishi, and Boeing. Dr. Sadeh has authored over 150 scientific publications, including "m-Commerce: Technologies, Services and Business Models" (2002).

SUMMARY OF ARGUMENT

The threshold question in this case is whether the government's use of GPS technology to track respondent's vehicle infringed a reasonable expectation of privacy and therefore constituted a search within the meaning of the Fourth Amendment.

Just recently, the Court recognized the need to consider the nature of new technologies when defining "the existence, and extent, of privacy expectations" under the Fourth Amendment. *City of Ontario* v. *Quon*, 130 S.Ct. 2619, 2629 (2010). See also *Katz* v. *United States*, 389 U.S. 347 (1967) (overturning ruling in *Olmstead* v. *United States*, 277 U.S. 438 (1928), regarding application of Fourth Amendment to telephone conversations).

The same attention to the impact of new technology is warranted with respect to the government's contentions here, which—in minimizing the fundamental change in information collection that results from the revolutionary nature of GPS—would have the effect of substantially limiting the application of the Fourth Amendment.

The government's argument rests on two propositions. First, that GPS tracking is the technological and practical equivalent of the beeper-assisted surveillance held not to constitute a search in *United States* v. *Knotts*, 460 U.S. 276 (1983). Second, that the constitutional analysis in *Knotts* is controlling here. The government is wrong on both counts.

GPS tracking is fundamentally different from beeper-assisted surveillance:

- GPS tracking is an automated process wholly divorced from human observation that employs technology unrelated to visual surveillance. Beeper-assisted surveillance requires a police officer to follow the targeted vehicle for the duration of the surveillance in order to ascertain where the vehicle travels during that period.

- The evidence produced by GPS tracking consists of longitude, latitude, and altitude coordinates showing the vehicle's locations. A beeper and its receiver do not produce data that can be presented in court. The beeper's audio signals are relayed in real-time, and communicate only the vehicle's direction and distance at any given moment relative to the receiver being monitored by the police officer. The police officer's testimony regarding what he saw and heard are the only evidence of the vehicle's location.

- GPS tracking compiles a precise—and highly detailed—record of the vehicle's location at ten-second intervals for the entire period that the tracking function is activated. Because a beeper indicates only the tracked vehicle's approximate direction and distance relative to the receiver, an officer's ability to record a comprehensive list of the vehicle's locations using beeper-assisted surveillance depends entirely on the officer's ability to maintain visual surveillance of the vehicle.

- GPS tracking can be conducted around-the-clock for extensive periods of time, because, once the receiver is installed, the data collection is automatic and requires no real-time human monitoring. Beeper-assisted surveillance for anything other than a short period of time requires significant personnel and other resources: a police car, receiver, and other necessary equipment must be assigned to each beeper twenty-four hours a day, seven days a week.

- GPS tracking can be used simultaneously on very large numbers of vehicles and individuals. Large-scale monitoring using beeper-assisted surveillance is a practical impossibility.

These differences between the two technologies lead to different outcomes under the reasonable expectation of privacy standard.

The government contends that as long as one individual fact is susceptible to human observation in a public place—such as a person's location at a particular moment in time—the government may use any means to monitor and record the person's location on a continuous basis. But this Court in *Katz* rejected the argument that an individual loses all privacy protection simply by appearing in public. Especially in this era of rapid advances in technology, the Court should refuse to grant what would amount to a blanket exclusion from Fourth Amendment review of the government's use of large categories of new technologies.

This Court's precedents make clear that GPS tracking triggers application of the Fourth Amendment for two reasons. First, it is a wholly automated process unrelated to human observation that generates information fundamentally different from—and far more precise and extensive than—human surveillance of the type that a person would reasonably expect. For these reasons alone, it intrudes upon reasonable expectations of privacy.

Second, even if GPS tracking were deemed merely to augment human surveillance, its precision and persistence is such that, based on the standards for technological enhancement applied in this Court's cases, its use intrudes on citizens' reasonable privacy expectations. GPS tracking cannot be "readily duplicate[d]" by the public (*Dow Chemical Co.* v. *United States*, 476 U.S. 227, 231 (1986)): members of the public would be subject to civil and perhaps criminal liability if they employed GPS technology to track a vehicle without the owner's consent. And the information obtained from GPS tracking reveals intimate details not detectable through human observation.

New technologies provide great benefits, but they also carry the potential to "shrink the realm of guaranteed privacy." *Kyllo* v. *United States*, 533 U.S. 27, 34 (2001). To avoid that result, this Court should carefully analyze the real-world effects of these technologies—carefully scrutinizing arguments resting on claimed equivalence of very different methods of gathering information—as well as citizens' reasonable privacy expectations, and apply its Fourth Amendment precedents based on those realities.

ARGUMENT

I. GPS TRACKING IS FUNDAMENTALLY DIFFERENT FROM THE BEEPER-ASSISTED SURVEILLANCE CONSIDERED BY THE COURT IN KNOTTS.

The government's argument that GPS tracking is legally indistinguishable from the use of the beeper in *United States* v. *Knotts*, *supra*, rests principally on its depiction of the two technologies as essentially equivalent: "*Knotts*, like this case, involved the use of a tracking device to monitor the movements of a vehicle on public roads. The tracking device in that case—a beeper—enabled officers to maintain surveillance of the vehicle's movements when visual observations failed." U.S. Br. 12.

In fact, GPS tracking differs fundamentally from the beeper-assisted surveillance that this Court considered in *Knotts*.

A. GPS Tracking

The Global Positioning System consists of a set of government-owned satellites that continuously transmit navigation data to Earth. Any person can access this data with a simple device called a GPS receiver, which reads the transmissions sent from the satellites. The receiver uses this data to calculate the receiver's latitude, longitude, and altitude—and thereby pinpoints its location. That location information may be stored in the device itself or sent on a continuous basis—using mobile phone technology—to another device, such as a computer, designated by the party who controls the receiver.

Initially, GPS was developed by the Department of Defense for military use. *See* Scott Pace et al., RAND Corp., *The Global Positioning System: Assessing National Policies*, app. B at 237-247, *available at* http://www.rand.org/content/dam/rand/pubs/monograph_reports/2007/MR614.pdf. Today, it is a dual-use system, providing separate services for the military and civilian communities. The Precise Positioning Service (PPS) is designed for military use, with the navigation data encrypted to control access. *Understanding GPS: Principles and Applications* 3-4 (Elliot D. Kaplan & Christopher J. Hegarty eds., 2d ed. 2006) (*Understanding GPS*). The Standard Positioning Service (SPS) transmits non-encrypted data, which anyone can use. *Id.* at 4.[2] GPS receivers employed by law enforcement officers utilize SPS.

The core of the system is a constellation of 27 government-owned satellites in fixed orbits approximately 20,200 km, or 12,552 miles, above the Earth.[3] These satellites are maintained by the United States Air Force.[4] For FY 2012 alone, the Administration requested $1.2 billion for maintaining and improving GPS.[5]

GPS operates using a concept called "time of arrival ranging." *Understanding GPS*, *supra*, at 3. Each satellite continuously transmits a ranging signal. *Id.* at 24. An atomic clock onboard the satellite controls the timing of the ranging signal broadcast, and every transmission from a satellite is embedded with information indicating the time the signal left the satellite. *Id.* at 25. The satellite transmissions do not target specific receivers on the ground, but rather can be used by any receiver—and an unlimited number of receivers—that are in a position to receive the satellite's transmissions.

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[2] Prior to May 1, 2000, the government introduced random errors into the SPS to reduce the accuracy of the information provided to civilians, but it has discontinued this practice. See *Understanding GPS*, *supra*, at 4.

[3] Global Positioning System, *Space Segment,* GPS.gov, http://www.gps.gov/systems/gps/space/ (last visited Oct. 2, 2011).

[4] *Global Positioning System Standard Positioning Service Performance Standard* 5-6 (4th ed. 2008), *available at* http://www.pnt.gov/public/docs/2008/spsps2008.pdf

[5] *President's Budget Request for FY 2012,* http://www.gps.gov/policy/funding/2012/ (last visited on Oct.2, 2011).

A GPS receiver on the ground contains an antenna tuned to the frequencies transmitted by the satellites, and a clock synchronized to the clock onboard the satellites. *Id.* at 21; Zafar Ullah & Floyd Goodrich, *GPS Technology: Know Where You Are, Know How It Works* (2009), *available at* http://www.arrownac.com/services-tools/design/white papers/resource_aug09_gps.pdf. When the receiver receives a ranging signal from a satellite, it uses the difference between the time when the ranging signal was sent and the time when the ranging signal was received in order to calculate the distance between the receiver and the satellite. Scott Pace, *The Global Positioning System*, *supra*, app. A at 220 ("GPS works by timing how long it takes coded radio signals to reach the earth from its satellites.").[6]

The receiver calculates its latitude, longitude, and altitude based on transmissions from the four nearest satellites using a process called trilateration. This process is best illustrated by imagining a GPS receiver located on the ground and four satellites (Satellites A, B, C, and D) located in the sky. The GPS receiver calculates that it is 10 miles away from Satellite A. Therefore, the receiver knows it is located somewhere on the surface of a sphere with a 10-mile radius, with the center of the sphere being Satellite A. Next, the receiver calculates it is located 15 miles away from Satellite B, which again means that it is located somewhere on the surface of a sphere with a 15-mile radius, centered on Satellite B.

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[6] More detailed information about the mathematical process by which a GPS receiver calculates this difference and subsequently determines its precise location can be found at *Understanding GPS*, *supra*, at 21-65.

By repeating these calculations with Satellites C and D, the receiver can calculate where all four spheres intersect with each other, which will be one discrete point on the Earth's surface.[7]

A GPS receiver also can compute its speed and the direction it is traveling with the data it receives from the satellites. Scott Pace et al., RAND Corp., *supra*, app. A at 225.

The accuracy of the receiver's calculation of location information depends in part on atmospheric effects and the quality of the receiver, but the Federal Aviation Administration has determined that high-quality non-military receivers "currently provide better than 3 meter horizontal accuracy." Global Positioning System, GPS.gov, *GPS Accuracy*, http://www-.gps.gov/systems/gps/performance/accuracy/ (last visited Oct. 2, 2011). With the use of augmentation systems, GPS receivers can pinpoint locations to within a few centimeters.[8]

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[7] This illustration is taken from Marshall Brain & Tom Harris, *How GPS Works*, http://download.intel.com/corporate/education/emea/eng/za/elem_sec/tools_resources/plans/gps/lessonplans/unit_support/educator_support/How_GPS_works.pdf (last visited Oct. 2, 2011).

[8] The accuracy of GPS data has increased in recent years due to use of the FAA's supplemental Wide-Area Augmentation System program and the Coast Guard's Nationwide Differential GPS program. Receivers can improve accuracy to pinpoint precision by using differential GPS, which involves fitting a known, fixed point with a receiver, and comparing information from the fixed receiver with information from the roving receiver. *See* Department of Defense, Defense Science Board Task Force, *The Future of the Global Positioning System* 10 (2005), *available at* http://www.acq.osd.mil/dsb/reports/ADA443573.pdf;

GPS receivers can be extremely small and inconspicuous. For example, the California-based company Telemetry Solutions manufactured the "world's smallest GPS receiver," which weighs 10 grams—approximately the weight of four pennies—and includes a receiver, a battery, and a system enabling data to be downloaded wirelessly. Christopher Mims, *GPS Receivers Now Small Enough to Attach to Almost Anything*, Technology Review (Aug. 5, 2011), *available at* http://www.technologyreview.com/-blog/mimss-bits/27134/. Because they are extremely light and durable, researchers have even used them to monitor fruit bats in the wild without interfering with their flight. *Ibid.*[9]

Receivers can be battery operated, such as the device used in this case,[10] or can be attached to a power source, such as a car's electrical system, in which case they can run indefinitely. See*, e.g.*, *State* v. *Jackson*, 76 P.3d 217, 221 (Wash. 2003) (describing GPS tracking devices that drew power from the target vehicles' electrical systems rather than their own batteries).[11] Other devices are solar-powered

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GPS Accuracy, http://www.gps.gov/systems/gps/performance/accuracy/ (last visited Oct. 2, 2011).

[9] Technology continues to improve. The company now offers a GPS receiver weighing eight grams that is solar powered. See *Wildlife GPS Collars with Wireless Data Transfer*, Telemetry Solutions, http://www.telemetrysolutions.com/track-wildlife/small-mammal-gps-collars.php (last visited Oct. 2, 2011).

[10] The device was battery powered, and would go into "sleep" mode while the vehicle was stopped in order to conserve battery power and enable it to function without recharging for longer periods of time. J.A. 84.

[11] See also *Spark Nano 2.0 Real-Time GPS Tracker*, Brickhouse Security, http://www.brickhousesecurity.com/covert-small-gps-tracking-device.html (last visited Oct. 2, 2011) (compact bat-

and thus do not require any maintenance after installation. *Solar Power Intensifies GPS Data Sets*, Telemetry Solutions, http://www.telemetrysolutions.-com/track-wildlife/small-solar-powered-gps-devices.-php (last visited Oct. 2, 2011).

Moreover, novel methods of attaching GPS receivers require no human contact with the vehicle being tracked. The Los Angeles Police Department has tested an "air-propelled miniature dart equipped with a global positioning device" that enables officers to tag cars as they pass. Richard Winton, *LAPD Pursues High-Tech End to High-Speed Chases*, L.A. Times, Feb. 3, 2006, at B1, *available at* http://articles.latimes.com/2006/feb/03/local/me-bratton3. As the Los Angeles police chief emphasized, "Instead of us pushing them doing 70 or 80 miles an hour * * * this device allows us *not to have to pursue after the car*." *Ibid.* (emphasis added).

The location information calculated by a GPS receiver may be stored in the receiver or transmitted to a remote computer using radio or mobile phone technology—all without any human involvement. See Dep't of Justice, Nat. Inst. of Justice, *Investigative Uses of Technology: Devices, Tools, and Techniques* 13 (2007), *available at* https://www.ncjrs.-gov/pdffiles1/nij/213030.pdf.[12]

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tery-powered 3-inch by 2-inch GPS tracker); *Livewire ATX: Hardwired GPS Vehicle Tracking System*, Brickhouse Security, http://www.brickhousesecurity.com/gps-gsm-tracker.html (last visited Oct. 2, 2011) (GPS system that "runs on the car's power so there's no batteries to replace").

[12] The descriptions of GPS devices in various lower court opinions highlight the different methods used to capture data from the devices. See, *e.g.*, *United States* v. *Cuevas-Perez*, 640 F.3d 272, 275 (7th Cir. 2011) (noting the GPS device was capable of

Once the information is transmitted to a computer, it can be transformed, using mapping software, into a visual depiction of the vehicle's precise route. Because a GPS receiver typically recalculates its location every five to ten seconds, such a mapping program can graphically plot those locations to reproduce the receiver's movements over time. Severin L. Sorensen, *SMART Mapping for Law Enforcement Settings: Integrating GIS and GPS for Dynamic, Near Real-Time Applications and Analysis*, in *Crime Mapping and Crime Prevention* 349 (David Weisburd & Tom McEwen eds.,1998) *available at* http://www.popcenter.org/library/crimeprevention/volume_08/12-Sorensen.pdf (discussing the incorporation of GPS technology into law enforcement crime mapping analysis).

GPS thus supplies users with "accurate, continuous, worldwide, three-dimensional position and velocity information." *Understanding GPS*, *supra*, at 3; see also Global Positioning System, *What is GPS?*, GPS.gov, http://www.gps.gov/systems/gps (last visited Oct. 2, 2011). When combined with a mapping program, the location information produces a complete real-time depiction of everywhere the GPS receiver—and therefore the vehicle or person to which that receiver is attached—has been. And once a re-

sending "minute-by-minute messages to its operator remotely"); *United States* v. *Pineda-Moreno*, 591 F.3d 1212, 1213 (9th Cir. 2010) (GPS devices "permitted agents to access the information remotely, while others required them to remove the device from the vehicle and download the information directly"); *Morton* v. *Nassau Cnty. Police Dep't*, 2007 WL 4264569, at *1, No. 05-CV-4000(SJF)(AKT)(E.D.N.Y. Nov. 27, 2007) ("The GPS transmitter has a cellular modem component that permits remote access to the stored tracking information and current location of the transmitter.").

ceiver has been planted on a car, the police may playback or monitor all of this tracking data in real time, from their stationhouse or anywhere else connected to the Internet.[13]

B. Beeper-Assisted Surveillance

A beeper is "a radio transmitter, usually battery operated, which emits periodic signals that can be picked up by a radio receiver." *Knotts*, 460 U.S. at 277. By using a receiving device to monitor signals from a beeper—also termed a "radio direction finder" or "bird dog"—an individual can determine the beeper's general direction relative to the receiver's location. Jerry L. Dowling, *"Bumper Beepers" and the Fourth Amendment*, Crim. L. Bull., Jul.-Aug. 1977, at 266-267.

An article written for law enforcement officials in the early 1970s explained the process of monitoring beeper transmissions. See William Shaw, *Miniature Tracking Transmitters*, L. & Order, Jan. 1973, at 24.

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[13] A former narcotics detective with the Chesterfield County Police Department in Chesterfield, Virginia, explained:

> [T]he GPS unit can be programmed to transmit an electronic signal via a cell tower to a base unit approximately every five seconds. The officer monitoring it can determine the latitude and longitude of the vehicle, tell how long the vehicle remains at its location, view a computer screen containing a map of the area where the vehicle is located, and see where the vehicle is headed—all without leaving police headquarters.

Rob Cerullo, *GPS Tracking Devices and the Constitution*, 71 Police Chief, no. 1, Jan. 2004, *available at* http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arch&article_id=179&issue_id=12004.

The receiving apparatus consisted of a receiving antenna and a radio frequency detector. *Id.* at 25. The receiving antenna was used to find the direction of the beeper by manually turning the antenna by hand to determine the direction from which the beeper signal originated. *Id.* at 29 ("There are direction finding loop antennas available that could provide an indication of direction but the loop must be turned manually to 'home' in on the signal source.").

Officers could attach an additional antenna to the monitoring car, so that one antenna would be on the right side and the other would be on the left. See Robert M. Brown, *The Electronic Invasion* 87 (1967) (*Electronic Invasion*). By noting which antenna received the strongest signal, the officers could determine whether the target was to the right or left of the police car.

An officer could roughly estimate the approximate distance between the receiver and the beeper by using an add-on device called a relative signal strength ("S") meter. *Id.* at 88; see also Jerry L. Dowling, *supra*, at 266, 268. This device connected to the FM monitor receiver and measured the intensity of the beeps. *Electronic Invasion supra*, at 88. Some agents believed that their ears were more reliable than the best S-meters, and therefore spent "months" training themselves "to listen for slight variations in the loudness of the target car's beeps." *Id.* at 89.

Under normal operating conditions, a beeper's signal could be monitored from a distance of two to four miles on an open road and up to twenty miles in the air. In congested urban areas, the range could drop to about two blocks. See Reply Br. for United States at 14-15 n.6, *United States* v. *Karo*, 468 U.S. 705 (1984). In addition to the obstructions present in an urban environment, the object that the beeper was attached to or hidden in could also interfere with the signal. William Shaw, *supra*, at 28 ("[I]f the transmitter is hidden under a fender or inside the vehicle you may find that vehicle's body acts as a shield, thereby greatly reducing the transmitting range.").

Neither beepers nor the receivers used to monitor them can by themselves ascertain or store the beeper's location. Rather—because a beeper is limited to providing a real-time indication of its location *relative* to the person monitoring through use of the directional finder—"beepers are used to supplement visual surveillance—a stopgap in case visual contact with the suspect is lost." Jerry L. Dowling, *supra*, at 266, 269.

C. Critical Differences Between GPS Tracking and Beeper-Assisted Surveillance

There are several important differences between GPS tracking and surveillance assisted by a *Knotts*-type beeper.

1. GPS tracking is an automated process wholly divorced from human observation that employs technology unrelated to visual surveillance.

Beeper-assisted surveillance requires a police officer to follow the targeted vehicle, for the duration of the surveillance, in order to ascertain the vehicle's location. That is because the beeper and receiver function only as directional finders, indicating the vehicle's direction relative to the receiver, and thereby aiding in visual surveillance by pointing the police in the direction of the vehicle. The vehicle's actual location can be determined only through the police officer's observations.

Thus, the *Knotts* Court explained that "officers followed the car in which the [beeper] had been placed, maintaining contact by using both visual surveillance and a monitor which received the signals sent from the beeper." 460 U.S. at 278. The officers "lost the signal from the beeper, but with the assistance of a monitoring device located in a helicopter the approximate location of the signal was picked up again about one hour later." *Ibid.*

A beeper enhances the effectiveness of real-time visual surveillance by enabling police officers to confirm that the vehicle that they see is the vehicle being tracked and providing a means of re-establishing visual surveillance. If officers become separated from the vehicle by more than a few miles, however, they must criss-cross the area until they pick up the beeper signal again.

GPS tracking, by contrast, does not require any visual surveillance by police officers after the receiver has been installed. Instead, the receiver automatically calculates its location once every ten seconds. A police computer receiving that information through a cell phone connection then uses a mapping program to plot the receiver's—and therefore the vehicle's—location. The technology enables the police to monitor and record the vehicle's location without ever observing or following the car themselves.

Moreover, GPS tracking produces this information by using a technology completely unrelated to—and wholly different from—visual surveillance of a vehicle or individual. As we have explained (at pages 7-14, *supra*), GPS tracking information is generated through the combined operation of four components: a multi-billion dollar system of satellites owned and operated by the U.S. Department of Defense; a small receiver that uses the satellites' transmissions to calculate latitude, longitude and altitude on a precise and continuous basis; a cell phone that transmits those coordinates to a police computer; and mapping software that converts those coordinates into human-intelligible information by plotting them on a map and storing them for further analysis and presentation. Visual surveillance of the GPS device or of the vehicle to which it is attached—whether by humans or by cameras that replicate human observation—is completely unnecessary to this process.

2. ***GPS tracking produces evidence that is not based in any way upon human surveillance.***

When an officer uses a beeper to assist him in following a vehicle, the beeper and its receiver do not produce data that subsequently is—or can be—presented in court. The beeper's audio signals are relayed in real-time, and communicate only crude approximations of the vehicle's direction and distance at any given moment relative to the receiver being monitored by the police officer.

At trial (or in a subsequent warrant application), it is the *officer* who testifies to what he heard and what he saw. His observations remain the only evidence of the vehicle's location.

A GPS receiver, on the other hand, calculates its longitude, latitude, and altitude coordinates and either records that data or transmits it to a police computer. The evidence is those coordinates themselves—or, more frequently, a map of the vehicle's movements created with mapping software.

3. ***GPS tracking produces evidence much more precise and detailed than the evidence resulting from beeper-assisted surveillance.***

a. If an officer employing beeper-assisted surveillance is following the target vehicle at a distance of one mile—and therefore is not maintaining visual surveillance of the vehicle—he or she will not be able to determine precisely where the vehicle is, only its approximate direction and distance relative to the receiver. And if the officer loses the beeper signal, he or she will not even know the vehicle's approximate direction and location. An officer's ability to record all of a vehicle's locations using beeper-assisted surveillance thus depends entirely on the officer's ability to maintain visual surveillance of the vehicle.

GPS tracking, on the other hand, automatically compiles a precise—and highly detailed—record of the vehicle's location at ten-second intervals for the entire period that the GPS receiver is operational. That provides a far more thorough and detailed account of the vehicle's location than any officer conducting beeper-assisted surveillance could possibly compile. In this case, for example, the government's GPS evidence consisted of more than two thousand pages of location data. J.A. 109-110, 128.

b. The ability of GPS tracking to identify the precise location of a vehicle over time has another, entirely independent, significant consequence—the resulting data can be used by law enforcement officers to generate information concerning extremely private aspects of a person's life.

Probabilistic models of a user's activity can be generated by combining the knowledge of what businesses are near any given location (gleaned from a simple Internet search) with the frequency of a tracked vehicle's visits to that location. *Cf.* Ramaswamy Hariharan, John Krumm & Eric Horvitz, *Web-Enhanced GPS*, 3479 Lecture Notes in Computer Sci. 301 (2005). For instance, the fact that a tracked car suddenly began stopping at an oncologist's office several times a month could reveal that a member of the family had cancer. The buildings that a person regularly visits could reveal his religious or political affiliations.

The MIT Reality Mining study tested the ability of tracking technology to divulge more than merely people's locations. Among other things, the study was able to show that a person's "workplace colleagues, outside friends, and people within a user's circle of friends" could be "identified with over 90% accuracy" based on common-sense heuristics (*e.g.*, "office acquaintances are frequently seen in the workplace, but rarely outside the workplace.") *Relationship Inference*, MIT Media Lab: Reality Mining, http://reality.media.mit.edu/dyads.php (last visited Oct. 2, 2011).[14]

[14] Computer models also make it possible to predict a person's movements in the future based on their past patterns. See Nathan Eagle, Aaron Clauset & John A. Quinn, *Location Segmentation, Inference and Prediction for Anticipatory Computing*, MIT Media Lab: Reality Mining, http://reality.media.mit.edu/pdfs/anticipatory.pdf (last visited Oct. 2, 2011).

4. GPS tracking can be conducted around-the-clock for extensive periods of time.

Beeper-assisted surveillance for anything other than a short period of time requires significant personnel and other resources. Because police officers must follow the target in real-time, a team of officers, equipped with a police car, receiver and other necessary equipment, must be assigned to each beeper twenty-four hours a day, seven days a week.

Moreover, the practical limitations of beeper-assisted surveillance limit even medium-term monitoring. It is inevitable that the officers will lose visual contact with the vehicle at various points, and therefore will be unable to be certain of the vehicle's precise movements during some, or even a substantial part, of the period of surveillance.

GPS tracking has no such limitations. Once the receiver is installed, the data collection is automatic and requires no real-time human monitoring. The only limitation is the duration of the receiver's power supply and—as discussed above (pages 11-12, *supra*)—there are an increasing number of options that provide an effectively unlimited power supply. Around-the-clock long-term tracking is realistically possible through, and only through, the use of GPS tracking.

5. GPS tracking can be used simultaneously on very large numbers of vehicles and individuals.

The inherent limitations of beeper-assisted surveillance just discussed also limit the number of vehicles that law enforcement officials can follow using that technology. It simply would not be possible to assign large numbers of officers to monitor beepers given the other demands on law enforcement.

The GPS system can accommodate an unlimited number of receivers. *Understanding GPS*, *supra*, at 3. And, because GPS tracking requires no target-specific commitment of personnel resources, it can be deployed on a widespread basis. The resulting data could be stored and analyzed using computers whenever law enforcement officials wished to gain information about a specific person or persons.

Indeed, given the shrinking size of GPS receivers, the day is not far off when a State could simply embed a GPS device in every license plate that it issues, so that tracking data would be available to police officers whenever they wished to ascertain the movements of a particular vehicle during a specified period of time.

And nothing limits the installation of GPS receivers to vehicles. As receivers shrink in size, it will be possible to install them in a person's clothing (for example, in a shoe, or the lining of a suit or other garment), or in a pocketbook or briefcase. Because the tracking does not require any physical surveillance by law enforcement officers, the government would be able to use the technology to track the movements of large numbers of individuals even more directly and precisely than through the attachment of a GPS receiver to a vehicle.

The large-scale monitoring that is a practical impossibility based on beeper-assisted surveillance is now a realistic possibility with GPS tracking.

II. THE CRITICAL DIFFERENCES BETWEEN GPS TRACKING AND BEEPER-ASSISTED SURVEILLANCE LEAD TO DIFFERENT RESULTS UNDER THE REASONABLE EXPECTATION OF PRIVACY STANDARD.

The threshold question in determining whether government conduct constitutes a search within the meaning of the Fourth Amendment is whether the conduct (1) encroaches upon a person's "actual (subjective) expectation of privacy," and (2) "the expectation [is] one that society is prepared to recognize as 'reasonable.'" *Katz,* 389 U.S. at 361 (Harlan, J., concurring). The government does not dispute the first issue. The question here is whether Jones's expectation that he would not be subject to the intrusion resulting from GPS tracking is reasonable.

The government's entire argument rests on a single point: that a person's vehicle is subject to visual observation when it travels on public roads. This Court's precedents make clear, however, that the protections of the Fourth Amendment apply even in public places. Because the information generated by GPS tracking is fundamentally different from what may be obtained through human observation—in its precision, in its duration, in its scope, and in the means by which it is collected—GPS tracking constitutes a search within the meaning of the Fourth Amendment.

A. The Court's Precedents Establish That GPS Tracking Intrudes On Individuals' Reasonable Expectation of Privacy.

An individual does not lose all privacy protection simply by appearing in public. As the Court recognized in *Katz*, what a person "seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected." 389 U.S. at 351.

For example, the Fourth Amendment limits the circumstances in which a person in public may be subjected to a physical search. *Terry* v. *Ohio*, 392 U.S. 1 (1968). The same is true of a package carried by a person in public. *E.g.*, *Bond* v. *United States*, 529 U.S. 334, 338-339 (2000) (officer's tactile inspection of a bag constituted a search because no one "expect[s] that other passengers or bus employees will * * * feel the bag in an exploratory manner").

Even a sniff by a dog interferes with reasonable expectations of privacy unless the dog is trained to detect only the presence of contraband. *Illinois* v. *Caballes*, 543 U.S. 405, 409-410 (2005); *United States* v. *Place*, 462 U.S. 696, 707 (1983); see also *United States* v. *Jacobsen*, 466 U.S. 109, 124 n.24 (1984) ("[T]he *reason* [the dog sniff] did not intrude upon any legitimate privacy interest was that the governmental conduct could reveal nothing about noncontraband items.").

This Court has found no interference with individuals' reasonable expectation of privacy in a public place only where the government conduct consisted of actual physical observation by law enforcement officers—in some cases augmented by technology that enhanced the officers' powers of observation. Thus, the Court has upheld the use of searchlights, binoculars, and similar devices. See*, e.g.*, *United States* v. *Lee*, 274 U.S. 559, 563 (1927).

That is the principle that was applied in *Knotts*. Observing that the officers "relied not only on visual surveillance, but also on the use of the beeper to signal the presence of [the] automobile to the police receiver," the Court stated that "[n]othing in the Fourth Amendment prohibited the police from ***augmenting the sensory faculties bestowed upon them at birth*** with such enhancement as science and technology afforded them in this case." 460 U.S. at 282 (emphasis added).

The government's argument here requires the Court to move far beyond this principle. The government contends that as long as one individual fact is susceptible to human observation in a public place—such as a person's location at a particular moment in time—the government may use any means to monitor and record the person's location on a continuous basis. Especially in this era of rapid advances in technology, the Court should refuse to grant what would amount to a blanket exclusion from Fourth Amendment review of the government's use of large categories of new technologies.

GPS tracking triggers application of the Fourth Amendment for two reasons. First, it is a wholly automated process unrelated to human observation that generates information fundamentally different from—and far more precise and extensive than—human surveillance of the type that a person would reasonably expect. Second, even if GPS tracking were deemed merely to augment human surveillance, its precision and persistence is such that, based on the standards for technological enhancement applied in this Court's cases, its use intrudes on individuals' reasonable privacy expectations.

One additional element is relevant to the Fourth Amendment analysis: the extent to which the intrusion on reasonable privacy expectations is effectuated through a physical intrusion on the individual's property. The Court relied heavily on this factor in *Silverman* v. *United States*, 365 U.S. 505 (1961). There, the government monitored conversations by use of a "spike mike," which worked by "ma[king] contact with a heating duct serving the house occupied by the petitioners thus converting their entire heating system into a conductor of sound." 365 U.S. at 506-507. The Court found the Fourth Amendment applicable because the government's action "usurp[ed] part of the petitioners' house or office—a heating system which was an integral part of the premises occupied by the petitioners, a usurpation that was effected without their knowledge and without their consent." *Id.* at 511.

Precisely the same analysis applies here. Installation of a GPS receiver converts an individual's car into a source of information about that individual. When that occurs without the owner's consent, this factor weighs heavily in favor of Fourth Amendment protection.

1. ***GPS tracking infringes reasonable expectations of privacy because the information is collected through means wholly unrelated to human observation and is more precise and more comprehensive than what can be obtained from human observation.***

This Court's decisions holding the Fourth Amendment inapplicable to government actions collecting information in public places rest on two critical factors, neither of which applies to GPS tracking.

First, where the Court has found no intrusion on reasonable expectations of privacy, the information was obtained through human observation, sometimes augmented by technological means. *Knotts*, 460 U.S. at 282; see also *Dow Chemical Co.*, 476 U.S. at 238 (aerial camera merely "enhanced" vision and did not exploit "some unique sensory device * * * but rather a conventional, albeit precise commercial camera commonly used in mapmaking").

GPS tracking, by contrast, does not involve *any* human observation, and the resulting evidence is made up of computer-generated data and not human observations. See pages 9-14 & 18, *supra*. "Unlike binoculars or a flashlight, the GPS device does not merely augment the officers' senses, but rather provides a technological substitute for traditional visual tracking." *Jackson*, 76 P.3d at 223.

GPS tracking is therefore fundamentally different from beeper-assisted surveillance and, under the Court's cases, that difference compels a different outcome. GPS tracking infringes individuals' reasonable privacy expectations. *Cf. Kyllo*, 533 U.S. at 33, 34 (use of thermal imager that revealed infrared radiation invisible to the human eye was "more than naked-eye surveillance" and constituted a search).[15]

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[15] The *Kyllo* Court indicated that the use of thermal imaging technology constituted a search "at least where (as here) the technology in question is not in general public use." 533 U.S. at 28. It did not hold the opposite—that there would never be a search if the technology is "in general public use"; the Court did not reach that question.

We submit that the "not in general public use" criterion is not the only standard by which to judge a technology's Fourth Amendment significance. It is especially inappropriate where the technology does not merely augment human observation but rather operates entirely without human observation. Given the trends in technology, considering only whether a technology is in general public use would have the inevitable result of "shrink[ing] the realm of guaranteed privacy," *Kyllo*, 533 U.S.

Second, in this Court's prior cases finding no intrusion on reasonable expectations of privacy, the information collected was not different in precision, scope, or quantity from what could be obtained through human observation. In *Dow Chemical*, for example, the Court held that the aerial photography "was not so revealing of intimate details as to raise constitutional concerns." 476 U.S. at 238; see also *id.* at 238 n.5 ("No objects as small as ½-inch in diameter such as a class ring * * * are recognizable, nor are there any identifiable human faces or secret documents captured in such a fashion as to implicate more serious privacy concerns.").

Again, GPS tracking is fundamentally different. It enables the collection of much more detailed and precise information over much longer periods of time than would be possible through human observation, even human observation assisted by a beeper or other technologies. See pages 9-14 & 19-22, *supra*.

GPS tracking "is not a mere enhancement of human sensory capacity, it 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." *People* v. *Weaver*, 12 N.Y.3d 433, 441, 909 N.E.2d 1195, 882 N.Y.S.2d 357 (N.Y. 2009). For that reason as well it constitutes a search under the Fourth Amendment.

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at 34, because many technologies have beneficial impacts on society unrelated to government surveillance.

In any event, as we discuss below (at pages 29-30, *infra*), GPS tracking technology as used by the government here does not fall within any "general public use" exception.

2. *Even if GPS tracking were deemed to augment human observation, it infringes reasonable expectations of privacy.*

GPS tracking would trigger the Fourth Amendment's protections even if it could be characterized as merely augmenting human surveillance. This Court has made clear that technological augmentation of human observation infringes reasonable expectations of privacy if the gathering of the information could not be "readily duplicate[d]" by a member of the public at large, because the relevant technology is not "in general public use"; or if the information obtained by the government reveals "intimate details" not detectable through ordinary human observation. *Dow Chemical*, 476 U.S. at 231, 238; see also *Kyllo*, 533 U.S. at 35 n.2, 39 n.6. GPS tracking infringes both of these limitations.

The standard for determining whether the government's information-gathering may be "readily duplicate[d]" is whether members of the public could use the technology to obtain the same information. *Kyllo*, 533 U.S. at 39 n.6 (quoting *California* v. *Ciraolo*, 476 U.S. 207, 215 (1986)) ("In an age where private and commercial flight in the public airways is routine, it is unreasonable for respondent to expect that his marijuana plants were constitutionally protected from being observed with the naked eye from an altitude of 1,000 feet."); *Dow Chemical*, 476 U.S. at 231 ("The photographs * * * are essentially like those commonly used in mapmaking. Any person with an airplane and an aerial camera could readily duplicate them.").

Members of the public cannot routinely employ GPS technology to track a vehicle without the owner's consent. To the contrary, affixing a GPS receiver to a car or a person without consent would constitute a tort under the common law of most if not all States, and several States have specifically prohibited the private use of tracking technology. See, *e.g.*, Cal. Penal Code § 637.7 (declaring "electronic tracking of a person's location without that person's knowledge violates that person's reasonable expectation of privacy" and making illegal the "use of an electronic tracking device" by anyone other than law enforcement officials); Haw. Rev. Stat. § 803-42a (same).

The intrusion effected by government GPS tracking therefore is not at all "routine" (*Kyllo*, 533 U.S. at 39 n.6) and cannot legitimately be "readily duplicate[d]" by the public. Indeed, in contrast to beepers (*Knotts*) and airplanes (*Dow Chemical*), the government itself owns the entire GPS satellite network and exclusively controls public access to it. For these reasons alone, the use of GPS technology to conduct covert monitoring of a person constitutes a search within the meaning of the Fourth Amendment.

Moreover, the information obtained from GPS tracking does reveal intimate details not detectable through ordinary human observation. As explained above, the GPS mapping software allows not only the plotting of coordinates on a map but also their association with the names of businesses at those addresses. The police could thus infer an individual's political or group affiliations based on the meetings they attend, their medical histories based on the doctors they visit, and their most intimate associates—information that most people reasonably expect to remain private and that implicates other constitutional rights. *Cf. NAACP* v. *Alabama ex rel. Patterson*, 357 U.S. 449 (1958). For that reason as well, the use of this technology triggers the protections of the Fourth Amendment.

B. The Fact That Some Information About An Individual's Travels In Public May Be Collected Through Human Surveillance Does Not Preclude A Reasonable Expectation Of Privacy For More Precise, Detailed, And Comprehensive Information.

The government contends that because a police officer could observe respondent's vehicle at any one particular location, respondent has no reasonable privacy expectation in *any* information relating to the location of the vehicle. That contention is wrong for two reasons.

To begin with, the information obtained through GPS tracking is fundamentally different from information that human surveillance could possibly produce—in terms of its precision, detail, and scope. See pages 9-14 & 19-22, *supra*. Because the two sets of information are not at all equivalent, the government's argument must be rejected at the outset because it rests on a false factual predicate.

Even if the two sets of information were reasonably equivalent, the government's argument would fail on legal grounds. This Court has squarely rejected the contention that simply because some information *could be* uncovered using a legal means, a more intrusive means to obtain it does not violate a person's reasonable expectations of privacy. See *Kyllo*, 533 U.S. at 35 n.2 ("The fact that equivalent information could sometimes be obtained by other means does not make lawful the use of means that violate the Fourth Amendment.").

In *Kyllo*, the government argued that the temperature inside the house could be ascertained by lawful means, such as observing melting snow on the roof, and that therefore the thermal imaging was permissible. The Court stated:

> [C]omparison of the thermal imaging to various circumstances in which outside observers might be able to perceive, without technology, the heat of the home * * * is quite irrelevant. The fact that equivalent information could sometimes be obtained by other means does not make lawful the use of means that violate the Fourth Amendment. The police might, for example, learn how many people are in a particular house by setting up year-round surveillance; but that does not make breaking and entering to find out the same information lawful.

Id. at 35 n.2. The crucial factor for Fourth Amendment analysis is the means of surveillance actually used by the police, not the hypothetical means they might have used.

The Court reached the same conclusion in *Silverman.* The government relied on precedents holding that the Fourth Amendment was not violated by using devices that assisted in monitoring conversations occurring on the other side of a wall. But, because the spike mike had penetrated the boundaries of the home itself, the Court held the means used by the government triggered the Fourth Amendment. *Silverman*, 365 U.S. at 509-510 ("Eavesdropping accomplished by means of such a physical intrusion is beyond the pale of even those decisions in which a closely divided Court has held that eavesdropping accomplished by other * * * means did not amount to an invasion of Fourth Amendment rights."); see also *Katz*, 389 U.S. at 352 (fact that contents of conversation might be discerned by a lip-reader or overheard by a passer-by did not affect reasonable expectations of privacy).

Here, therefore, the possibility that human observation might be able to produce information similar to GPS tracking does not mean that individuals cannot have a reasonable expectation of privacy from GPS tracking.

There are two important reasons for this rule. First, it often will be difficult for the Court to determine whether one method of information gathering does in fact generate the same type of data as another. Judging each method on its own terms avoids that uncertain inquiry.

Second, simply because human observation may collect *some* information in a particular category does not mean that human observation is capable of collecting such information comprehensively. This case perfectly demonstrates the distinction. Officers may be able to collection some information regarding an individual's location, but that does not mean that human observation is capable of collecting location information with the continuous detail of GPS tracking. Focusing on the distinct means used by the government avoids embroiling the Court in analogies that are wholly inapposite.[16]

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[16] The government suggests (U.S. Br. 50) that this case simply concerns the efficiency with which law enforcement authorities conduct investigations—"the information that the tracking device reveals about the vehicle's location could also be obtained (albeit less efficiently) by means of visual surveillance." That is false. As we have explained (at pages 9-14 & 19-22, *supra*), the

C. Requiring A Warrant Will Not Impose A Significant Burden On Law Enforcement.

The issue before the Court in this case is not whether GPS tracking *ever* may be used by the government. Rather, it is whether the government must obtain a warrant in order to employ this technology. As in *Karo*, the government's position "is based upon its deprecation of the benefits and exaggeration of the difficulties associated with procurement of a warrant." 468 U.S. at 717.

Claims about the onerousness of a warrant requirement ring especially hollow here, because the police did in fact secure a warrant. *Cf. id*. at 718 ("It is worthy of note that, in any event, this is not a particularly attractive case in which to argue that it is impractical to obtain a warrant, since a warrant was in fact obtained in this case."). The current dispute arises only because the officers failed to comply with the warrant's terms. J.A. 21-34, 100-101, 105-110.

Nor is the issuance of the warrant here unique. Reported decisions indicate that warrants authorizing GPS tracking have been sought and obtained in other jurisdictions as well. *See, e.g.*, *United States* v. *Williams*, 650 F. Supp. 2d 633, 638 (W.D. Ky. 2009); *United States* v. *Yokshan*, 658 F. Supp. 2d 654, 658 (E.D. Pa. 2009); *Commonwealth* v. *Connolly*, 454 Mass. 808, 810, 913 N.E.2d 356, 360 (Mass. 2009); *State* v. *Sveum*, 328 Wis. 2d 390, 378, 787 N.W.2d

information produced by GPS tracking is significantly different in precision, detail, and duration from what may be gathered through visual surveillance. Those differences are one of the principal reasons why GPS tracking cannot be analogized to beeper-assisted surveillance for purposes of the Fourth Amendment.

317, 321 (Wis. 2010), cert. denied, 131 S. Ct. 803 (2010); *State* v. *Scott*, A-0039-04T4, 2006 WL 2640221 (N.J. Super. Ct. App. Div. Sept. 15, 2006) ("Although the order * * * authorizing the installation of the GPS tracking device was not designated as a search warrant, the parties implicitly agreed below that the propriety of the order be determined by the standard of 'probable cause.'").[17]

More generally, there is little evidence that warrant requirements have proven difficult to satisfy. Law enforcement officers applied for 3,195 warrants authorizing wiretaps during 2010. All but one was granted. *Report of the Director of the Administrative Office of the United States Courts on Applications for Orders Authorizing or Approving the Interception of Wire, Oral, or Electronic Communications* 31, *available at* http://www.uscourts.gov/Statistics/WiretapReports/WiretapReport2010.aspx; see also Richard Van Duizend *et al.*, National Center for State Courts Report, *The Search Warrant Process: Preconceptions, Perceptions, and Practices* 3.172 (1985), *available at* http://www.cwsl.-edu/content/benner/the%20Search%20warrant%20process.pdf ("Magistrates rarely deny an application for a search warrant.").

Law enforcement authorities often complain about the effect of a warrant requirement in the con-

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[17] Indeed, when federal agents seek GPS tracking data from cellphone providers, "the Criminal Division of the Justice Department recommends the use of a warrant based on probable cause." Statement of James A. Baker, Associate Deputy Attorney General, Before the Committee on Judiciary, U.S. Senate, April 6, 2011, *available at* http://judiciary.senate.gov/pdf/11-4-6%20Baker%20Testimony.pdf.

text of exigent circumstances—where police officers must act immediately based on facts that they learn, or risk losing the suspect or the evidence. But planning is an essential part of the process of using GPS tracking: the officers must identify a target vehicle and determine how to place the GPS receiver on the vehicle, and wait until the vehicle is unattended and their actions in placing the device will be unobserved. Obtaining a warrant in conjunction with this planning process is unlikely to impose a significant burden.

In the event exigent circumstances did arise, applying the Fourth Amendment to GPS tracking would carry with it the exceptions to the Fourth Amendment's warrant requirement based on hot pursuit and other emergencies.

On the other side of the balance, the Court has recognized that the point of the warrant requirement

> is not that it denies law enforcement the support of the usual inferences which reasonable men draw from evidence. Its protection consists in requiring that those inferences be drawn by a neutral and detached magistrate instead of being judged by the officer engaged in the often competitive enterprise of ferreting out crime.

Johnson v. *United States*, 333 U.S. 10, 14 (1948). That protection is especially important in view of the dramatically intrusive nature of GPS tracking as well as the ease with which the technology can be deployed on a widespread basis.

CONCLUSION

The judgment of the court of appeals should be affirmed.

Respectfully submitted.

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