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Tiny Constables and the Cost of Surveillance: Making Cents Out of *United States v. Jones*

In United States v. Jones*, five Supreme Court Justices wrote that government surveillance of one's public movements for twenty-eight days using a GPS device violated a reasonable expectation of privacy and constituted a Fourth Amendment search. Unfortunately, they didn't provide a clear and administrable rule that could be applied in other government surveillance cases. In this Essay, Kevin Bankston and Ashkan Soltani draw together threads from the* Jones *concurrences and existing legal scholarship and combine them with data about the costs of different location tracking techniques to articulate a cost-based conception of the expectation of privacy that both supports and is supported by the concurring opinions in* Jones.

INTRODUCTION

As Judge Richard Posner once said, "Technological progress poses a threat to privacy by enabling an extent of surveillance that in earlier times would have been prohibitively expensive," thereby "giving the police access to surveillance techniques that are ever less expensive and ever more effective."[1] Among these "'fantastic advances'"[2] in surveillance technology is the Global Positioning System (GPS), which provides law enforcement with an inexpensive means to track the precise geographic locations of criminal suspects. The Supreme Court recently addressed this technology in *United States v. Jones*, which considered whether the police's attachment of a GPS device to a suspect's car, and the use

1. United States v. Garcia, 474 F.3d 994, 998 (7th Cir. 2007).

2. *Id.* (quoting Lopez v. United States, 373 U.S. 427, 441 (1963) (Warren, C.J., concurring in the result)).

of that device to monitor the car's movements along public roads for twenty-eight days, constituted a search under the Fourth Amendment.[3]

All nine Justices answered that question in the affirmative, but they produced three different opinions. Five Justices, in an opinion authored by Justice Scalia, did not rule on the question of whether the monitoring of Jones's movements via the GPS device constituted a search. Rather, the majority found that the attachment of the device to Jones's car violated his Fourth Amendment expectation of privacy under a trespass-oriented theory of Fourth Amendment protection.[4] Four other Justices signed a concurring opinion by Justice Alito, rejecting the majority's trespass theory and arguing that the prolonged monitoring of the GPS device constituted a search by violating Jones's expectation of privacy.[5] And finally, Justice Sotomayor both joined the majority opinion and wrote her own concurring opinion, agreeing with the majority that the installation constituted a search but also agreeing with Justice Alito that "'longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy.'"[6]

The *Jones* concurrences, taken together, are potentially a watershed moment in the Court's Fourth Amendment jurisprudence. Prior to *Jones*, the Court's precedent on location tracking—regarding radio "beeper"-based vehicle tracking in the 1980s—indicated that one could have no reasonable expectation of privacy in one's public movements.[7] In *Jones*, five Justices rejected that proposition, at least with respect to prolonged government surveillance of one's public movements. Unfortunately, those Justices stopped short of clarifying when one does have such an expectation or when surveillance violates it—other than Justice Alito's conclusion that "the line was surely crossed before the 4-week mark."[8]

Trying to make sense of the *Jones* concurrences and reduce them to a clear and administrable rule—or, alternatively, arguing that they make no sense and cannot be so reduced—has become something of a cottage industry amongst privacy law scholars.[9] Building on the work of those who have come before us,

3. *See* United States v. Jones, 132 S. Ct. 945 (2012).

4. *Id.* at 949-53.

5. *Id.* at 957-64 (Alito, J., concurring).

6. *Id.* at 954-57 (Sotomayor, J., concurring) (quoting *id.* at 964 (Alito, J., concurring)).

7. *See* United States v. Karo, 468 U.S. 705, 713-14 (1984); United States v. Knotts, 460 U.S. 276, 282 (1983).

8. *Jones*, 132 S. Ct. at 964 (Alito, J., concurring) (failing to articulate a specific test and refusing to "identify with precision" a clear line between short-term GPS tracking that would not implicate the Fourth Amendment and long-term tracking that would).

9. As part of a contest at the 2012 Privacy Law Scholars Conference, over a dozen top scholars submitted short papers (hosted at www.usvjones.com) attempting to articulate a rule from

this Essay is our attempt to make sense—and "cents"—out of *United States v. Jones*, by demonstrating how new technologies are continually reducing the cost of surveillance and by attempting to formulate a new approach to defining the Fourth Amendment's protections based on those falling costs.

Specifically, we propose that a new surveillance technique is likely to violate an expectation of privacy when it eliminates or circumvents a preexisting structural right of privacy and disrupts the equilibrium of power between police and suspects by making it much less expensive for the government to collect information. We explain how courts might put that general proposition into practice by using estimates of the actual costs of particular modes of location tracking to apply a rough rule of thumb: if the new tracking technique is an order of magnitude less expensive than the previous technique, the technique violates expectations of privacy and runs afoul of the Fourth Amendment.

Although we derive this approach from the specific example of location tracking and limit our Essay to that topic, we are hopeful that it may also prove a useful tool in evaluating other surveillance techniques.

I. FOURTH AMENDMENT EQUILIBRIUM ADJUSTMENT AND THE SEARCH FOR METRICS OF DISEQUILIBRIUM

The courts' application of the Fourth Amendment is a balancing act, whereby judges tighten or relax the law's protections in response to changing technology and social norms. When new technologies expand law enforcement's capabilities, the law does (and should) respond by placing new limits on the government; when new technologies give criminals a leg up, the law does (and should) respond by loosening the government's reins. At least, that is the gist of the "equilibrium-adjustment" theory of the Fourth Amendment that Professor Orin Kerr recently proposed.[10]

Professor Paul Ohm characterized Kerr's equilibrium-adjustment idea as an effective theory for explaining how courts have grappled with a wide range of Fourth Amendment issues over the decades,[11] and we agree. Also, at least when it comes to tightening the Fourth Amendment's restrictions in the face of new

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the *Jones* concurrences. Additionally, Orin Kerr has written an extensive critique of the concurrences, and complained that no one has yet crafted a coherent explanation for how the concurrences' logic could be applied elsewhere. *See* Orin S. Kerr, *The Mosaic Theory of the Fourth Amendment*, 111 MICH. L. REV. 311, 346-47 (2012).

10. Orin S. Kerr, *An Equilibrium-Adjustment Theory of the Fourth Amendment*, 125 HARV. L. REV. 476 (2011).

11. Paul Ohm, *The Fourth Amendment in a World Without Privacy*, 81 MISS. L.J. 1309, 1312 (2012).

tools of government surveillance,[12] we agree with Kerr and Ohm that such equilibrium adjustment is normatively desirable.[13]

We also join Ohm in seeking to "lend rigor" to Kerr's approach by proposing "hard, objective measures of how much the playing field has tilted"—relevant statistics to guide courts that are trying to measure the impact of a new surveillance technology and decide whether the law should adjust to restore equilibrium.[14] Ohm suggests that where a court is weighing police use of a new technology, the police should have to present statistics quantifying the technology's effect on criminal investigations.[15] But beyond making "an admittedly unorthodox proposal"—that "it should take, on average, just as long to solve a crime today as it has in the past"—Ohm stops short of identifying the best statistics to measure, leaving that to future debate and litigation.[16]

However, by closing with a citation to the theory of Professor Harry Surden, Ohm may point us towards another potential approach for identifying Fourth Amendment disequilibrium: comparison of the *cost* of acquiring particular evidence with or without the new surveillance technology.[17]

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12. As Ohm and others have highlighted, the issue of new government tools is a particularly pressing one. *Id.* at 1313-25 (describing government access to an ever-growing variety of third-party records and surveillance capabilities as a threat to privacy); Peter Swire & Kenesa Ahmad, *"Going Dark" Versus a "Golden Age for Surveillance,"* CTR. FOR DEMOCRACY & TECH. (Nov. 28, 2011), https://www.cdt.org/blogs/2811going-dark-versus-golden-age-surveillance (describing the rapidly growing range of new surveillance capabilities and information sources available to government investigators).

13. *See* Kerr, *supra* note 10, at 494-525 (describing six categories of cases where equilibrium adjustment has come into play, one being new government tools of surveillance such as GPS devices); *id.* at 525-26 (defending equilibrium-adjustment as a normative theory); Ohm, *supra* note 11, at 1312-13 (approving of equilibrium-adjustment as a descriptive and normative theory where new technologies favor one side of the police-criminal divide but questioning how well it addresses situations where technology has given both sides a new advantage).

    We are less convinced by Kerr's application of his theory to defend the Fourth Amendment's third-party doctrine, an application that Ohm and others have effectively criticized. *See* Ohm, *supra* note 11, at 1342-45. *See generally* Blake Ellis Reid, Note, *Substitution Effects: A Problematic Justification for the Third-Party Doctrine of the Fourth Amendment*, 8 J. TELECOMM. & HIGH TECH. L. 613 (2010) (critiquing Kerr's use of an earlier version of the equilibrium-adjustment—a theory of "substitution effects"—to defend the third-party doctrine).

14. Ohm, *supra* note 11, at 1313.

15. *Id.* at 1352.

16. *Id.* at 1346.

17. *See id.* at 1354-55 (citing Harry Surden, *Structural Rights in Privacy*, 60 SMU L. REV. 1605 (2007)).

II. HOW *JONES* SUPPORTS THE STRUCTURAL PRIVACY RIGHTS APPROACH AS A MODEL OF FOURTH AMENDMENT PROTECTION

The theory of "structural privacy rights" that Surden proposes is a simple idea synthesizing several complex ones.[18] The simple idea is that structural constraints—physical and technological barriers—make certain conduct costly, sometimes impossibly costly.[19] These costs act as non-legal regulations, essentially providing a non-legal "right" against the behaviors they prevent.[20] Yet rapid changes in technology can quickly and unexpectedly eliminate these long relied-upon structural rights, especially when it comes to privacy.[21] Surden's message to policymakers, similar to Kerr's message to the courts, is that they can recognize and adjust for diminishing structural rights against privacy invasion by adding new legal protections to replace them as they are lost—i.e., that they can impose new legal costs to compensate for the drop in actual costs.[22]

One wonders whether Justice Alito has read Surden's work, because his opinion in *Jones* is highly consistent with a cost-centric "structural privacy rights" logic: first noting the structural constraints that would previously have made long-term location tracking impossibly costly and difficult, and then granting Fourth Amendment protection to fill the privacy gap left by GPS tracking technology's elimination of those constraints.[23] After joking that such comprehensive surveillance would have been impossible in the Framers' era absent "a very tiny constable . . . with [the] incredible fortitude and patience" to hide somewhere in a coach for twenty-eight days,[24] Justice Alito explains in terms echoing both Kerr and Surden:

> In the pre-computer age, the greatest protections of privacy were neither constitutional nor statutory, but practical. Traditional surveillance for any extended period of time was difficult and costly and therefore rarely undertaken. The surveillance at issue in this case—constant monitoring of the location of a vehicle for four weeks—would have required a large team of agents, multiple vehicles, and perhaps

18. Surden acknowledges in particular his debts to Lawrence Lessig and Ronald Coase. *See* Surden, *supra* note 17, at 1617-18.

19. *Id*. at 1610-14.

20. *Id*.

21. *Id.* at 1617-20.

22. *Id.* at 1625-28.

23. *See* United States v. Jones, 132 S. Ct. 945, 963-64 (2012) (Alito, J., concurring).

24. *Id.* at 958 n.3.

> aerial assistance. Only an investigation of unusual importance could have justified such an expenditure of law enforcement resources. Devices like the one used in the present case, however, make long-term monitoring relatively easy and cheap.[25]

Alito continues:

> [R]elatively short-term monitoring of a person's movements on public streets accords with expectations of privacy that our society has recognized as reasonable. But the use of longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy. For such offenses, society's expectation has been that law enforcement agents and others would not—and indeed, in the main, simply could not—secretly monitor and catalogue every single movement of an individual's car for a very long period.[26]

Justice Sotomayor's concurrence adopts a similar logic,[27] such that all five concurring Justices in *Jones* seemed to embrace, albeit implicitly, an equilibrium-adjustment approach[28]—and more specifically, a cost-focused structural privacy rights approach—to resolve the Fourth Amendment question. Indeed, one might nominate this approach as a fifth model of Fourth Amendment protection on top of the four that Kerr has already identified, if only there were a way to systematize and standardize its application.[29] But as presented in *Jones*, the structural privacy rights model is more of a fuzzy principle than a clear and administrable rule.

A central shortcoming of Justice Alito's opinion is that it hinges on the ever-decreasing cost of prolonged location tracking, but never supports its reasoning with data. It doesn't specifically describe or compare the cost of prolonged tracking done with and without GPS technology. Nor does the opinion use any data to elaborate on how great a cost difference between prolonged tracking before and after the introduction of GPS technology would justify an equilibrium-adjusting increase in Fourth Amendment protection. If

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25. *Id.* at 963-64 (footnote omitted).

26. *Id.* at 964 (internal citation omitted).

27. *Id.* at 955 (Sotomayor, J., concurring) (taking into account how technological advances have made previously impossible surveillance possible and agreeing with Justice Alito that longer-term GPS monitoring violates the expectation of privacy in investigations of most offenses).

28. Orin S. Kerr, *Defending Equilibrium-Adjustment*, 125 HARV. L. REV. F. 84, 87-89 (2012) (citing all three *Jones* opinions as examples of equilibrium-adjustment and summarizing Justice Alito's logic in equilibrium-adjustment terms).

29. *See* Orin S. Kerr, *Four Models of Fourth Amendment Protection*, 60 STAN. L. REV. 503 (2007).

the opinion had "shown its work," other courts could emulate and apply it. But sadly, as Stephen E. Henderson has noted, Justice Alito's opinion is "an empirical opinion without any empirics."[30]

Those empirics do exist, however, and it is the project of identifying and modeling them to which we turn next.

III. COMPARING THE COSTS OF DIFFERENT LOCATION TRACKING METHODS

The cost of tracking a suspect's location has decreased significantly as new technologies have become available to the police. Not all technologies result in the substantial cost savings that would warrant a recalibration of Fourth Amendment law. But some of them, including the dramatic shift in the cost of tailing a suspect before and after the introduction of GPS technology, represent what Surden calls "rights-shifts," suddenly and irrevocably eliminating a previous structural privacy right.[31]

This distinction between ordinary technological advances and extraordinary rights-shifts becomes plain in even rudimentary, back-of-the-envelope calculations to estimate and compare the approximate cost of various location tracking techniques. We recognize that different techniques are often used in combination, but for the sake of argument we will estimate the cost of each in isolation. In doing so, we rely on the following assumptions. First, we model our calculations on the circumstances of the *Jones* case by assuming an investigation staffed by federal agents seeking to conduct continuous and covert surveillance of a vehicle's movements through urban and suburban environments. Second, our calculations focus only on the cost of acquiring the location information being sought, and do not include the cost of later reviewing it or making investigative use of it. Third, our calculations do not include fixed costs, such as the cost of equipment, as they are amortized over time and over a large number of cases. We only include marginal costs such as personnel costs, operating costs, and other service fees that are specific to an investigation. For example, we do not include the cost of purchasing the car but we do include costs associated with operating the vehicle, such as gasoline. We combine these costs to calculate the total average cost per hour of each type of surveillance for three different time periods of surveillance—one day, seven days, and twenty-eight days as in *Jones*—to demonstrate the falling cost per hour of certain techniques over time. The cost of some techniques does not

30. Stephen E. Henderson, *After* United States v. Jones*, After the Fourth Amendment Third Party Doctrine*, 14 N.C. J.L. & TECH. 431, 453 (2013).

31. Surden, *supra* note 17, at 1618.

vary depending on the length of the investigation, but for those with varying costs, we present a range of values.

We consider the cost of several location surveillance techniques: physical pursuit by foot and in vehicles, as well as location tracking using a radio beeper, a GPS device, or a cell phone.

A. Foot Pursuit

The most basic way to track the location of an individual is to assign an agent to follow that person on foot. An agent can monitor and record an individual's whereabouts while maintaining some distance to avoid detection. Foot pursuit has clear advantages given that the agent is usually within the line of sight of the suspect and can immediately apprehend the suspect in the act of a crime. Additionally, the agent has the ability to visually confirm that the person he is following is, in fact, the target. However, foot pursuit is constrained by the likelihood that the agent will be recognized as the length of surveillance goes on or that the suspect will give him "the slip" by switching modes of transportation or otherwise evading pursuit.

Regardless of the various pros and cons of foot surveillance, our main concern is with its cost as a means of acquiring location information. In our model, the primary cost of foot pursuit is the salary of the agent. An FBI agent's salary[32] plus benefits[33] and availability pay[34] is approximately $130,962 per year, assuming an agent of average experience.[35] Agents are required, "to average a 50-hour work week over the course of the year."[36] So, given 2,600 "working hours" in a standard calendar year, we estimate the hourly "pay cost" for an FBI agent to conduct surveillance on foot to be $50 per hour. We

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32. Average base pay ($65,552) + (base pay * average adjustment based on location (20.17%)) = $78,774. *FBI Agent Salary*, CRIM. JUST. SCH. INFO, http://www.criminaljusticeschoolinfo.com/fbi-agent-salary.html (last visited Aug. 29, 2013). To determine average base pay, we averaged the base pay for GS 10 through GS 13. *See id.*

33. Benefits are equal to approximately thirty-three percent of salary, which includes the location adjustment factor discussed above. Tad Dehaven, *Federal Employees Continue to Prosper*, CATO AT LIBERTY (Aug. 10, 2010, 10:29 AM), http://www.cato.org/blog/federal-employees-continue-prosper.

34. The FBI salary figure reflects a twenty-five percent adjustment for availability pay. "Availability pay is a 25% increase in adjusted salary (base salary + locality pay) for all Special Agents due to their requirement to average a 50-hour work week over the course of the year." *Special Agent Career Path Program*, FBI, https://www.fbijobs.gov/113.asp (last visited Dec. 9, 2013).

35. Based on the average of GS 10 through 13 (after GS 13, FBI agents typically transition into management roles). *Id.*

36. *Id.*

therefore consider this the "base unit" cost for a law enforcement agent engaged in surveillance.

$$\frac{\text{FBI Agent Salary + Benefits}}{\text{Working Hours in a Year}} = \frac{\$98{,}467 + 32{,}495}{2600} = \$50/\text{hour}$$

B. Covert Foot Pursuit with Five Agents

Law enforcement typically uses a technique known as a "surveillance box" to overcome the limitations of single-agent pursuit and successfully conduct longer-term covert surveillance.[37] This approach stations multiple agents—in our example, five[38]—around a target in such a way that, no matter which way the target travels, one agent will have a clear path to follow. This allows the agents to monitor the subject without interruption, even if the target exhibits unexpected behavior, by allowing agents to "hand off" the task between one another when necessary to change shifts or take a break. Assuming a five-agent box at a cost of $50 each per agent-hour, we arrive at an hourly cost of $250 for continuous covert surveillance.

$$\text{FBI Agent Cost Per Hour} \times \text{Number of Agents} = \$50 \times 5 = \$250/\text{hour}$$

C. Single Car Pursuit

Law enforcement can also track a suspect from a vehicle, typically using two agents per vehicle.[39] However, single-vehicle pursuit suffers from many of

37. ACM IV SEC. SERVS., COUNTERING HOSTILE SURVEILLANCE: DETECT, EVADE, AND NEUTRALIZE PHYSICAL SURVEILLANCE THREATS 27 (2008) ("The box is based on the systematic positioning of surveillance assets around the area where the static target is located in order to prepare for a mobile surveillance follow when the target begins to move. The techniques of the surveillance box basically consist of the logical coverage of roads or routes by which the target can depart the fixed location.").

38. We assumed five agents based on consideration of several sources. Box surveillance "requires a minimum of three assets but is most effectively employed with four or more." *Id.* at 29; *see also* Carrie Johnson, *FBI Still Struggling with Supreme Court's GPS Ruling*, NPR (Mar. 21, 2012, 4:04 AM), http://www.npr.org/2012/03/21/149011887/fbi-still-struggling-with-supreme-courts-gps-ruling (noting that in the wake of the *Jones* opinion, teams of six to eight agents were used to replace GPS tracking in many cases). This number was also confirmed directly by a former FBI agent in June 2013 as well as by the FBI source contacted by the reporter. Interview with Anonymous Former FBI Agent (July 19, 2013).

39. ACM IV SEC. SERVS., SURVEILLANCE COUNTERMEASURES: A SERIOUS GUIDE TO DETECTING, EVADING, AND ELUDING THREATS TO PERSONAL PRIVACY 17 (1994) ("A surveillance vehicle normally has two operators, a driver and a navigator. The navigator reads a map and directs

the same limitations as single-agent foot pursuit, and also adds vehicle operating costs such as fuel. We estimated the hourly cost of the car using the Internal Revenue Service's standard deduction, assuming an average speed of thirty-five miles per hour and assuming that the suspect will be in motion about twenty-five percent of the time.[40] The additional cost of using a vehicle to pursue a suspect is relatively low—the bulk of the cost in both of these cases is from personnel and not technology expenses. We combined those expenses to arrive at an approximate average cost of $105 per hour.

(Agent Cost Per Hour × Number of Agents) + Vehicle Operating Cost Per Hour
= ($50/hour × 2) + $5/hour
= $105/hour

D. Covert Car Pursuit with Five Cars

As with foot pursuit, the problems of single-vehicle pursuit are typically overcome by using a surveillance box. This method "consists of positioning surveillance vehicles in such a manner as to control routes of travel out of a specified area."[41] So, if the target is on a city grid, a surveillance team would need five vehicles to cover all possible movements—one for each direction and another able to move ahead of the team in case the target makes an unexpected move and the box has to shift to catch up.

Assuming one agent per car and five cars, with each agent costing $50 per hour, gives us a base personnel cost of $250, to which we add $25 in operating costs for all five cars using the same hourly cost of $5 per car that we calculated for single-car pursuit. We thus arrive at $275 as the total hourly cost of covert car pursuit.

(Agent Cost Per Hour × Number of Agents) + (Vehicle Operating Cost Per Hour
× Number of Vehicles)
= ($50/hour × 5) + ($5/hour × 5)
= $275/hour

the driver. When in the command vehicle position, the navigator transmits the [target's] location and actions to the entire team.").

40. Because the target is not likely to be in motion twenty-four hours a day for twenty-eight days, we choose a reasonable estimate that the suspect will be driving one quarter of the time (thus, 35 mph average city speed * 0.25 travel time * $0.555/mile standard deduction = $4.86). I.R.S. Publ'n 463, *15-16 (Feb. 20, 2013), http://www.irs.gov/pub/irs-pdf/p463.pdf.

41. ACM IV SEC. SERVS., *supra* note 39, at 16.

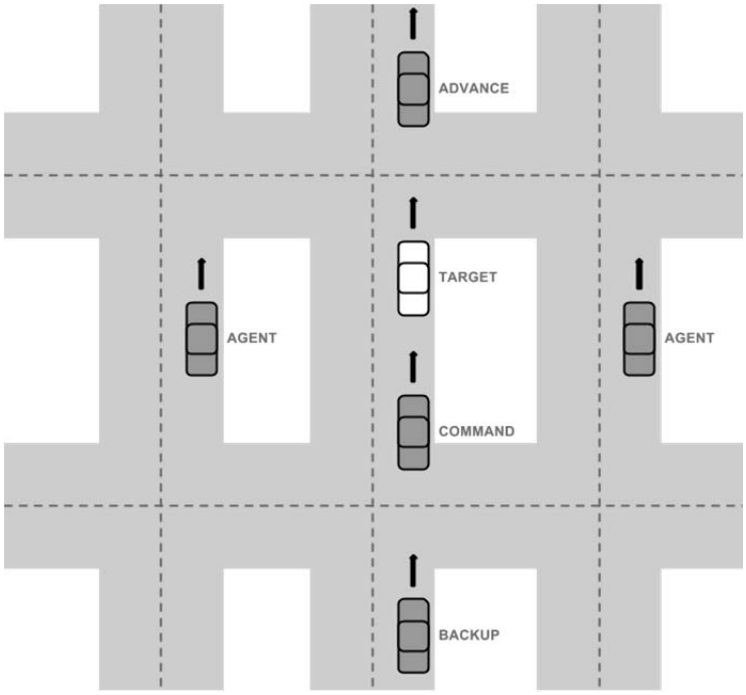

Figure 1.

A SURVEILLANCE BOX ESTABLISHED FOR COVERT PURSUIT OF TARGET THROUGH CITY STREETS

E. One Car Covert Pursuit Using "Beeper" Technology

Agents in a vehicle can also track a suspect using a radio-based "beeper" device that sends a signal received by an antenna on the agent's vehicle.[42] This signal can indicate the direction of the transmitter's location from a distance of two to four miles.[43] Law enforcement agents can attach the transmitter to a suspect's vehicle or surreptitiously place it on an object that will travel with the suspect.[44] Beepers are cheap to operate once the equipment has been

42. For a good rundown of how 1970s-1980s era radio beepers worked, from which many of the following citations came, see Brief of Ctr. for Democracy & Tech. et al. as Amici Curiae in Support of Respondent at 14-16, United States v. Jones, 132 S. Ct. 945 (2012) (No. 10-1259).

43. *See* Reply Brief for the United States at 8 n.6, United States v. Karo, 468 U.S. 705 (1984).

44. For example, in *Knotts*, officers arranged for a transmitter to be placed inside a chloroform container that was sold to the suspect. United States v. Knotts, 460 U.S. 276, 277 (1983). The officers then followed the signal as the suspect traveled on public roads, until arriving at the suspect's cabin. *Id.* at 281.

purchased, requiring only two agents: one to drive and one to make any necessary adjustments to the receiver during pursuit.[45]

The hourly cost will vary depending on the length of the investigation, because the initial installation costs will be amortized over time.[46] We are conservatively estimating that it takes an agent a full hour to install and another hour to remove a device attached directly to the vehicle's electrical system, with another agent keeping a look out, totaling four hours for each investigation, regardless of length. So, if the agents follow a target for only one day, beeper technology costs $113 per hour, but if the investigation continues for twenty-eight days the hourly cost falls to $105.

$$\frac{\text{Device Install \& Remove Time} \times \text{Agent Cost Per Hour}}{\text{Range of Hours of Investigation}} + (\text{Agent Cost Per Hour} \times 2 \text{ Agents}) + \text{Vehicle Operating Cost Per Hour}$$

$$= \frac{4 \text{ hours} \times \$50}{(24 \text{ to } 627 \text{ hours})} + (\$50 \times 2) + \$5$$

$$= \$105 \text{ to } \$113 \text{ per hour}$$

F. Cell Phone Tracking Using an IMSI Catcher or "Stingray"

Rather than pursue a suspect directly or by using beeper technology, law enforcement agents can track the location of a target's cell phone by using a device—known as an IMSI Catcher or "Stingray"—that simulates a cell tower in order to collect information about the location of nearby cell phones.[47]

Agents use Stingrays in a manner similar to their use of beepers, and with the exception of the attachment-related costs, the cost of using an IMSI catcher for surveillance is essentially the same as using a beeper. Therefore, putting aside the up-front cost of the IMSI catcher itself, the only costs for IMSI catcher surveillance are the cost of the agent operating the device, the cost of

45. *See* William Shaw, *Miniature Tracking Transmitters*, LAW & ORDER, Jan. 1973, at 29.

46. The hourly cost may also vary based upon maintenance costs, such as the rate at which batteries must be replaced. We know from the *Knotts* case that a beeper can last at least three days without a battery change. *See Knotts*, 460 U.S. at 279 ("Relying on the location of the chloroform derived through the use of the beeper and additional information obtained during *three days* of intermittent visual surveillance of respondent's cabin, officers secured a search warrant.") (emphasis added). However, newer devices can draw power directly from the vehicle's electrical system, so we consider that scenario instead.

47. For further background on the Stingray, see Kim Zetter, *Secrets of FBI Smartphone Surveillance Tool Revealed in Court Fight*", WIRED: THREAT LEVEL (Apr. 9, 2013, 6:30 AM), http://www.wired.com/threatlevel/2013/04/verizon-rigmaiden-aircard/all.

the agent driving the pursuit vehicle containing the device, and the operating costs of that vehicle.

(Agent Cost Per Hour × Number of Agents) + Vehicle Operating Cost Per Hour
= ($50/hour × 2) + $5/hour = $105/hour

G. Tracking Using a GPS Device

A recent survey of over seventy law enforcement agencies demonstrates how new technologies are transforming policing: eighty-three percent of the respondents to the survey "use Global Positioning System technology (GPS) to track the movements of criminal suspects."[48] Clearly, GPS-based vehicle tracking is an incredibly popular alternative to foot, car, or beeper-based pursuit.

Although there are different types of GPS devices, we will focus on the devices that are powered directly from the vehicle's battery.[49] These devices require less upkeep, but are more difficult to install because they require an agent to get access to a vehicle's electrical system. As with beeper technology, we conservatively estimate that this technology takes one hour to install and one hour to remove, with one agent doing the work and another agent looking out. Also as with the beeper, these fixed installation and removal costs result in a range of hourly costs depending on the length of the investigation.

In addition to the personnel costs incurred by installing and uninstalling, there is a monthly service fee associated with GPS devices. Tracking with a GPS system requires access not only to the device itself, but also to the network receiving the data the device collects about the target's location. There are private companies that provide service contracts similar to a consumer cell phone contract with a fixed cost for the device and a fee for its use. We calculated the hourly cost of GPS tracking based on the monthly fees associated with products offered by LiveViewGPS, a company that sells GPS tracking

48. POLICE EXEC. RESEARCH FORUM, CRITICAL ISSUES IN POLICING SERIES: HOW ARE INNOVATIONS IN TECHNOLOGY TRANSFORMING POLICING? 2 (2012), http://policeforum.org/library/critical-issues-in-policing-series/Technology_web2.pdf.

49. As with battery-powered beepers, the cost of a GPS device that has its own source of battery power would be calculated slightly differently because agents would have to revisit the car and change the battery throughout the course of the investigation. For example, the battery in the GPS device used in the *Jones* case had to be changed once in twenty-eight days. *See* United States v. Jones, 132 S. Ct. 945, 948 (2012) ("Over the next 28 days, the Government used the device to track the vehicle's movements, and once had to replace the device's battery when the vehicle was parked in a different public lot in Maryland.").

equipment to law enforcement.[50] The monthly service fee for its hard-wired GPS products is approximately $40 per month.[51]

Combining these costs—the per-month fee plus two hours of salary for each of two agents to install and uninstall the device—the total cost of surveillance using a GPS device would be $240 per month. That comes out to $10 per hour over one day, $1.43 per hour over seven days, and $0.36 per hour over twenty-eight days.

$$\frac{(\text{Agent Cost Per Hour} \times \text{Device Install \& Remove Time}) + \text{Monthly Service Fee}}{\text{Hours of Investigation}} = \frac{\text{Total Cost}}{\text{Hour}}$$

$$\text{For 1 day:} \quad \frac{(\$50 \times 4 \text{ hours}) + \$40}{24 \text{ hours}} = \frac{\$240}{24 \text{ hours}} = \frac{\$10}{\text{hour}}$$

$$\text{For 7 days:} \quad \frac{(\$50 \times 4 \text{ hours}) + \$40}{168 \text{ hours}} = \frac{\$240}{168 \text{ hours}} = \frac{\$1.43}{\text{hour}}$$

$$\text{For 28 days:} \quad \frac{(\$50 \times 4 \text{ hours}) + \$40}{672 \text{ hours}} = \frac{\$240}{672 \text{ hours}} = \frac{\$0.36}{\text{hour}}$$

H. Cell Phone Tracking with Carrier Assistance

Rather than pursue a suspect in the field, law enforcement agents can track subjects by following the signal of their cell phones by obtaining location information from the provider.[52] Cell phone carriers have the ability to provide reliable data on the location of a phone at any minute with a reasonable degree of accuracy, often down to a particular city block.[53]

Data gathered by the American Civil Liberties Union (ACLU) show that

50. *See Law Enforcement GPS Tracking*, LIVEVIEWGPS, http://www.liveviewgps.com/law+enforcement.html (last visited Nov. 4, 2013).

51. The highest monthly fee for unlimited use of a professional-grade GPS tracking device from LiveViewGPS is $39.99. *All GPS Tracking Products*, LIVEVIEWGPS, http://www.liveviewgps.com/all+gps+tracking+products.html (last visited Nov. 4, 2013).

52. *Cell Phone Location Tracking Public Records Request*, ACLU, http://www.aclu.org/protecting-civil-liberties-digital-age/cell-phone-location-tracking-public-records-request (last visited Nov. 4, 2013) ("All cell phones register their location with cell phone networks several times a minute, and this function cannot be turned off while the phone is getting a wireless signal.").

53. Aaron Blank, *The Limitations and Admissibility of Using Historical Cellular Site Data to Track the Location of a Cellular Phone*, 18 RICH. J.L. & TECH. 1, 2-3 (2012) ("Whenever a cell phone makes a call, the call is routed through a cell site at a fixed geographic location. Cellular companies keep records of which site processes a call.").

cell phone companies will provide location data to law enforcements at varying rates. As of August 2009, "Sprint charges $30 per month per target to use its L-Site program for location tracking. AT&T's E911 tool costs $100 to activate and then $25 a day. T-Mobile charges a much pricier $100 per day."[54] We used this data to develop an hourly rate for each company, and we present the minimum and maximum charges as the range of hourly costs law enforcement might expect to pay for this method of surveillance. Our calculations include any fees charged to initialize the process (when applicable) because they are specific to an investigation, but those costs are included in the hourly rate.

Given the downward trajectory of technological costs, the increased automation of these services via self-service web portals, and the fact that reimbursement to carriers is limited to reasonable, directly incurred costs,[55] we might expect that these rates will decline further over time.

$$\text{Fees for obtaining cell location data} = \frac{\$0.04 \text{ to } \$5.21}{\text{hour}}$$

Breakdown by Cell Carrier:

AT&T: $100 set up fee + $25/day
- For 1 day of surveillance: $125/24 hours = $5.21/hour
- For 1 month of surveillance:

$$\$100 \text{ set up} + (\$25/\text{day} \times 28 \text{ days}) = \frac{\$800}{28 \text{ days} \times 24 \text{ hours}} = \frac{\$800}{672 \text{ hours}} = \$1.19/\text{hour}$$

T-Mobile: $100/day = $4.17 /hour

Sprint: $30/month
- For 1 day of surveillance: $30/24 hours = $1.25/hour
- For 1 month of surveillance: $30/672 hours = $0.04/hour

54. *See id.*

55. 18 U.S.C. § 2706(a) (2012).

Table 1.

AVERAGE COSTS OF DIFFERENT LOCATION TRACKING METHODS

	1 day		1 week		28 days	
Method	Estimated cost	Cost per hour	Estimated cost	Cost per hour	Estimated cost	Cost per hour
Foot Pursuit	$1,200.00	$50.00	$8,400.00	$50.00	$33,600.00	$50.00
Car Pursuit	$2,520.00	$105.00	$17,640.00	$105.00	$70,560.00	$105.00
Covert Foot Pursuit	$6,000.00	$250.00	$42,000.00	$250.00	$168,000.00	$250.00
Covert Car Pursuit	$6,600.00	$275.00	$46,200.00	$275.00	$184,800.00	$275.00
Beeper	$2,720.00	$113.33	$17,840.00	$106.19	$70,760.00	$105.30
IMSI Catcher or "Stingray"	$2,520.00	$105.00	$17,640.00	$105.00	$70,560.00	$105.00
GPS	$240.00	$10.00	$240.00	$1.43	$240.00	$0.36
Cell Phone (AT&T)	$125.00	$5.21	$275.00	$1.64	$800.00	$1.19
Cell Phone (T-Mobile)	$100.00	$4.17	$700.00	$4.17	$2,800.00	$4.17
Cell Phone (Sprint)	$30.00	$1.25	$30.00	$0.18	$30.00	$0.04

IV. A MATHEMATICAL FORMULA FOR REASONABLE EXPECTATIONS OF PRIVACY?

The *Jones* concurrences, read in the context of Surden's structural privacy rights model and the Kerr/Ohm dialogue about equilibrium and metrics, point to a new but still somewhat fuzzy rule: If a new surveillance technique eliminates a previous structural right of privacy by making it extremely inexpensive for the government to collect information that otherwise would have been impossible or prohibitively costly to obtain, the use of that technique violates an expectation of privacy. Such a rule would effectively use the Fourth

Amendment to impose new legal costs to replace a lost structural right and thereby restore equilibrium.[56]

Sensibly applying such a rule requires data, and the data we've collected demonstrate some basic facts about the costs of location tracking. The data support Justice Alito's conclusion that following covertly on foot and by car—which cost roughly the same—are very expensive endeavors requiring a lot of manpower.[57] Following covertly using a beeper or an IMSI catcher is significantly but not radically less expensive because, although it reduces the number of agents necessary from five to two, it does not eliminate the need for agents to be on duty throughout the surveillance. The cost of GPS-based tracking does radically reduce the cost, however, because it reduces the manpower needed to just the few hours necessary to install and uninstall the device. Carrier-assisted cell phone tracking reduces costs even more so by eliminating the need for installation, bringing the costs to as low as $30 total to monitor a suspect for an entire month.

Focusing on the examples most relevant to the *Karo* (beeper), *Knotts* (beeper) and *Jones* (GPS device) precedents, we find that the total cost of using one car and a beeper over a twenty-eight-day period is nearly *three hundred times* the cost of doing the same tracking using a GPS device. The difference between GPS tracking and traditional five-car pursuit is even more dramatic: the total cost of using the cars is nearly *775 times more expensive* than the cost of using GPS. In contrast, the difference in the cost of beeper surveillance and covert car pursuit without a beeper is significant but well within the same order of magnitude: twenty-eight days of covert car pursuit is only about 2.5 times the cost of beeper-assisted surveillance.

Relying on the surveillance costs involved in these precedents, we arrive at a rough rule of thumb: If the cost of the surveillance using the new technique is an order of magnitude (ten times) less than the cost of the surveillance without using the new technique, then the new technique violates a reasonable expectation of privacy.

Consistent with the *Jones* concurrences, this approach follows a structural privacy rights model, like Surden's, and seeks equilibrium, as Kerr suggests.

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56. Some may criticize this rule as "equat[ing] police efficiency with unconstitutionality," United States v. Knotts, 460 U.S. 276, 284 (1982), but we instead view it as a means of balancing state and individual power in a manner that "assur[es] preservation of that degree of privacy against government that existed when the Fourth Amendment was adopted," United States v. Jones, 132 S. Ct. 945, 947 (2012) (quoting Kyllo v. United States, 533 U.S. 27, 34 (2001)). Improvements to police efficiency are desirable, but radical increases in police power due to rapid technological change—without additional legal constraints to prevent abuse—are not.

57. *See supra* note 25 and accompanying text.

Unlike the concurrences, however, it provides a clear, objective metric for determining when a previously existing structural right has been lost. Has the new technique reduced costs by a factor of ten or more? If so, a rights-shift has occurred and the Fourth Amendment must be used to impose new legal costs and restore balance.[58] Drawing the line at an order of magnitude is admittedly somewhat arbitrary, but is also an indisputable benchmark and easily applicable test for whether or not a particular type of surveillance has become radically less expensive, which is ultimately the question on which we are suggesting courts focus.

This test provides an objective metric, as Ohm suggests,[59] but is both easier to derive and more specific to the particular case and technology at hand than the more general metrics he proposes. This test also addresses one of the primary criticisms of Justice Alito's approach: that it rests on the subjective expectations of people who lack any reliable knowledge about the possibility, likelihood, or capabilities of the particular surveillance techniques being used. As Kerr has argued, "Some people will guess that privacy invasions are common. Others will guess that they are rare. But exceedingly few will know the truth, which makes such probabilistic beliefs a poor basis for Fourth Amendment regulation."[60] This test, however, doesn't rely on anyone's subjective expectations but only on objective, verifiable facts.

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58. In applying this metric, we are not looking back to the cost of gathering the same information at the time of the Founding. As Kerr has explained, when applying equilibrium-adjustment theory,

> [H]arking back to some earlier time does not necessarily mean looking back to 1791. It merely means looking back to a period before the relevant technological change occurred. Courts engaging in equilibrium-adjustment aim to return to the status quo level of police power before the triggering event. While it is *possible* to use 1791 as the reference point, judges can use any reference point before the technological change.

Kerr, *supra* note 28, at 86. So, for example, the most relevant costs when looking at GPS are the costs of the last generation of technology, beepers. Meanwhile, one would categorize GPS and cell tracking in same generation such that the fact that cell tracking isn't less than 1/10th the cost of GPS isn't relevant. As Kerr states,

> The theory of equilibrium-adjustment posits that existing Fourth Amendment doctrine reflects generations of past adjustments based on new technologies. We don't easily see those generations because the new technologies of the past appear to us as simply part of the present status quo. I introduced "Year Zero" to help reveal the past generations of change.

Id.

59. *See supra* note 14 and accompanying text.

60. Kerr, *supra* note 9, at 349; *see also* Kerr, *supra* note 29, at 531-32 (critiquing the "probabilistic" model of the Fourth Amendment protection).

Just as importantly, this rule makes sense of the Supreme Court's differential treatment between the beeper tracking in *Karo* and *Knotts* and the GPS tracking in *Jones*. The more than fifty percent decrease in the per-hour cost between covert car pursuit ($275) and beeper tracking ($105-113) was large, but not large enough to require an equilibrium adjustment.[61] However, GPS tracking ($0.36-$10) is *more than ten times less expensive* than beeper tracking ($105-$113), clearly triggering the rule.

Similarly, the incredibly inexpensive technique of cell phone tracking clearly requires an equilibrium-adjusting application of Fourth Amendment protections for any length of surveillance. This conclusion is clear when comparing traditional covert car pursuit or beeper surveillance to even the most expensive hourly rate for cell phone tracking using the most expensive cell phone carrier. It costs $5.21 per hour for one day of surveillance of an AT&T customer. One day of beeper surveillance is more than *twenty times* as expensive, at as much as $113 per hour, and covert car pursuit costs over *fifty times* that, at $275 per hour.

The difference is even more dramatic when the length of the surveillance increases. For example, the average cost of cell phone tracking across the three major providers is about $1.80 per hour for twenty-eight days of tracking. Using beeper technology for the same period of time is nearly *sixty times* more expensive, while covert car pursuit is over *150 times* more expensive.

Speaking more generally, any technology used for mass location surveillance would trigger our rule, because as the number of targets increases, the cost of tracking each one approaches zero. This result accords with the Court's suggestion in *Knotts* that technologies enabling "dragnet-type law enforcement," whereby "twenty-four hour surveillance of any citizen of this country [would] be possible," may justify the application of "different constitutional principles" than the garden-variety single-target tracking case does.[62] Judge Posner subsequently made the same point when discussing GPS tracking:

> The new technologies enable, as the old (because of expense) do not, wholesale surveillance. . . . It would be premature to rule that such a

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61. Like beeper surveillance, the comparably expensive IMSI catcher or "Stingray" surveillance ($105/hour) is not so much less expensive than traditional covert car pursuit as to warrant an equilibrium adjustment. However, also like beeper surveillance, IMSI catcher surveillance can still violate a Fourth Amendment expectation of privacy when used to track location inside of a private space. *See* United States v. Karo, 468 U.S. 705, 714-15 (1984) (finding that police monitoring of a beeper's location while it was in a private residence violated a Fourth Amendment expectation of privacy).

62. United States v. Knotts, 460 U.S. 276, 283-84 (1983).

> program of mass surveillance [of public movements] could not possibly raise a question under the Fourth Amendment—that it could not be a search because it would merely be an efficient alternative to hiring another 10 million police officers to tail every vehicle on the nation's roads.[63]

Rather than reserving judgment on the question, our rule asks and answers it: mass surveillance technologies, by reducing the cost of tracking any citizen to pennies or less per day, require imposition of Fourth Amendment constraints as a legal prophylactic to replace lost structural constraints. Put another way, our rule concludes that mass-tracking technology implicates the Fourth Amendment exactly *because* it is an efficient alternative to the (impossibly costly) hiring of another ten million police officers.

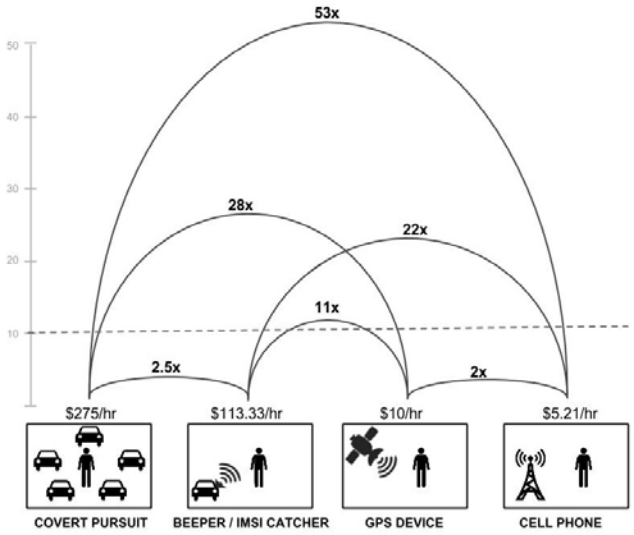

Figure 2.

A VISUAL COMPARISON OF LOCATION TRACKING METHODS

This chart compares the cost of each method of tracking a suspect's location, using the most expensive possible per-hour cost for each method. Even when using the most costly rate—for example, $10 per hour for GPS tracking or $5.21 per hour for cell phone tracking—the drop in cost between old and new techniques is very dramatic and well over an order of magnitude.

This conclusion can be illustrated by a simple example. The FBI has stated that in response to the *Jones* ruling, it had to either get warrants for, or

63. United States v. Garcia, 474 F.3d 994, 998 (7th Cir. 2007).

deactivate, the 3,000 GPS devices that were deployed at that time across the United States.[64] This implies that the Bureau had the technical capacity to covertly follow at least 3,000 targets simultaneously using GPS technology. Without that technology, it would require 15,000 agents to covertly follow the same number of targets (assuming five agents for each target). Therefore, even if the FBI were to instruct *all* of its 13,785 special agents[65] to ignore *all* other duties and remain active for *every* hour of *every* day (an assignment that is humanly impossible), it would *still* be 1,215 agents short of being able to follow that many suspects. These figures dramatically illustrate how mass surveillance that was impossible prior to the introduction of new technologies like GPS is now firmly within the government's grasp. When such surveillance would have required ludicrous expenditures of time and treasure, there was no need for the Fourth Amendment to protect against it. However, now that the structural constraints against that surveillance have disappeared and the absolutely impossible has become easily possible, Fourth Amendment protection is desperately necessary.

This view is not only consistent with that of several scholars who have interpreted the *Jones* concurrences to support a rule restricting mass surveillance,[66] but is also consistent with the concerns expressed by the Justices themselves during the *Jones* oral argument. As Justice Breyer put it:

> [T]he question that I think people are driving at, at least as I understand them and certainly share the concern, is that if you win this case, then there is nothing to prevent the police or the government

64. *See* Johnson, *supra* note 38.

65. *Frequently Asked Questions*, FBI, http://www.fbi.gov/about-us/faqs (last visited Nov. 4, 2013) ("On May 31, 2013, a total of 35,902 people worked for the FBI, including 13,785 special agents and 22,117 professional staff.").

66. *See* David Gray & Danielle Citron, *The Right to Quantitative Privacy*, 98 MINN. L. REV. (forthcoming 2013) (manuscript at 34), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2228919 (proposing that the *Jones* concurrences support a technology-specific inquiry: "In our view, the threshold Fourth Amendment question should be . . . whether an investigative technique or technology has the capacity to facilitate broad programs of indiscriminate surveillance that raise the specter of a surveillance state. If it does, then granting law enforcement unfettered access to that technology would violate reasonable expectations of privacy."); *see also* Priscilla J. Smith, *Much Ado About Mosaics: How Original Principles Apply to Evolving Technology in* United States v. Jones, 14 N.C. J.L. & TECH. 557 (2013) (discussing how the *Jones* concurrences and the Justices' questions at oral argument indicate an overriding concern about the disappearing structural constraints against location tracking, and in particular, the disappearing structural constraints against mass location surveillance).

> from monitoring 24 hours a day the public movement of every citizen of the United States.[67]

The Chief Justice put an even finer point on it: "You think there would also not be a search if you put a GPS device on all of *our* cars, monitored *our* movements for a month? You think you're entitled to do that under your theory?"[68]

Ultimately, several Justices posed questions raising the concern that a failure to regulate GPS tracking could enable mass or indiscriminate warrantless surveillance.[69] And although the *Jones* concurrences themselves do not explicitly discuss the issue of mass surveillance, the structural rights calculus that these opinions support clearly implicates that question and provides an answer: where technology renders previously impossible surveillance possible on a mass scale, the Fourth Amendment must be applied to restore equilibrium.

CONCLUSION

This Essay set out to make a targeted contribution to an ongoing conversation about how the Fourth Amendment's protections can and should be applied to balance out the rapid technology-based expansion of the government's power to collect information about its citizens. Our contribution is the suggestion that dollar cost can be a key metric for judging when such a radical shift in police power has occurred. With location tracking as our example, we've detailed the precipitous drop in cost between old and new surveillance techniques, and, consistent with previous academic discussions and the *Jones* concurrences, we have suggested ways in which such data about costs could be used to apply a simple and administrable rule.

We do not argue that the courts should abandon the reasonable expectation of privacy as the primary test for Fourth Amendment protection, but instead propose a supplementary new tool for deciding when such an expectation exists in cases concerning new surveillance technologies. Nor do we suggest that the cost metric can or should be the only factor in making that decision; we only seek to demonstrate its viability as a powerful yardstick against which to judge a technology's impact on privacy. As such, using order-of-magnitude difference as a rule of thumb is just one way of using cost as a metric, and we

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67. Transcript of Oral Argument at 12-13, United States v. Jones, 132 S. Ct. 945 (2012) (No. 10-1259), http://www.supremecourt.gov/oral_arguments/argument_transcripts/10-1259.pdf.

68. *Id.* at 9 (emphasis added).

69. *See* Smith, *supra* note 66, at 585-89 (extensively quoting from *Jones* oral argument).

welcome other such proposals for assessing whether a radical technology-prompted rights-shift has occurred.

We also recognize that even our simple rule of thumb raises some questions about implementation and administrability. The assumptions that inform our calculations can and should be questioned, as there may be more accurate ways of assessing shifts in surveillance costs, and we welcome suggestions and further research on this point. Like Ohm, we imagine that if our approach is ever embraced, the exact nature of the cost calculus, and what data should be used for it, will be the subject of much debate and litigation.[70] For now, our modest hope is to inspire an enterprising criminal defense attorney to articulate cost-based arguments when moving to suppress GPS or cell tracking data. Our less modest hope is to see that motion granted.

Finally, there remains work to be done in assessing how such a cost-based structural privacy rights approach might apply beyond the immediate example of location tracking—for example, in the context of drone surveillance, communications surveillance, or data mining. That work is beyond the scope of this Essay, though we expect it would yield both new insights for and new challenges to our basic proposition: When highly revealing surveillance of a citizen's activities is possible for pennies a day, we need the Fourth Amendment to protect us. Otherwise, we may soon live in a world of unlimited virtual "tiny constables" monitoring our every move.

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70. *See* Ohm, *supra* note 11, at 1352.