Wireless 911 call Routings Using Population Weighted Address Points

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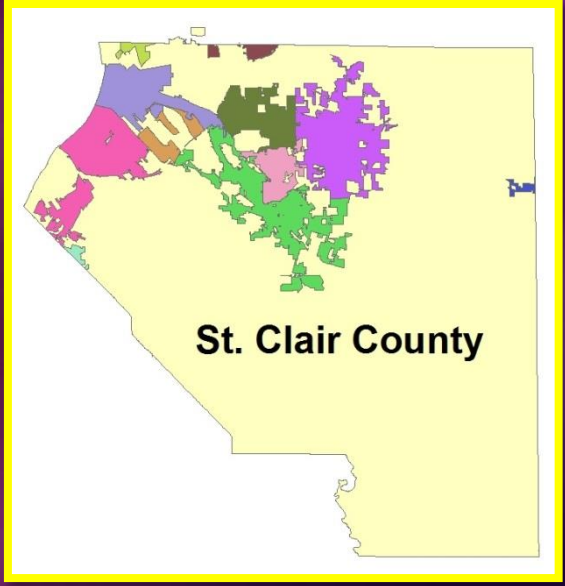
Overview

- Introduction
- Problems for the existing routing assignments
- Benefits of improving call routing assignments
- Methodology to improve call routing assignments
- New call routing assignment process
- Conclusions

Introduction

- St. Clair County, IL
  - Located in the Metro-East region of the St. Louis metropolitan area
  - Population: 270,000; Area: 674 square miles
  - 8 Public Safety Answering Points (PSAPs) in 2016



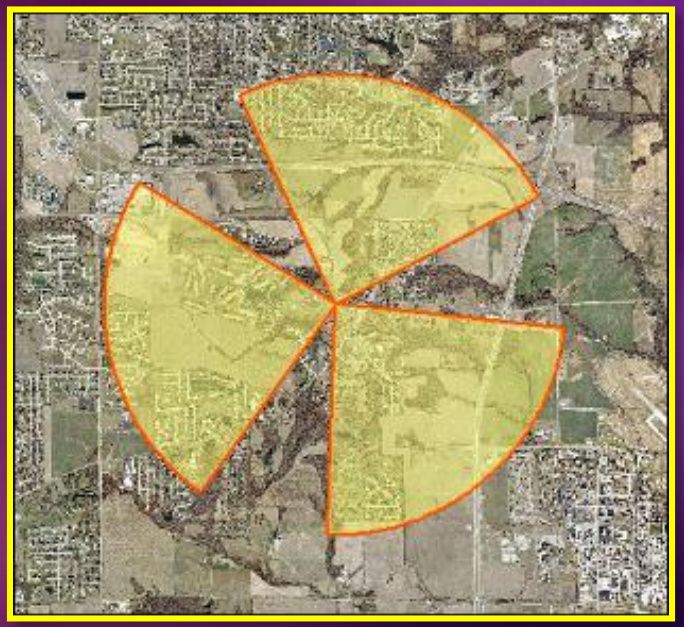
Introduction

- Wireless 911 call routing
  - Determines which PSAP to route a wireless 911 call

- Call routing assignments
  - Each cell sector is assigned to a PSAP to receive the wireless 911 calls based upon cell sector coverage area.
  - Local 911 administration office is responsible for assigning default PSAP to each sector and provides the information to wireless carriers.

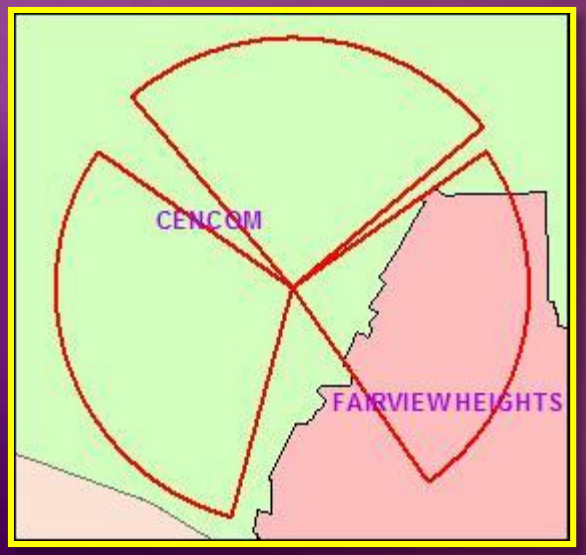
Introduction

- Cell towers/sites
  - Cellular networks use directional antennas to radiate.
  - Cell sites can either be omnidirectional or sectored.



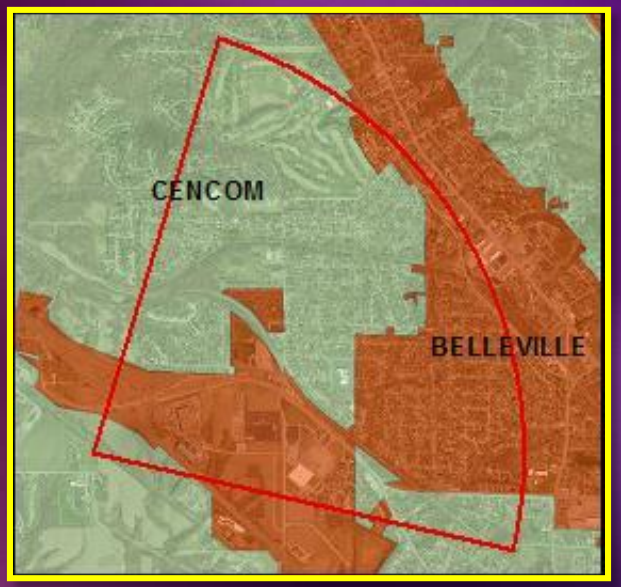
Problems for the existing call routing assignments

- Existing call routing assignments are primarily manual processes
  - Review cell sectors one by one with PSAP boundaries.
  - If a sector covers more than one PSAP, visually estimate population and assign the sector to the PSAP with the highest population in that sector.



Problems for the Existing call routing assignments

- Manual process is inefficient
  - More than 700 cell sectors
- Visual estimation of population is less accurate



Benefits of improving call routing assignments

- If a 911 call is routed to a wrong PSAP, it has to be transferred to the right PSAP, which takes time
  - In an emergency, seconds matter
- When seconds matter, we save seconds
- Creating more accurate methods for PSAP assignments could reduce:
  - call transfers
  - emergency response time
  - workload at 911 call centers
    - calls getting answered twice

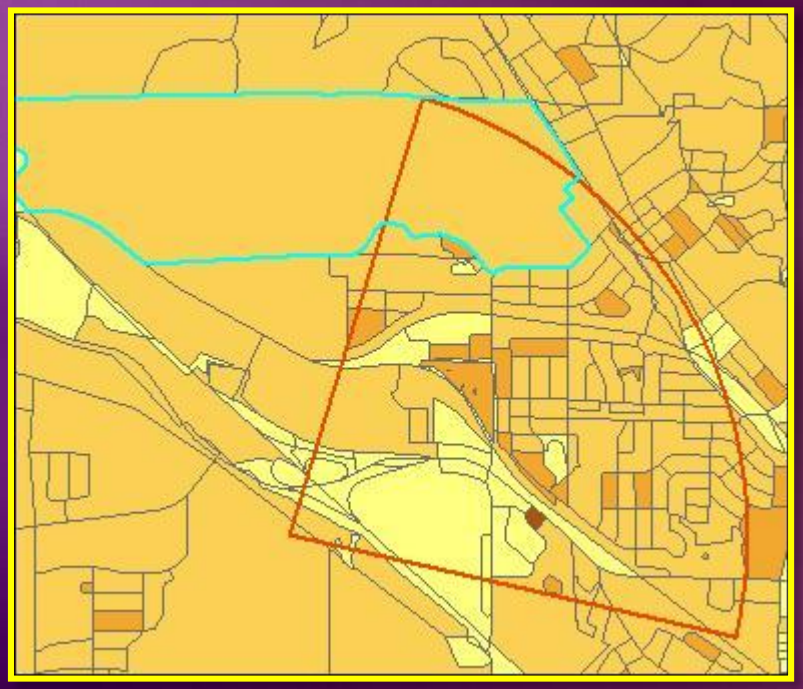
Developing more accurate methods to assign PSAP to each cell sector are necessary and important.

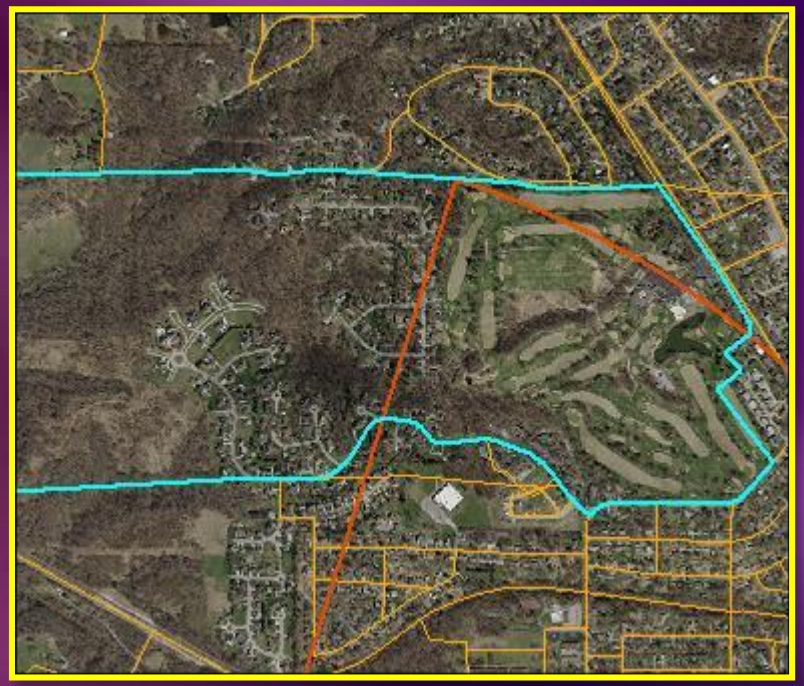
Methodology to improve call routing assignments

- Develop more accurate population estimate methods at a given geographic unit.
- Calculate the number of people present at any cell sector – PSAP polygons.
- Assign PSAP to each cell sector based upon population counts.
- Review and adjust results.

New call routing assignment process

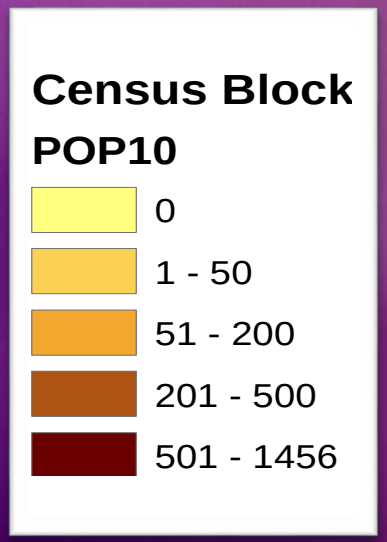
- Population estimates based upon 2010 census block population data
  - Area weighted population method: less accurate

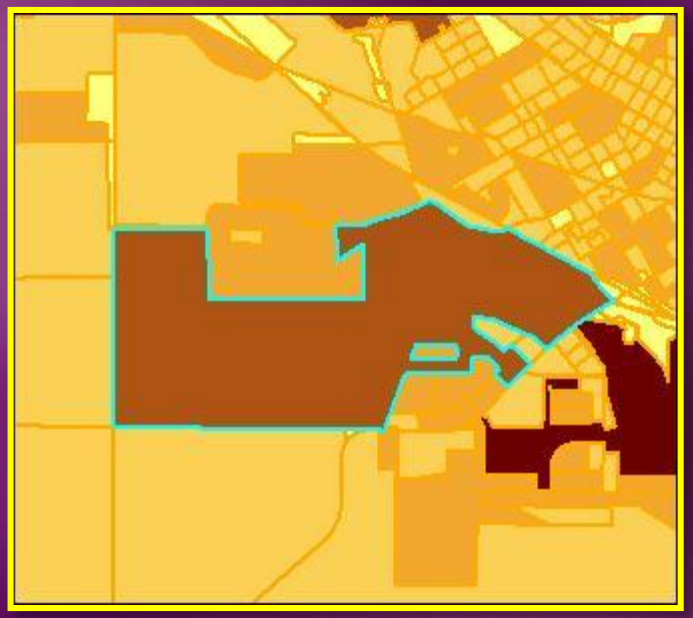


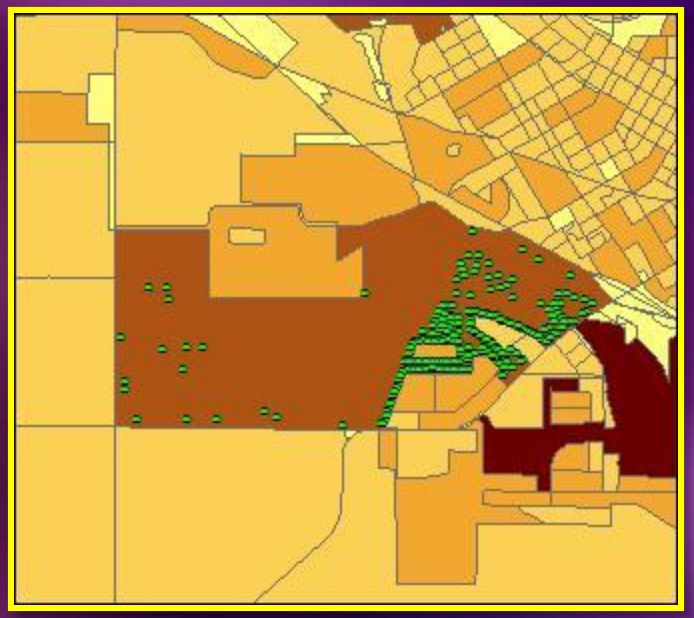


New call routing assignment process

- Population weighted address points method:
  - Calculate the number of address points in each census block polygon.

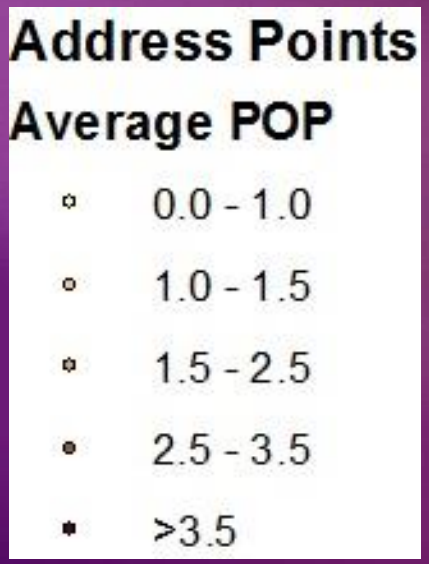


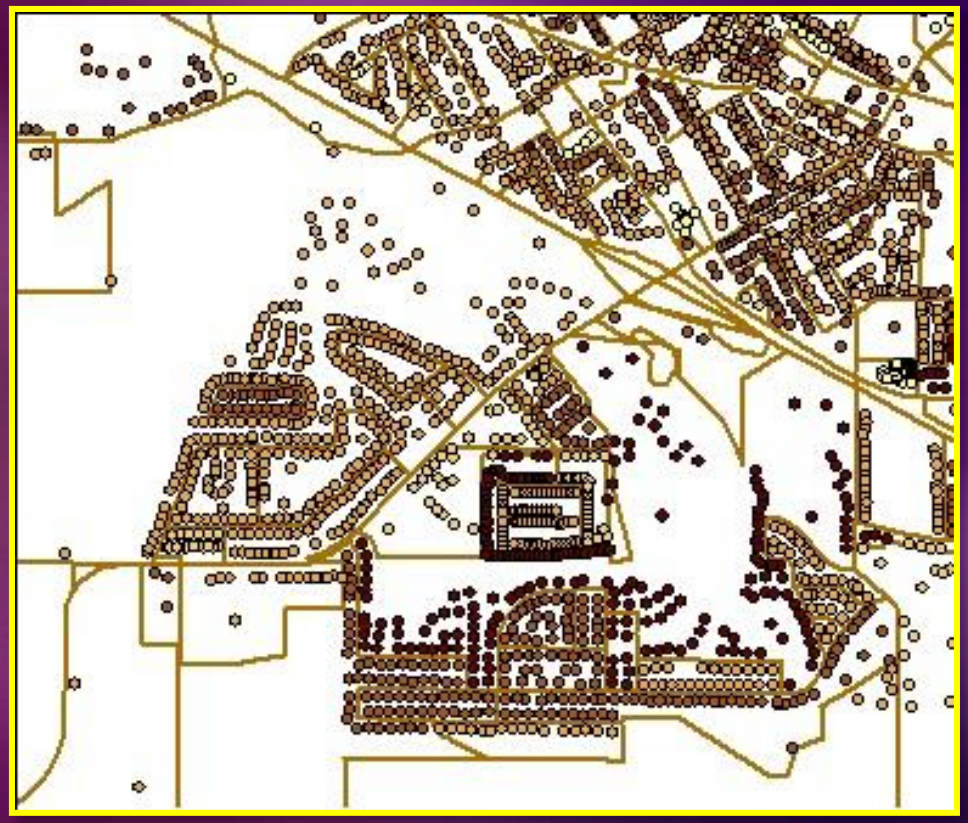




New call routing assignment process

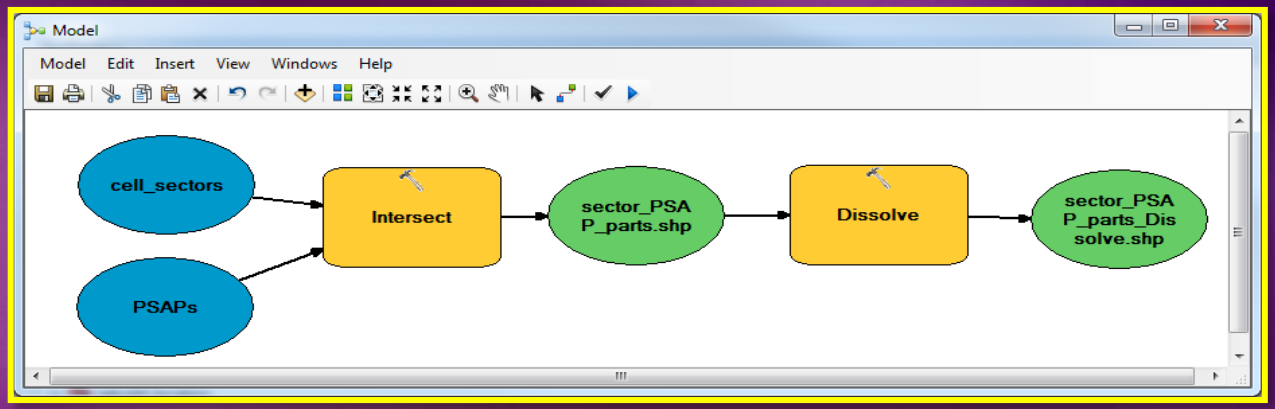
- Calculate average population of each address point in each census block.
- Each address point is weighted by its population.

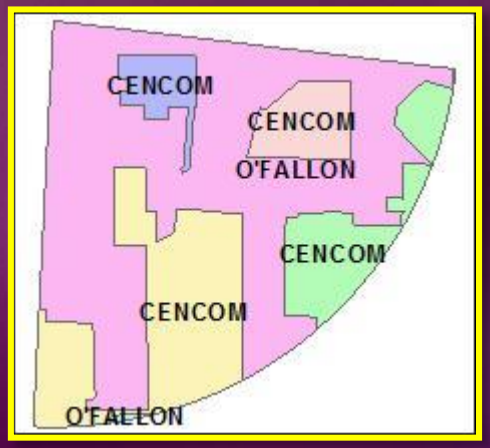


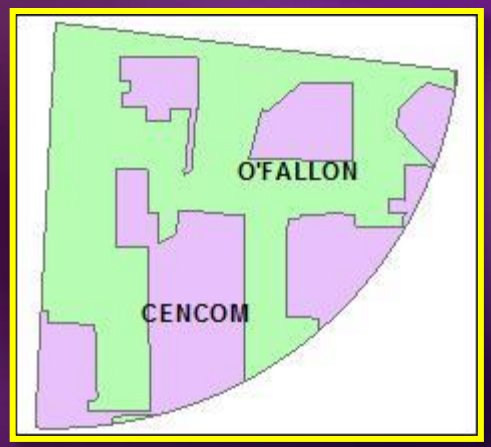


New call routing assignment process

- Call routing assignments
  - ArcGIS desktop Model Builder is used to create models to automate workflows.
    - Create cell sector –PSAP polygons

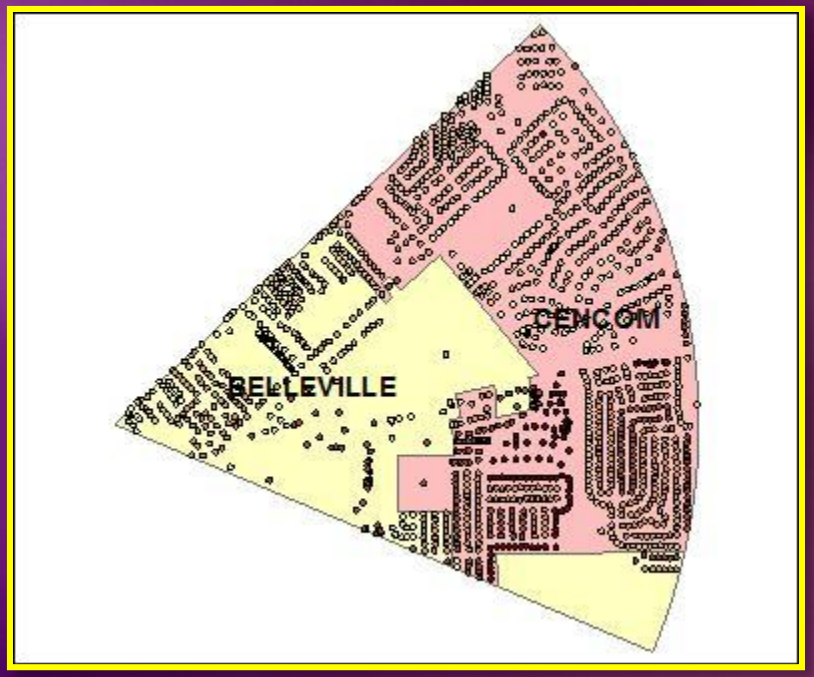


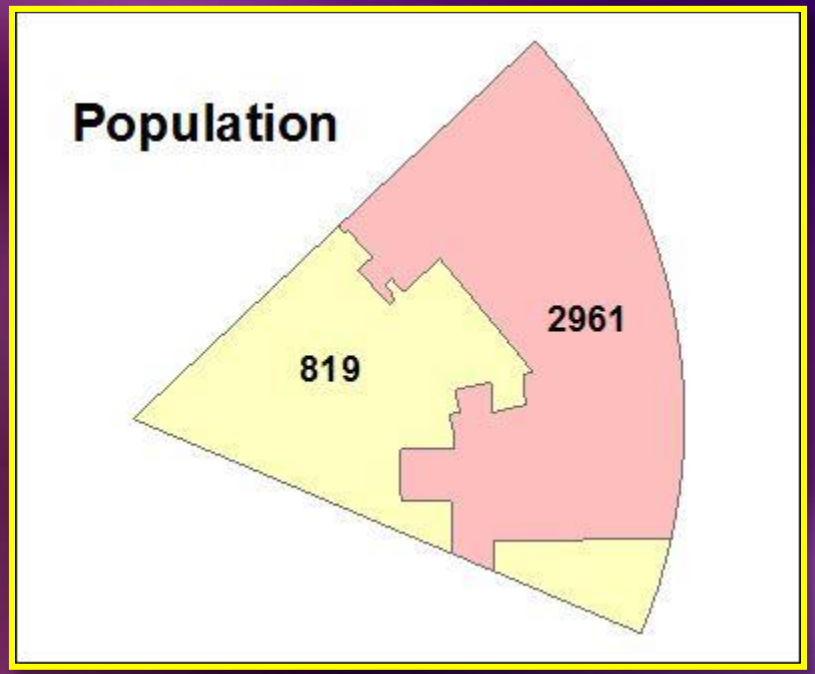




New call routing assignment process

- Calculate population estimates in each sector – PSAP polygon using population weighted address points.





New call routing assignment process

- Python scripts are used to loop through the sector-PSAP polygon population attributes to identify the PSAPs which contain the highest percentage of population in each cell sector.

Python

```
...
... for uniq_sector_item in Cell_uniq_sectors_list:
...       max_points = 0
...       Cell_sector_parts = arcpy.UpdateCursor("sector_join_addressPT")
...       for sector_part_item in Cell_sector_parts:
...            if sector_part_item.CELLID == uniq_sector_item and
 sector_part_item.Sum_PT_POP > max_points:
...                 max_points = sector_part_item.Sum_PT_POP
...       del sector_part_item
...       del Cell_sector_parts
...       Cell_sector_parts = arcpy.UpdateCursor("sector_join_addressPT")
...       for sector_part_item1 in Cell_sector_parts:
...            if sector_part_item1.CELLID == uniq_sector_item and
 sector_part_item1.Sum_PT_POP == max_points:
...                 sector_part_item1.ASSIGN = 1
...                 Cell_sector_parts.updateRow(sector_part_item1)
...       del sector_part_item1
```

New call routing assignment process

- Results

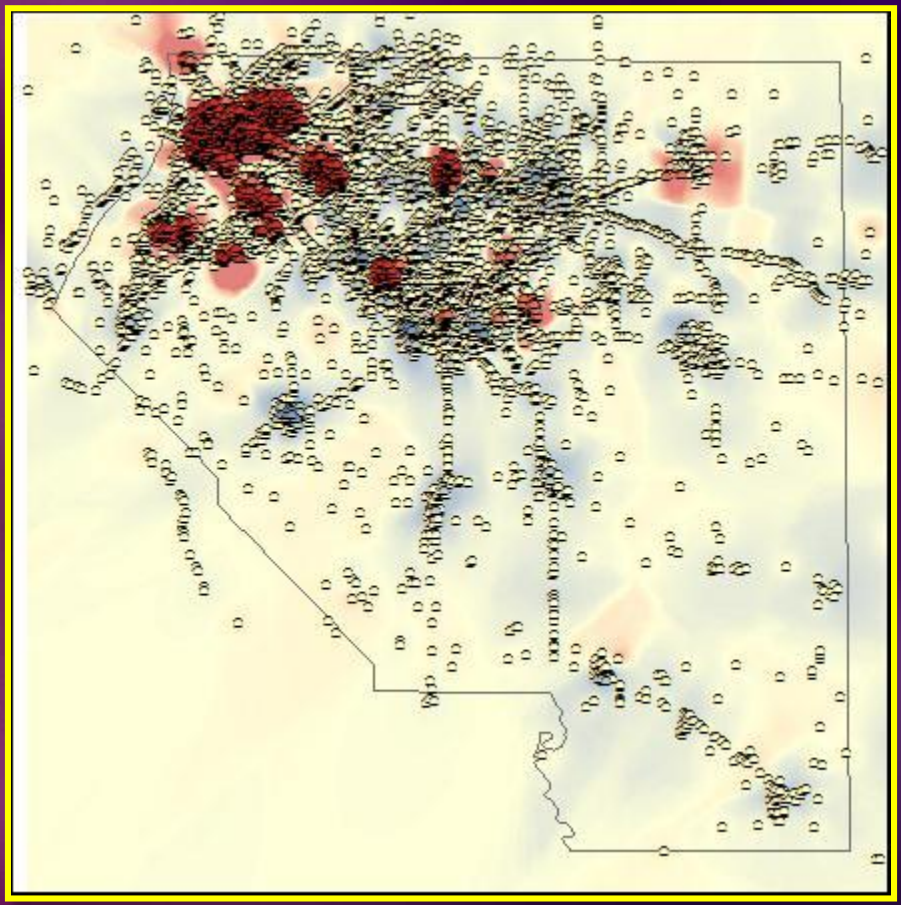
Table

result_sample

Carrier	Cell_ID	UNIQUEID	COMMUNITY	PSAP	WESN
VERIZON	170-1	22 H INDUSTRIAL DR - 3NE	CAHOKIA	EAST ST LOUIS	319
VERIZON	170-2	22 H INDUSTRIAL DR - 3NW	CAHOKIA	CAHOKIA	316
VERIZON	170-3	22 H INDUSTRIAL DR - 3S	CAHOKIA	CAHOKIA	316
VERIZON	243-1	50 H FULLERTON RD - 3N	SWANSEA	SWANSEA	326
VERIZON	243-2	50 H FULLERTON RD - 3SE	SWANSEA	BELLEVILLE	315
VERIZON	243-3	50 H FULLERTON RD - 3SW	SWANSEA	BELLEVILLE	315
VERIZON	233-1	100 H LUDWIG DR - 3N	FAIRVIEW HEIGHTS	CENCOM	75
VERIZON	233-2	100 H LUDWIG DR - 3SE	FAIRVIEW HEIGHTS	FAIRVIEW HEIGHTS	321
VERIZON	233-3	100 H LUDWIG DR - 3SW	FAIRVIEW HEIGHTS	FAIRVIEW HEIGHTS	321
VERIZON	207-1	104 H ROSS LN - 3NW	BELLEVILLE	BELLEVILLE	315
VERIZON	207-2	104 H ROSS LN - 3E	BELLEVILLE	BELLEVILLE	315
VERIZON	207-3	104 H ROSS LN - 3S	BELLEVILLE	CENCOM	75
VERIZON	346-1	110 H N 13TH ST - 3N	E ST LOUIS	EAST ST LOUIS	319
VERIZON	346-2	110 H N 13TH ST - 3SE	E ST LOUIS	EAST ST LOUIS	319
VERIZON	346-3	110 H N 13TH ST - 3SW	E ST LOUIS	EAST ST LOUIS	319
VERIZON	402-1	139 H LINCOLN PLACE CT - 3NE	BELLEVILLE	BELLEVILLE	315
VERIZON	402-2	139 H LINCOLN PLACE CT - 3S	BELLEVILLE	BELLEVILLE	315
VERIZON	402-3	139 H LINCOLN PLACE CT - 3NW	BELLEVILLE	CENCOM	75
VERIZON	234-1	141 H IOWA AV - 3N	BELLEVILLE	BELLEVILLE	315
VERIZON	234-2	141 H IOWA AV - 3SE	BELLEVILLE	BELLEVILLE	315
VERIZON	234-3	141 H IOWA AV - 3SW	BELLEVILLE	BELLEVILLE	315

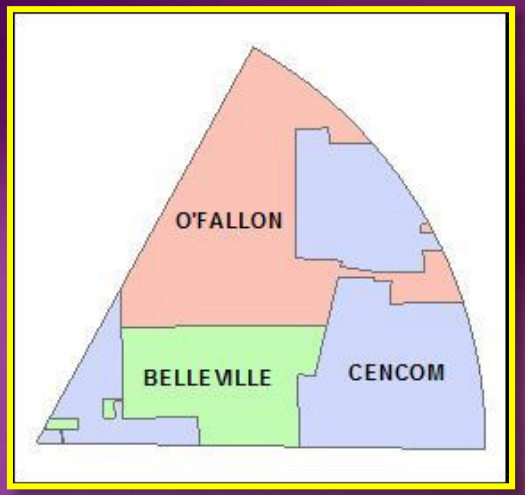
New call routing assignment process

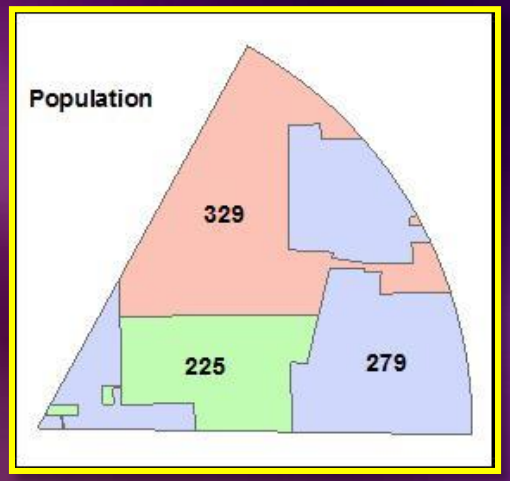
- Result Adjustments
  - Mapped 20,000 wireless 911 calls
  - Hot spot analysis

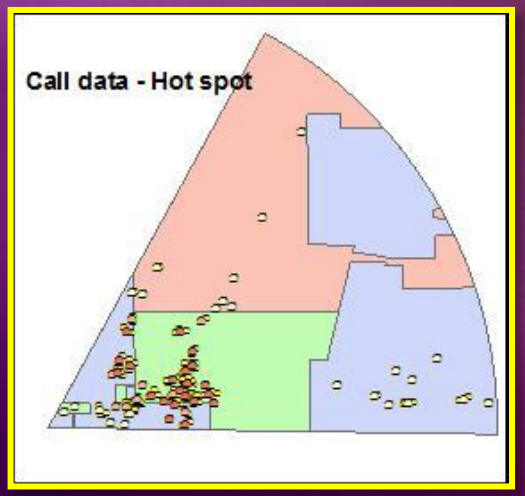


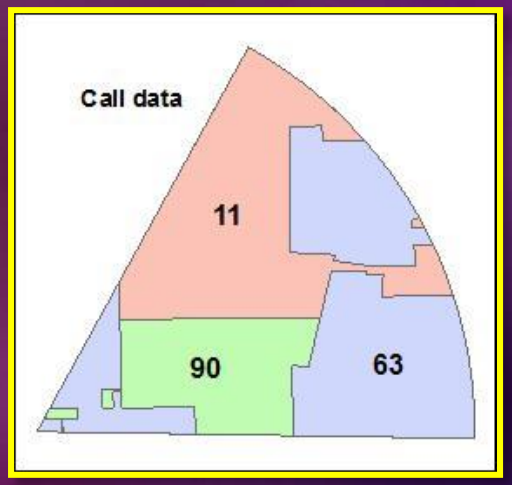
New call routing assignment process

- Adjustment example









Conclusions

- More accurate wireless 911 call routing assignments reduce
  - Volume of call transfers
  - Response time
- Two new processes improve call routing assignments:
  - Primary assignment uses population weighted address points method
  - Secondary routing validation uses wireless 911 call hot spot analysis
- Process is repeatable using computer programs
  - Reduces workload when PSAP boundaries change, new towers are built, or sector coverage polygons change