

THE JUDGES' JOURNAL

A QUARTERLY OF THE JUDICIAL DIVISION AMERICAN BAR ASSOCIATION

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Scientific Fact or Junk Science? Tracking a Cell Phone without GPS

Vol. 53 No. 1

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An often-encountered problem writing a quarterly technology column for a print publication about an issue playing out in courtrooms is that subsequent technological advancements may solve the problem before the article is published. Nevertheless, there is an issue percolating in courtrooms around the country that may show up on your doorstep before the arrival of a technological solution—using historical telephone records to approximate the location of a cell phone at some time in the past. This discussion has nothing to do with GPS (Global Positioning Systems) because this technology is universally accepted in the scientific community for determining locations of persons, places, and things. This discussion concerns determining the location of a plain old cell phone that does not have GPS capability and whether using historical cell phone records that identify the cell antenna used by a cell phone making or receiving a call is a sufficiently reliable basis to identify the approximate location (within a few blocks or a fraction of a mile) of a cell phone.

Imagine this scenario playing out in a courtroom near you: A defendant is charged with first-degree murder of a person he has known since childhood in the neighborhood in which they grew up. In recent years, the defendant has been known to sell illegal drugs in the old neighborhood, although he has not lived there in over a decade. There are cell phone records that show several telephone calls between the defendant and his childhood friend up to 15 minutes before the decedent's approximate time of death, and no telephone calls between their cell phones after that time. A traffic camera photographed the defendant's vehicle one block away from the location where the decedent was killed about 15 minutes after the estimated time of death, headed away from the murder scene. In the decedent's vehicle, where he was killed, forensic examiners discover the defendant's fingerprint on a bag of partially eaten potato chips and the fingerprints of an unknown individual on the inside door handle. And, finally, there is evidence that the defendant left his home and

About The Judges' Journal

The Judges' Journal is produced quarterly by ABA Judicial Division. The Division's award-winning quarterly publication is one of the nation's foremost judicial journals and the authoritative source on innovations in the justice system. *The Judges' Journal* is designed to keep members current on issues affecting the courts and promote discussion about the direction of the judicial process. Members of the Judicial Division enjoy a complimentary subscription to this publication (a \$25 value).

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returned approximately a half hour before and a half hour after the approximate time of death.

With just this evidence, the prosecution faces the prospect that its case against the defendant may be dismissed without ever getting to a jury. However, there is more evidence the prosecution plans to present. Specifically, the prosecution is offering an expert witness who will testify that, in his opinion, the defendant's cell phone traveled several miles in a direction away from his home and toward the crime scene within a half hour of the estimated time of death. He will also testify that the defendant's cell phone was near the crime scene at the approximate time of death. Finally, the prosecution expert will testify that the defendant's cell phone traveled from the vicinity of the crime scene to the defendant's home over a half hour interval following the approximate time the decedent was killed.¹ As expected, the defense is making vigorous efforts to preclude this expert testimony, arguing that such an opinion based solely on historical cell site information is junk science.²

To understand the issues, I must first give a little background about mobile antennas. Typical mobile cell antennas sit on a tower and are aimed in directions 120 degrees apart to cover the full circumference of the circle emanating from the tower. Although this discussion primarily references typical mobile cell antennas, a substantial number of cell antenna configurations do not fall into this category. For instance, cell phone antennas may point in two directions along the path of the highway to provide coverage to vehicles traveling both ways on the highway, as there is little or no need to provide signal coverage outside the highway in areas of sparse population. In addition, a cell antenna on the side of a mountain may be pointed in one direction to provide service to the population in the valley below. Additionally, a cell antenna may be disguised, camouflaged, or otherwise hidden, such as on a building's roof or in a structure that looks like a tree, or inside a church steeple, or within the façade on the side of a building . . . you get the point.

According to the prosecution expert, a cell phone will generally communicate with the antenna pointed in its direction that provides the strongest signal, which normally comes from the closest antenna. Exceptions to this general rule occur when there is interference or signal blockage, such as a building or other structure, along the straight-line path between the antenna and the cell device. In this case, according to the prosecution expert, the cell device will still communicate with the antenna that provides it the strongest signal, normally the next closest antenna that is pointed in the direction of the cell device.

The prosecution expert also advises there are numerous locations in urban areas where cell signals overlap. Where this occurs, it is not unusual for the cell device to switch from one antenna to another. This can happen when a cell user moves or turns in a direction in which one antenna's signal is stronger than the other because of interference or blockage, and can even include movement inside a building from one room to another.

The prosecution and defense experts agree that historical cell records provide limited information. The types of information within these historical records include:

1. Identification of the antenna(s) with which a cell device connects when a call is initially made or received and when that call is terminated;
2. The azimuth of the antenna (the direction in which the antenna is pointed) with which the cell device is communicating when the call is both initiated and terminated; and

3. The initiating time and the terminating time of the call.³

Historical cell site records provide only the first and last antennas with which the cell device communicated during a call. Even if a cell user moves through several areas of coverage and uses multiple antennas during one call, historical call records show only the first and last antennas used during that call.

The prosecution expert offers his opinion that, based on the antenna with which the cell device communicated when a call was made or terminated, and the coverage area of that antenna, he is able to give a general approximation of the area in which the cell device was located at that time. This expert further represents that he can approximate the path of travel based on the different antennas the cell phone used and the signal coverage area for each antenna, if the user makes or receives multiple calls.

Contrary to the prosecution's position, the defense expert offers his opinion that any attempt to estimate the location of a cell phone device based on the cell phone's communication with a particular cell tower upon initiating or receiving a call is junk science. This expert further states that it is erroneous to assume that a cell phone will always connect with the closest antenna pointed in its direction because numerous factors can affect signal strength, including terrain, weather, physical obstructions, antenna maintenance, and call volume.

The defense expert further advises that the practical range of an antenna's signal is up to 22 miles and concludes there is no reliable basis to assume that a cell device will connect with the first, second, third, or even the fourth closest cell antenna. In further explanation, the defense expert explains that for a tower antenna signal having an arc of 120 degrees (one-third of a circle), based on a generally accepted formula for calculating that area ($1/3\pi r^2$), the antenna may actually be in communications with a cell device located anywhere within a geographic area exceeding 500 square miles. In response, the prosecution argues that the idea of a single cell tower serving an area of that size, larger than most cities in the continental United States, is improbable.

In support of the defense position that determining the location of a cell device based on historical cell site records is unreliable, the defense expert provides additional information. First, a cell device often receives a signal from more than one antenna. Second, absent GPS data, the only other way to obtain reasonably accurate information about the location of a cell phone device is by triangulation, namely, computing the distance between the cell device and three antennas based on the time delay of the signal between the device and each antenna, and drawing a circle around each tower, with each circle having a radius of the phone's distance from that tower. The circles will intersect to pinpoint the location of the phone. Additionally, an even more complex version of triangulation makes it possible to determine a phone's location: If two antennas receiving a signal from the cell device and the direction of the signal are known, a mathematical algorithm may be utilized to pinpoint the location of the cell device.⁴

As an example of these capabilities, the defense expert notes that, pursuant to Federal Communications Commission regulation, most cell telephone service providers have upgraded their 9-1-1 network to report the telephone number and location of 9-1-1 calls made from wireless phones, a capability called Enhanced 9-1-1, or E9-1-1.⁵ Unfortunately, this information concerning the location of a cell device is captured only in real time by the service providers and is not stored. Even if a service provider initially captured information

regarding the location of a cell device, this information is not available in the historical records.

The final response by the prosecution expert is that the ability to determine the location of a cell device from historical cell call records is becoming more precise because cell phone service providers are constantly installing more antennas, and reducing the coverage area of each antenna, to provide better service to cell customers.

So, the question being put to you is whether to exclude the cell site expert testimony, limit it, or merely let the jury determine the persuasiveness of the competing experts. This article does not offer a resolution of the issue or assess the merits of the prosecution and defense claims. The purpose is to alert judicial officers that, absent the availability of GPS data, litigation concerning this type of evidence should be anticipated. Several courts have determined that proposed expert testimony of this type offering an opinion concerning the approximate location of a cell device based on historical cell site records is admissible and appropriate for consideration by the jury or judicial fact finder.⁶ However, similar proffered evidence is now being challenged by defense counsel more often than in the past and defense counsel frequently cite one decision that limited the extent to which an expert may offer an opinion concerning the location of a cell device based on historical cell site records.⁷ When this issue reaches the well of your courtroom, you'll be ready to hear it—hopefully.

Endnotes

1. Thomas A. O'Malley, *Using Historical Cell Site Analysis Evidence in Criminal Trials*, U.S. Att'ys' Bull., Nov. 2011, at 16, available at http://www.justice.gov/usao/eousa/foia_reading_room/usab5906.pdf.
2. Mark Hansen, *Prosecutors' Use of Mobile Phone Tracking Is "Junk Science," Critics Say*, A.B.A. J., June 2013, at 15, available at http://www.abajournal.com/magazine/article/prosecutors_use_of_mobile_phone_tracking_is_junk_science_critics_say.
3. The same information is available for text messages sent and received.
4. 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. 3, ¶¶ 11–13 (2011), <http://jolt.richmond.edu/v18i1/article3.pdf>.
5. 9-1-1 Service, Fed. Commc'ns Comm'n, <http://transition.fcc.gov/pshs/services/911-services> (last visited Dec. 9, 2013). The FCC has designed and established transition periods for service providers that do not yet meet the requirements of the regulations.
6. See O'Malley, *supra* note 1; Blank, *supra* note 4.
7. See *United States v. Evans*, 892 F. Supp. 2d 949 (N.D. Ill. 2012).