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
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
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
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.

<table>
<thead>
<tr>
<th>Address Points</th>
<th>Average POP</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0.0 - 1.0</td>
</tr>
<tr>
<td></td>
<td>1.0 - 1.5</td>
</tr>
<tr>
<td></td>
<td>1.5 - 2.5</td>
</tr>
<tr>
<td></td>
<td>2.5 - 3.5</td>
</tr>
<tr>
<td></td>
<td>&gt;3.5</td>
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</tbody>
</table>
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.
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 address PT")
    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 address PT")
    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
    del Cell sector parts.updateRow(sector part item1)
    del sector part item1
```
New call routing assignment process

Results

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Cell ID</th>
<th>UNIQUEID</th>
<th>COMMUNITY</th>
<th>PSAP</th>
<th>VESN</th>
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New call routing assignment process

Result Adjustments

- Mapped 20,000 wireless 911 calls
- Hot spot analysis
New call routing assignment process

- Adjustment example
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