

GEO-LOCATION

Process of Locating One
Geographically

HCSLI

Historic

Cell

Site

Location

Information

HCSLI Uses

Locate Phone At/Near To Crime Scene:

Demonstrate Movement Patters;

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.

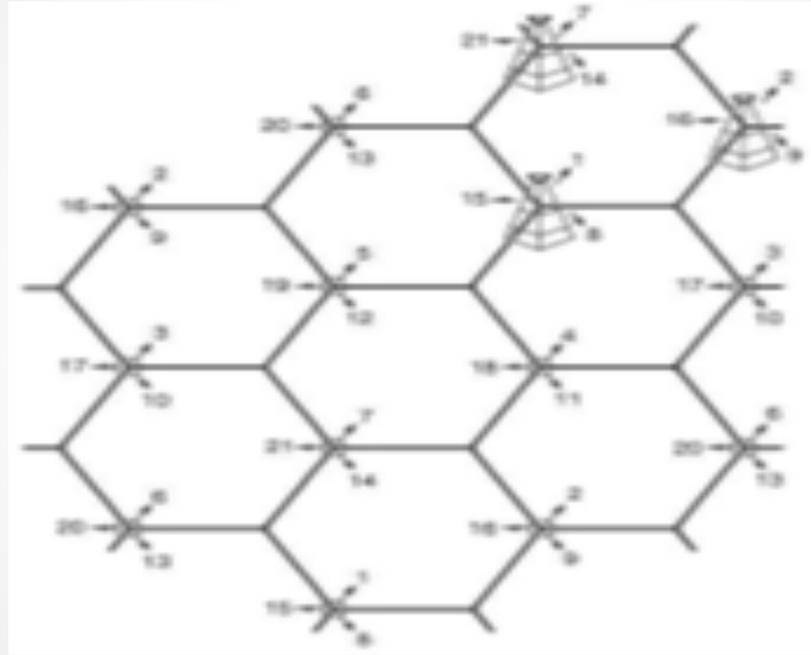
A “**cell sector**” refers to a specific sector emanating from a cell tower.

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 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)
- **subscriber's consent**. 18 U.S.C. § 2703(c)(1).

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.

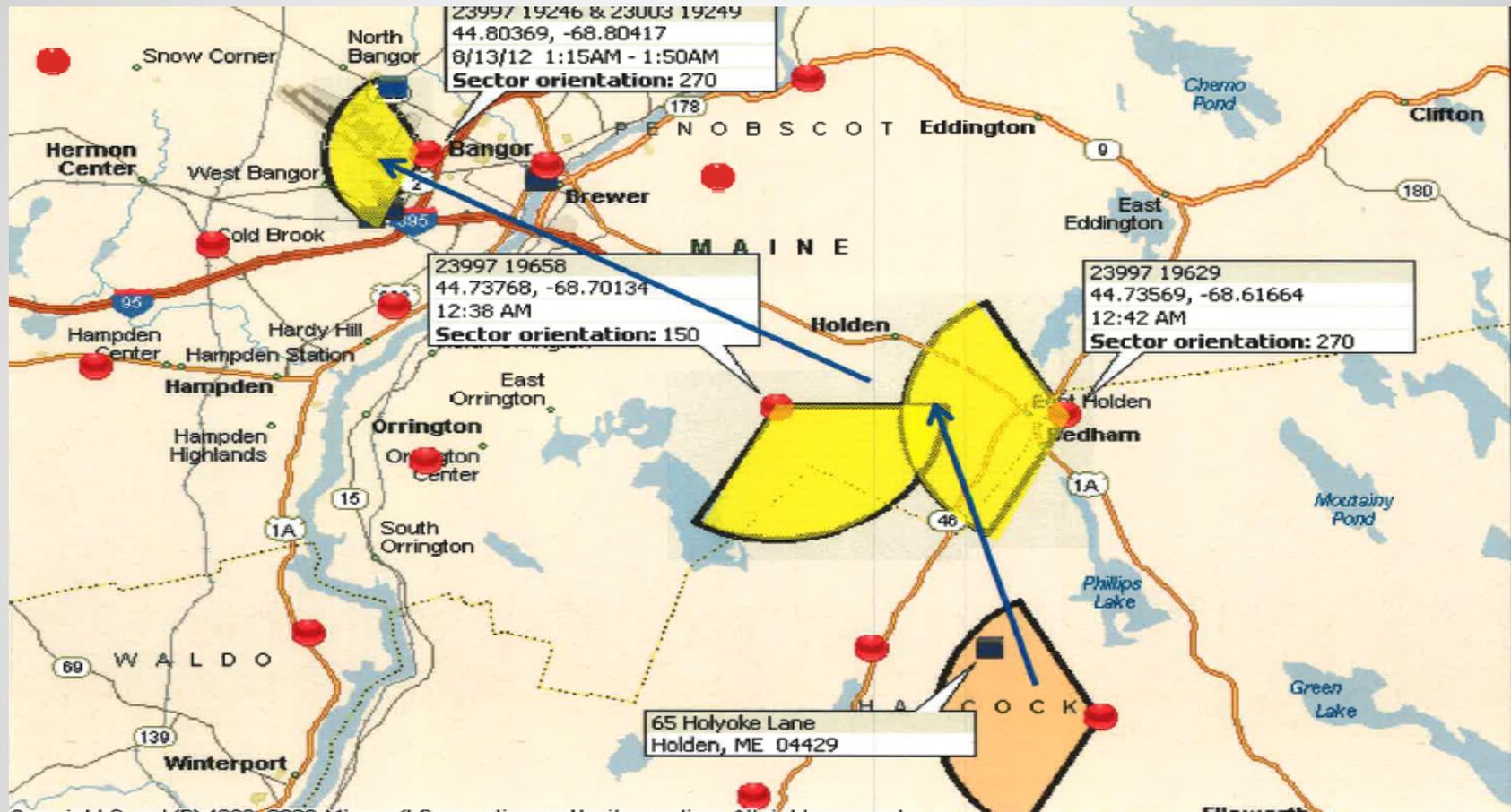
18 U.S.C. § 2703(f)(1), (2) (2010).

Call Type	Target Phone	Conn DateTime	Seizure Time	Originating #	Terminating #	Elapsed Time	Number Dialed	Description	LAC	CID	Longitude	Latitude	Azimuth
VOICE	(207)922-7736	8/12/12 6:14 PM	0:10	12077456234	12079227736	0:18	12079227736	m2M_DIR	23997	19248	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:15 PM	0:09	12079518346	12079227736	0:30	12079227736	m2M_DIR	23997	19674	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:21 PM	0:32	12079227736	12079070232	0:01	12079070232	M2m_DIR	23997	19674	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:22 PM	0:33	12079227736	12078527709	0:02	12078527709	M2m_DIR	23997	19245	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:22 PM	0:29	12079227736	12078525775	0:00	12078525775	M2m_DIR	23997	19245	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:23 PM	0:01	12079227736	12076109378	0:04	12076109378	M2m_DIR	23997	19674	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:24 PM	0:13	12079227736	12072660204	1:09	12072660204	M2M_DIR	23997	19245	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:26 PM	0:32	12079227736	12074316425	0:03	12074316425	M2m_DIR	23997	19674	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:26 PM	0:19	12079227736	12073992962	2:47	12073992962	M2m_DIR	23997	19674	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:34 PM	0:28	12079227736	13612185474	2:12	13612185474	M2m_DIR	23997	19677	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:45 PM	0:33	12079227736	12076592094	0:00	12076592094	M2m_DIR	23997	19245	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:47 PM	0:14	12079227736	12077456234	0:13	12077456234	M2m_DIR	23997	19248	-68.80417	44.80369	150
VOICE	(207)922-7736	8/12/12 6:47 PM	0:00	12072101070	12079227736	0:43	12079227736	m2M_DIR	23997	19677	-68.81425	44.76419	30
VOICE	(207)922-7736	8/12/12 6:48 PM	0:09	12079227736	12072101070	0:00	12072101070	M2m_DIR	23997	19247	-68.80417	44.80369	30
VOICE	(207)922-7736	8/12/12 6:49 PM	0:05	12079227736	12072101070	0:00	12072101070	M2m_DIR	23997	19555	-68.76899	44.82660	150
VOICE	(207)922-7736	8/12/12 6:51 PM	0:34	12079227736	12079070232	0:03	12079070232	M2m_DIR	23997	19488	-68.78800	44.85316	150

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 ?

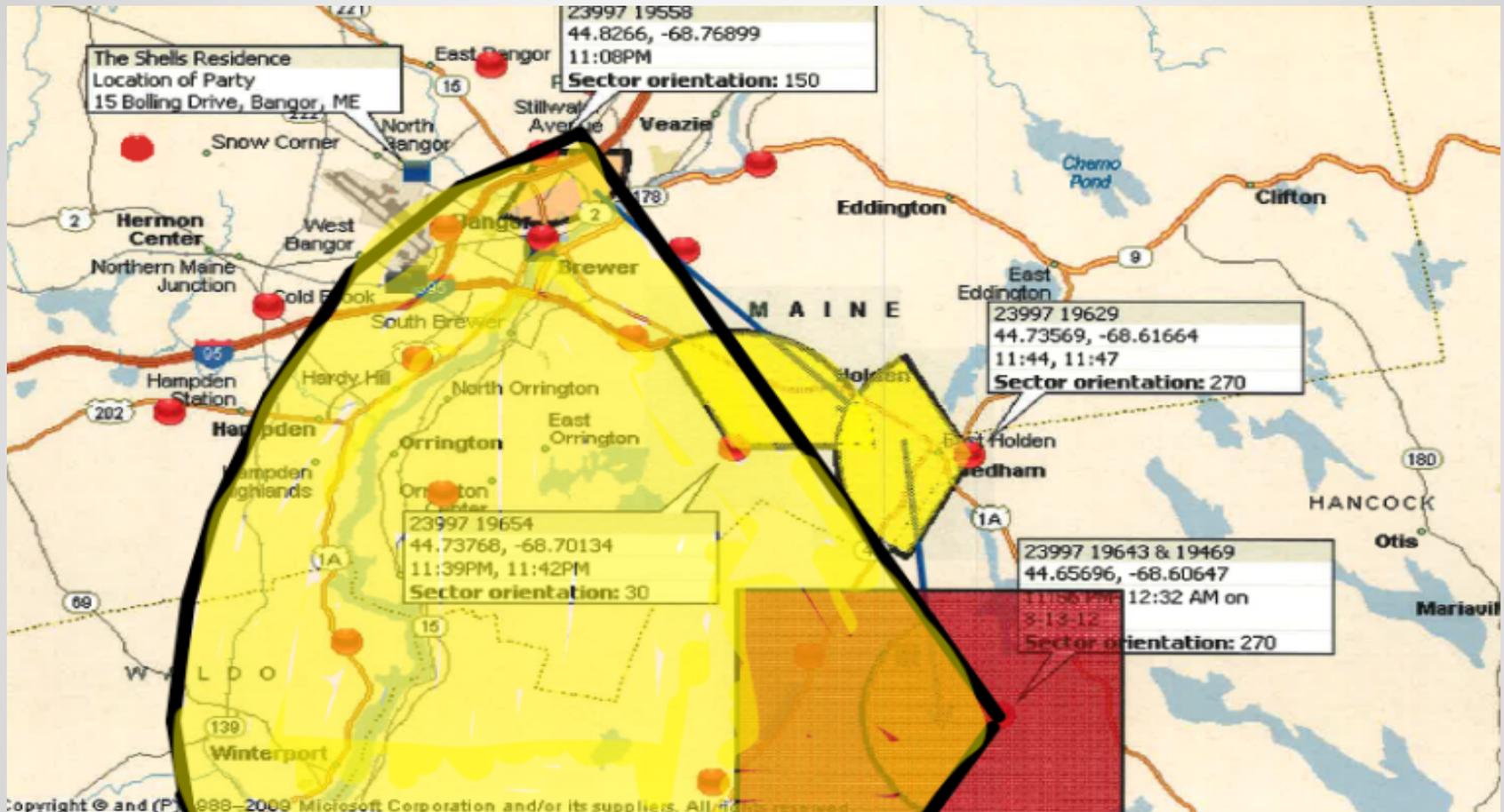


FBI Plots Reflecting Movement

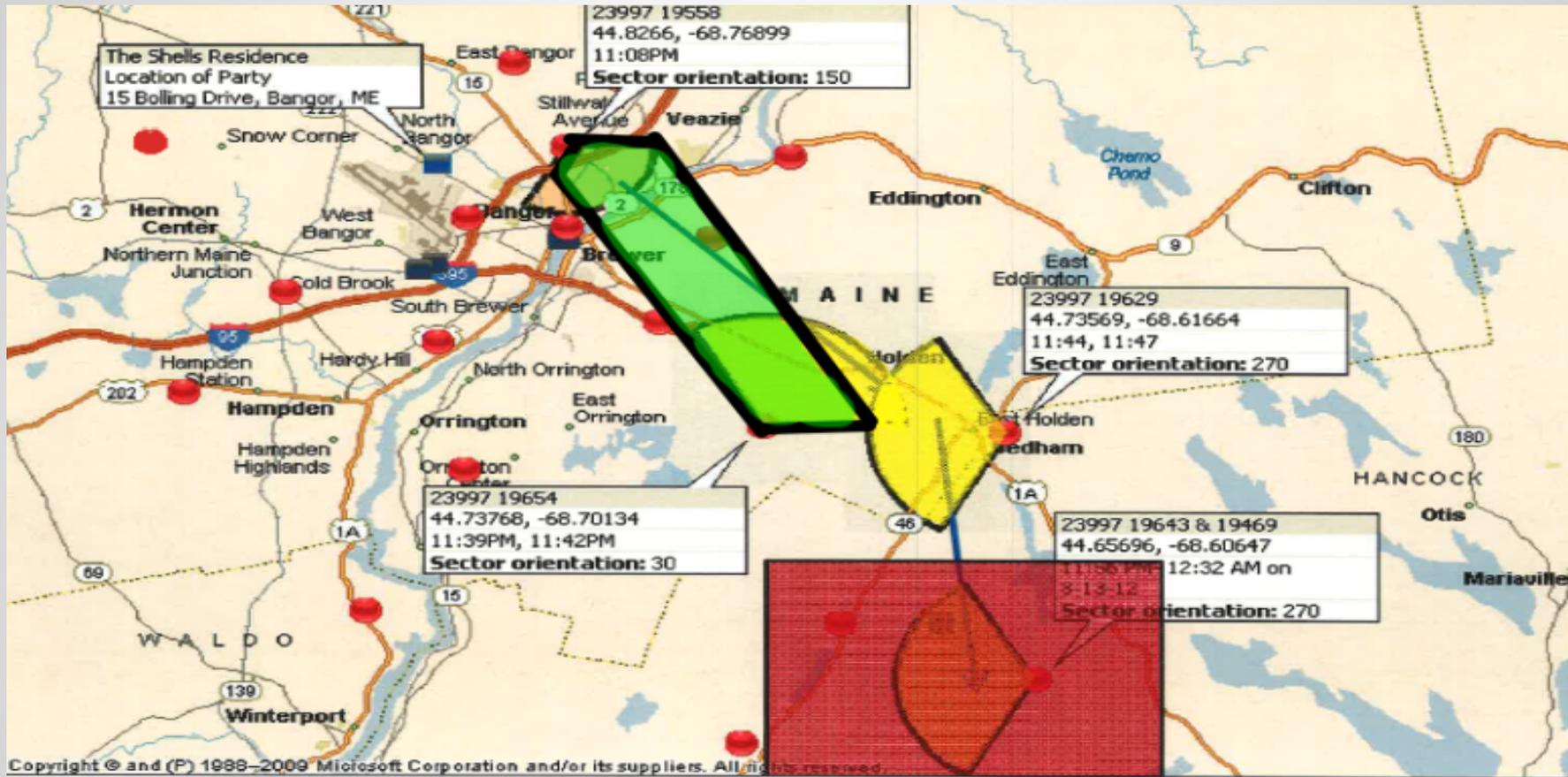
Sector Ranges ?

Disagreement among Experts re: Range:

- Coverage/Range Limits:
 - FBI: 1 to 2 miles
 - MSP: 8 miles
 - NIST: 21 miles



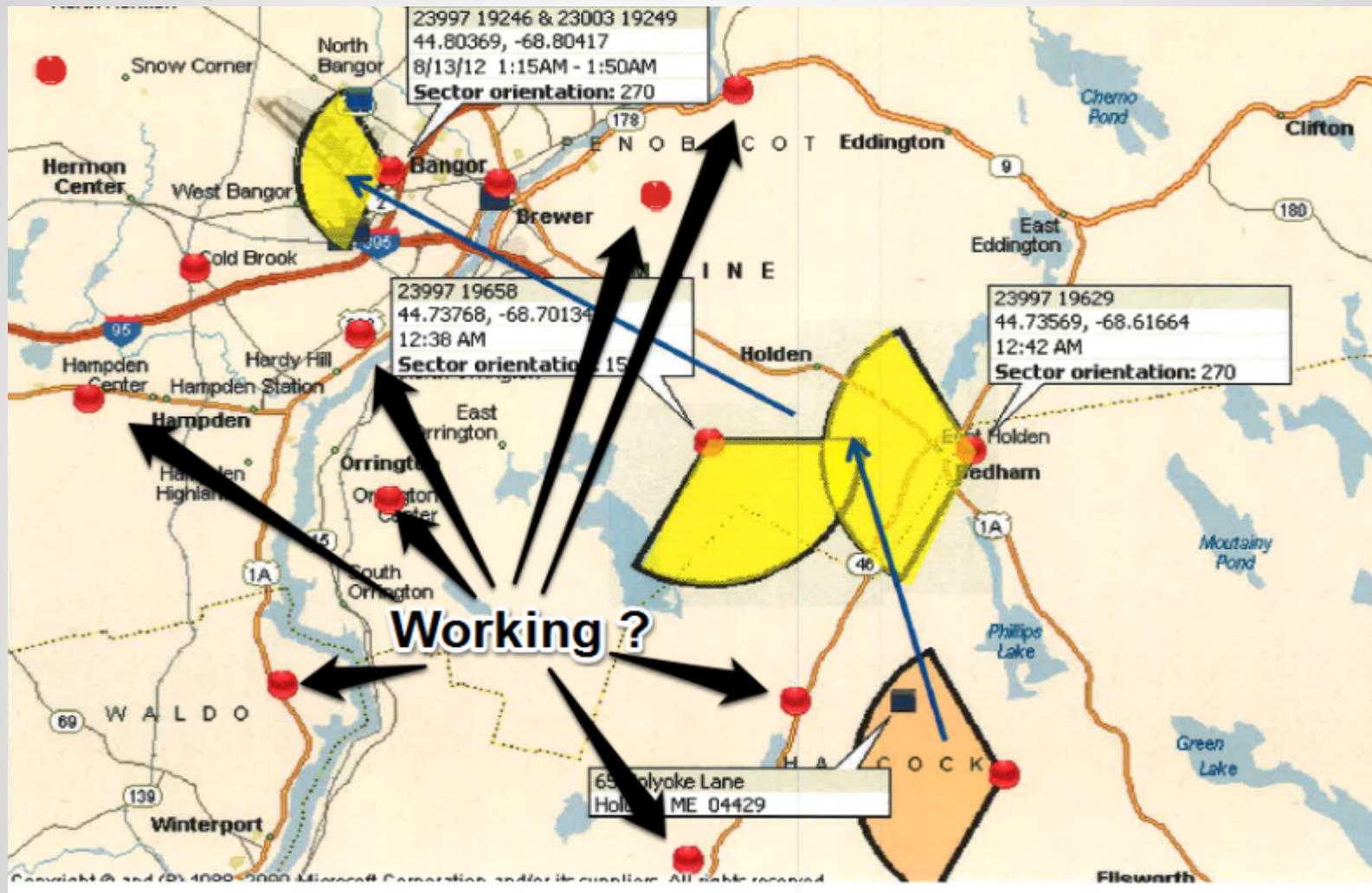
Alternative Plot with Range Adjustment



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

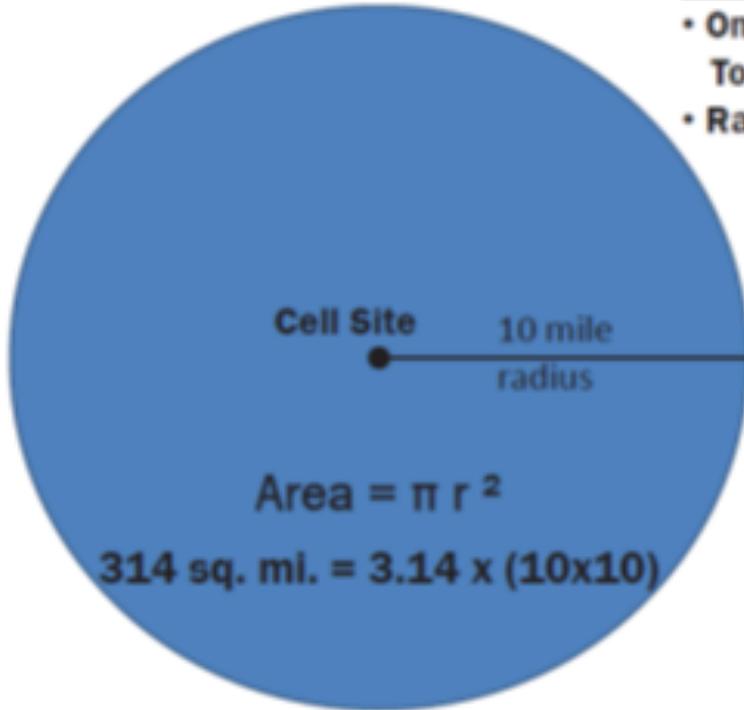


Do the Math

Area of Coverage 1

Assume:

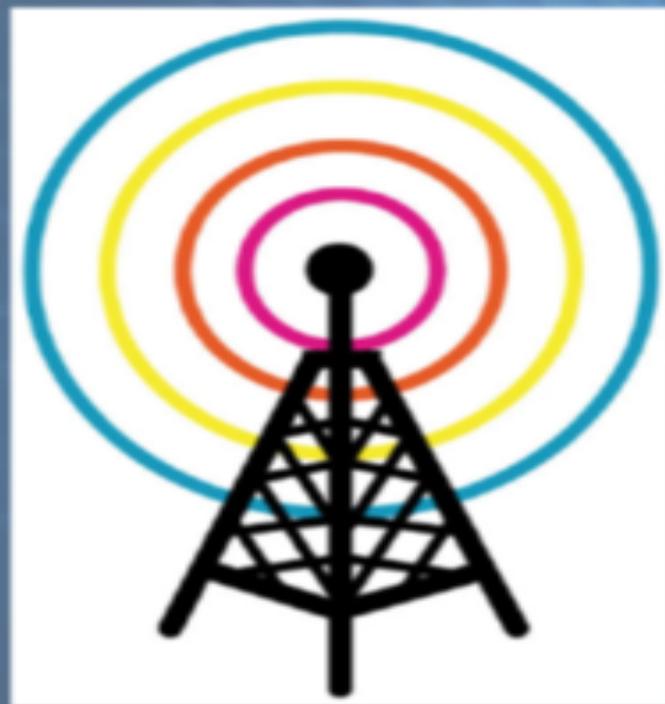
- Omni-Directional Tower
- Radius 10mi - 35mi



$$\text{Area} = \pi r^2$$

$$314 \text{ sq. mi.} = 3.14 \times (10 \times 10)$$

Defense Expert: Cell Tower Range



- A CELL TOWER SIGNAL CAN REACH A TOTAL OF 31.2 MILES!!!
 - (See State v. Davis MMX-CR08-0185484-T, N.T. 11/29/2010 at 29-30)
 - 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...

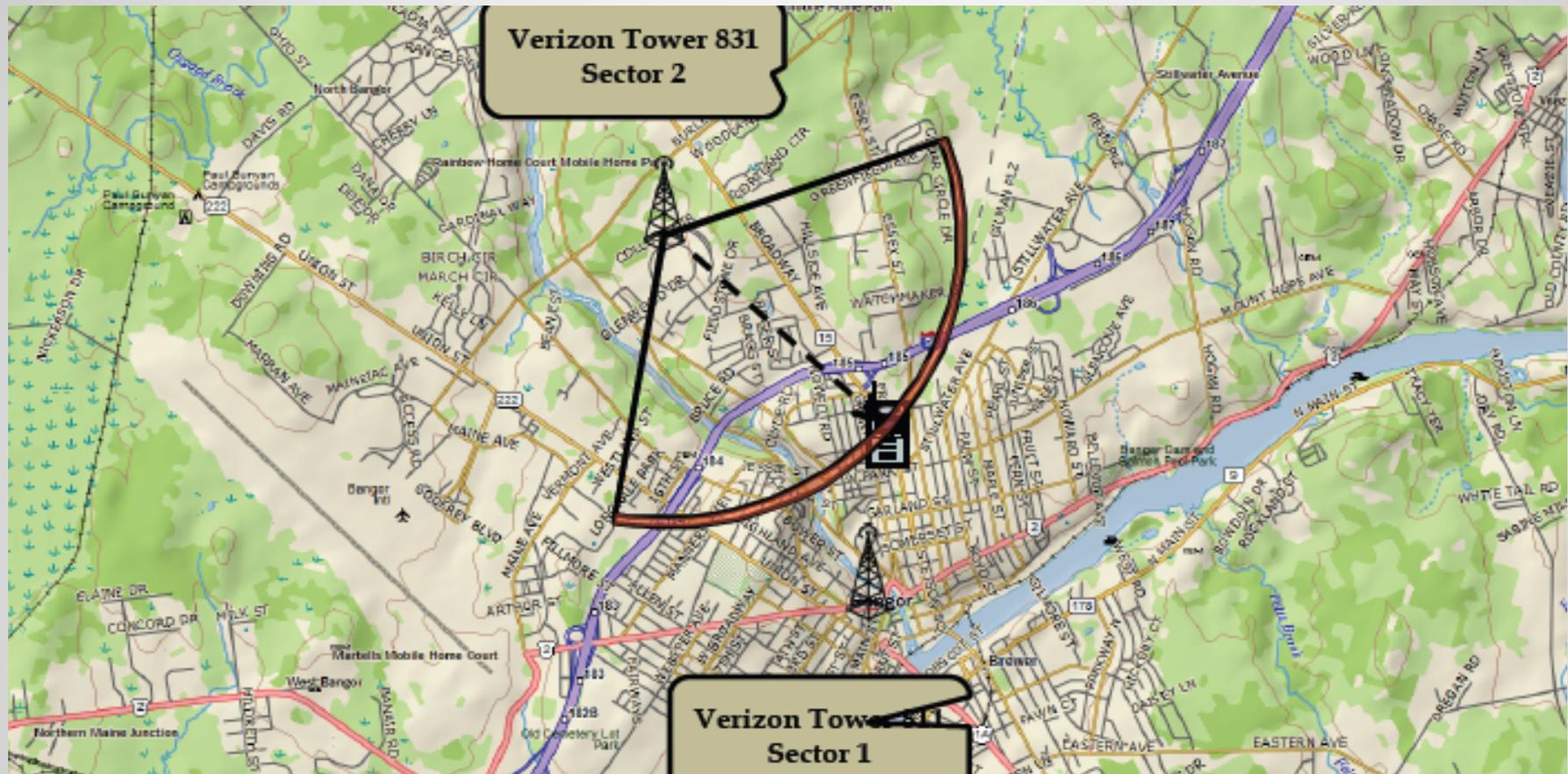


- Just think, the average plot of land per house in a suburban area is $1/3$ of an acre.
- That's 5,376,000 potential occupancy locations! Plus all the roads, yards, and spaces in between.
- Now, in an urban area, imagine a ten story apartment building, with ten units per floor – Just do the math!



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.



Plot using PCMD

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 Programmer ?

Evidentiary Issues: Reliability

The Court -- **Gatekeeper** to guard against unreliable expert evidence.
State v. Bickart, 2009 ME 7 ¶12.

(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.

Constitutional Issues

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