GEO-LOCATION

Process of Locating One Geographically
HCSLI

Historic
Cell
Site
Location
Information
HCSLI Uses

Locate Phone At/Near To Crime Scene:
Demonstrate Movement Patterns;
Corroborate/Impeach Statements;
Establish Associations among/between Persons;
Track Movements
Who Uses HCSLI?

**Defense:**
- Alibi;
- Alternative Suspect;
- Corroborate Statements;

**Law Enforcement:**
- Investigative Tool = Locate missing persons;
- Fact Investigations;
Cellular Network Components

1) Base Transceiver Stations -- “cell towers” and “cell sites”;
2) Mobile Stations -- “cell phones” and “mobile phones”;
3) Mobile Switching Center -- “brains;” and
4) Public Switched Telephone Network for connection to wired telephones
Cell Towers/Sites

Cellular networks use directional antennas usually mounted and positioned on the cell towers to radiate in separate sectors facing different directions.

A “cell sector” refers to a specific sector emanating from a cell tower.

The number of sectors around a cell tower may vary by cellular provider but typically involve three separate 120-degree, pie-shaped arcs connected to form a circle of 360-degree coverage around the cell tower.
Typical Cell Tower & Sector
Cells are arranged in the pattern of a hexagonal grid

Adjoining cells overlap coverage to avoid disconnection when signal strength drops by transferring call to the next cell
Cell Range

While phone activated it periodically transmits/receives signals to/from the network to scan the strength of every potential cell site.

The selection process to determine which tower will “service” a cell phone is a matter of disagreement.

Cellphone connects to the cell site with the signal that is: nearest (or) strongest (or) cleanest (or) as selected by network
Experts will disagree whether the “serving cell tower” is the:

1. The closest tower;
2. The tower which is in a direct line of sight of a cell phone;
3. The strongest signal received by a cell phone;
4. The cleanest signal received by a cell phone;
5. The signal chosen by the network as a function of load balancing;
Call Detail Records (CRDs)

CDRs are a cell provider’s business records that contain accurate date, time, and location information for cell phones including:

- the telephone number of the wireless or wire-based phone connecting with the relevant cell phone,
- whether the voice calls or text messages were incoming or outgoing, the duration of voice calls, and
- the cell tower and cell tower sectors at the beginning and end of voice calls or when text messages are sent or received.

Unlike a witness’ memory, CRDs are not prone to impeachment based on their accuracy, reliability, or bias.
How To Get CRDs:

Electronic Communications and Privacy Act (ECPA), 18 U.S.C. §§ 2510–2522, requires:

- **a court order**, 18 U.S.C. §§ 2703(c), (d)
- **search warrant**, 18 U.S.C. § 2703(c)
Request CDRs ASAP

Cell providers retain CDRs for 6 - 18 months

CDRs may be preserved pending issuance of legal process for a period of 90 days pursuant to a written request which may be extended for an additional 90-day period upon a renewal request.

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Typical Synthesis of CDR Information
Use the CDRs to Plot Cell Sector

- Use cell tower identifiers to plot the tower
- Identify the latitude/longitude of the tower
- Identify Sector directionality or azimuth angle
- Pie Shapes identify coverage boundaries
- Scope of Coverage Area?
Typical FBI Plot of Single Cell Sector
FBI Plots Reflecting Movement
Sector Ranges?

Disagreement among Experts re: Range:

- Coverage/Range Limits:
  - FBI: 1 to 2 miles
  - MSP: 8 miles
  - NIST: 21 miles
Alternative Plot with Range Adjustment
Alternative Plot Showing Common Area Coverage
JDSU Drive Testing

- Industry-standard RF mapping equipment and software to map the actual RF coverage footprint
- Cell providers use JDSU DT to adjust directional antennas/add new cell towers for improved wireless coverage

- CAST experts use JDSU DT in a different ways:
  - Identify the “servicing” cell site for a known location at that time.
  - Identify the actual coverage range of a particular cell site through “reselection”
- Impeachable if the expert cannot correlate the conditions from test to actual time
Do the Math

**Area of Coverage 1**

**Assume:**
- Omni-Directional Tower
- Radius 10mi - 35mi

**Cell Site**

10 mile radius

**Area = \pi r^2**

314 sq. mi. = 3.14 x (10x10)
Defense Expert: Cell Tower Range

- A CELL TOWER SIGNAL CAN REACH A TOTAL OF 31.2 MILES!!!
  

  - That is a total area of 2,800 square miles!

  - Which is the equivalent of 1,792,000 acres!
More Math . . .

The possibilities are endless...

- Just think, the average plot of land per house in a suburban area is 1/3 of an acre.
- That’s 5,376,000 potential occupancy locations! Plus all the roads, yards, and spaces in between.
- Now, in an urban area, imagine a ten story apartment building, with ten units per floor – Just do the math!

“Dude... I'm right here”
Per Call Measurement Data (PCMD)

- PCMD -- Measurement Data including the time it takes a signal to leave a cellular handset and the return back to the tower.
- When combined with the cell sector information -- gauge how far away the handset is from the cell tower.
- PCMD is captured for every phone call & text message and anytime there is a connection or data event.
- PCMD is extremely perishable information -- only be available for 7-14 days.
- Not routinely preserved by general preservation letter, make specific request.
- PCMD is only found in on code division multiple access (CDMA) networks. Sprint-Nextel and Verizon Networks.
Discovery Issues:

Rule 16(c)(3) Reports by State Experts by Order upon Motion:

- The subject matter on which the expert is expected to testify;
- The substance of the facts to which the expert is expected to testify;
- A summary of the expert’s opinions and the grounds for each opinion
HCSLI Expert Reports

- The methodology used in conducting the historical cell site analysis;
- The mapping of cell tower locations based on cell provider records;
- The orientation of cell sectors for the cell provider’s cell towers;
- The methodology in plotting cell sector coverage;
- The methodology and equipment (JDSU drive test) used to measure and map actual RF signal coverage within certain cell sectors; &
- The conclusions regarding cell phone location in cell sites
Evidentiary Issues

R. Evid. 401 – Relevance
Location of Phone vs. Person?
Who’s phone?
Link phone to person?
  Registered or Prepaid Phones?
Who possessed?
Evidentiary Issues

R. Evid. 403 – Confusing/Misleading?

- Sector Ranges indefinite;
- Boundary error margins;
- Can’t locate phone w/in Sector range;
- Maps overemphasize
Evidentiary Issues

R. Evid. 701 – Lay testimony –
e.g., Records Custodian;

· Customer Account Info -- Phone Registration
· Identification of Phone Number
· Call Detail Records
· Link Phone (or #) to Person – Life History Usage
Evidentiary Issues

R. Evid. 702 – Expert Witness:
If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

- Law Enforcement Agent
- Records Custodian
- RF/Cell Network Engineer
- Network Progammer
Eviedntiary Issues: Reliability


1. the testimony meets a threshold level of reliability:
   - Generally acceptance or
   - Conforms to a generally accepted explanatory theory.
     *State v. Williams*, 388 A.2d 500 (Me. 1978).

2. the testimony is relevant, and

3. it will assist the trier of fact in understanding the evidence or determining a fact in issue. *Bickart*, 2009 ME 7.
Confrontation Clause:
Testimonial v. Nontestimonial Evidence

Most business records are Nontestimonial Evidence
Q – Whether Maps prepared by Gove’t Expert are any different?

Fourth Amendment: Cell Records
*Store Communications Act*, 18 U.S.C. § 2703
Portable Electronic Device Content Information Act, 16 M.R.S.A. § 642(1)

Disclosure to Gov’t Requires Warrant