Next-Generation 911 (NG911) in Utah: Current Status and GIS Update

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gis.utah.gov

Overview

- Next-Generation 911 (NG911) Background
- Utah NG911 Project
  - Current Status
  - Next Steps
- UGRC Data Process
- Challenges & Technical Solutions

UGRC

New name, same great taste!

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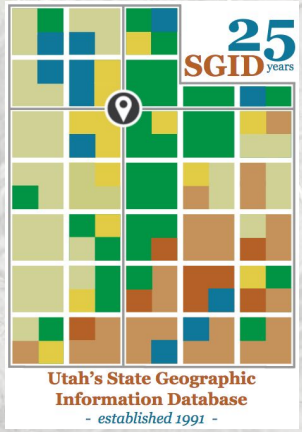
TURN GPS
real-time precision
turngps.utah.gov



- State of Utah's GIS office
- Established in 1989 via Utah Code 63F-1-506
- Department of Government Operations (DGO)
  - Division of Technology Services (DTS)
- State Geographic Information Database (SGID)
- Discover - Imagery & Basemap services
- TURN GPS Reference Network
- GIS & Web development
- Funded through combination of state funds and project work

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"Encourage and facilitate the effective use of geospatial information and technology for Utah"

Current/Old 911 System (E911)

- Analog system reliant on data tables to route 911 calls to appropriate Public Safety Answering Point (PSAP)
  - Master Street Address Guide (MSAG) - streets
    - Maintained by PSAPs
  - Automatic Location Identification (ALI) - addresses
    - Maintained by telecom
- Landline/VOIP calls linked to static addresses with pre-determined PSAP
- Wireless calls routed based on cell tower sector, then lat/lon information (typical accuracy within ~30-500 m

MSAG Table

	A	B	C	D	E	F	G	H	I	J	K	L
1	DIR	STREET	LOW	HIGH	COMM	ST	O_E	ESN	DATE MODIFIED	EXCHANGE	ENTITY	MSAG
37	E	500 SOUTH	1	600	NEPHI	UT	B	430	4/29/1996		29	JUABUT
38	E	570 SOUTH	400	600	NEPHI	UT	B	430	4/29/1996		29	JUABUT
39	E	600 NORTH	1	900	NEPHI	UT	B	430	4/29/1996		29	JUABUT
40	E	600 SOUTH	1	300	NEPHI	UT	B	430	4/29/1996		29	JUABUT
41	E	635 SOUTH	498	498	NEPHI	UT	B	430	4/29/1996		29	JUABUT
42	E	700 NORTH	1	950	NEPHI	UT	B	430	4/29/1996		29	JUABUT

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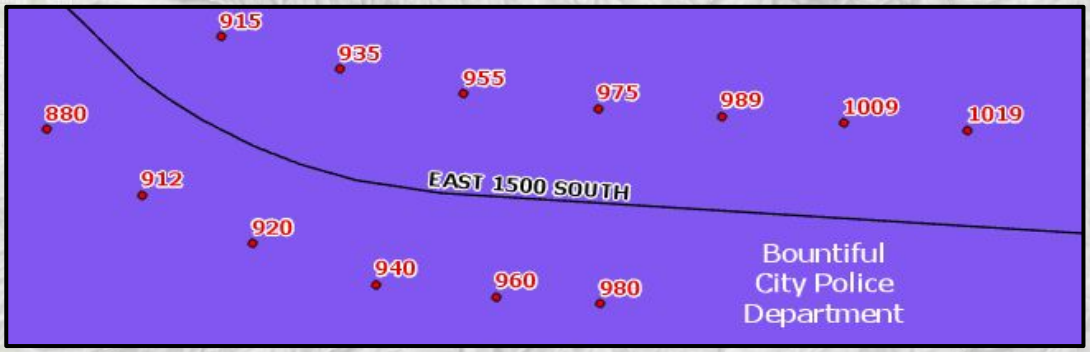
Next Generation 911 (NG911)

- Calls will be routed to PSAPs based GIS data depending on caller location
  - PSAP boundaries
  - Road centerlines
  - Address points
- Dynamic routing possible by changing PSAP boundaries during emergencies, downtime, or high call volume
- Internet Protocol (IP)-based communications system with upgraded call handling equipment
  - Enables additional data streams (text, photos, video, sensor, IoT, etc.)

GIS-driven!



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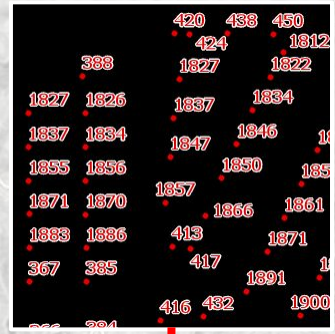
Data Consolidation Efforts

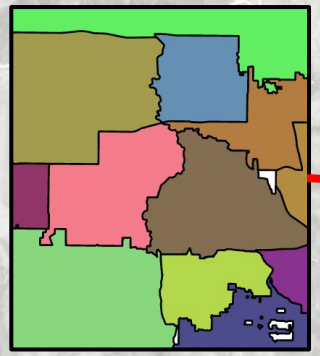
- Aggregate data from counties into statewide database (SGID)
  - Frequency based on population
  - Roads, Address Points, Parcels
- Road centerline editing database pushed to production database monthly
  - Schema parallels NG911, but isn't exact
- Other statewide data compiled and updated as needed

Roads

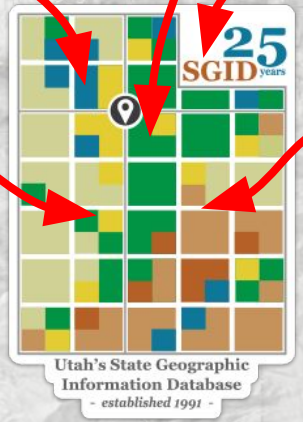


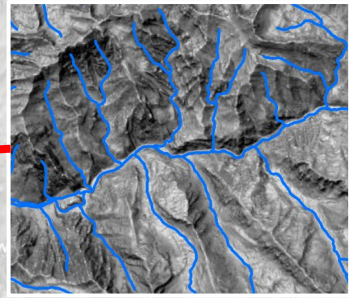
Address Points

Parcels



Boundaries





More...

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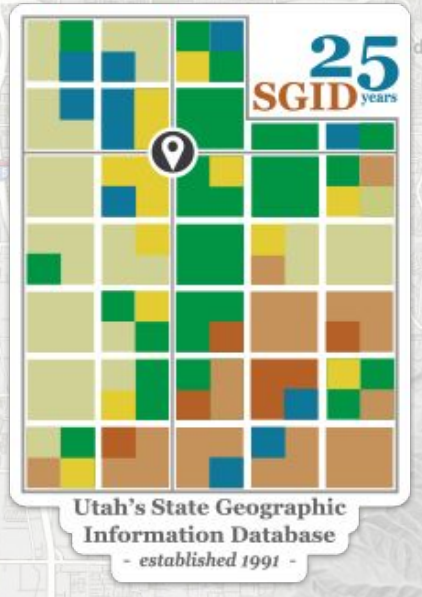
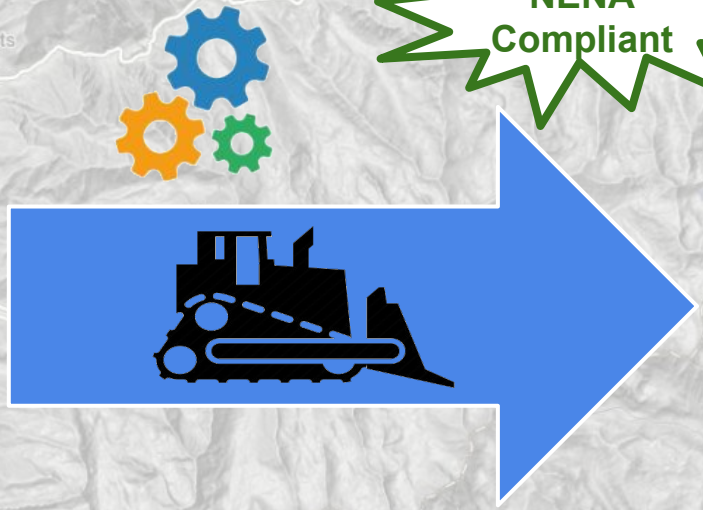
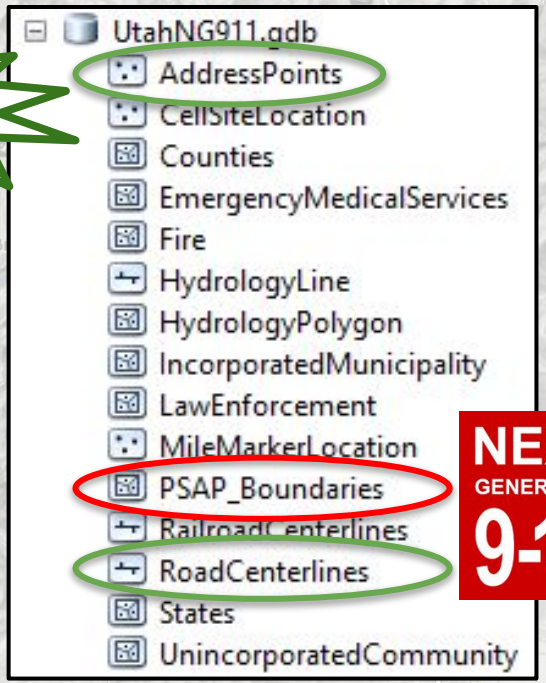
Data Consolidation Efforts

- Monthly process to Extract, Transform, Load (ETL) data from SGID into NG911 database





NENA Compliant



NEXT GENERATION 9-1-1

- Field Name
- Data Type
- Character Length
- Etc.

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Utah NG911 Project

Stakeholders and Roles

- Utah Communications Authority (UCA) - 911 Division
  - Orchestrate NG911 transition
  - Oversee the entire process - contracts, equipment, training, data, etc.
- Motorola - primary contractor for NG911 and core services
  - Build NG911 infrastructure
  - Provide NG911 software, routers, comm equipment, etc.
- UGRC
  - Provide GIS Data (geodatabases, web services, web maps, etc.)
  - Work with UCA and Motorola to facilitate NG911 transition
  - Quality-check GIS data, & work w/ stewards to clean/update data
- PSAPs
  - Work with other stakeholders during PSAP's NG911 transition
  - Install equipment/software, train employees, provide data feedback

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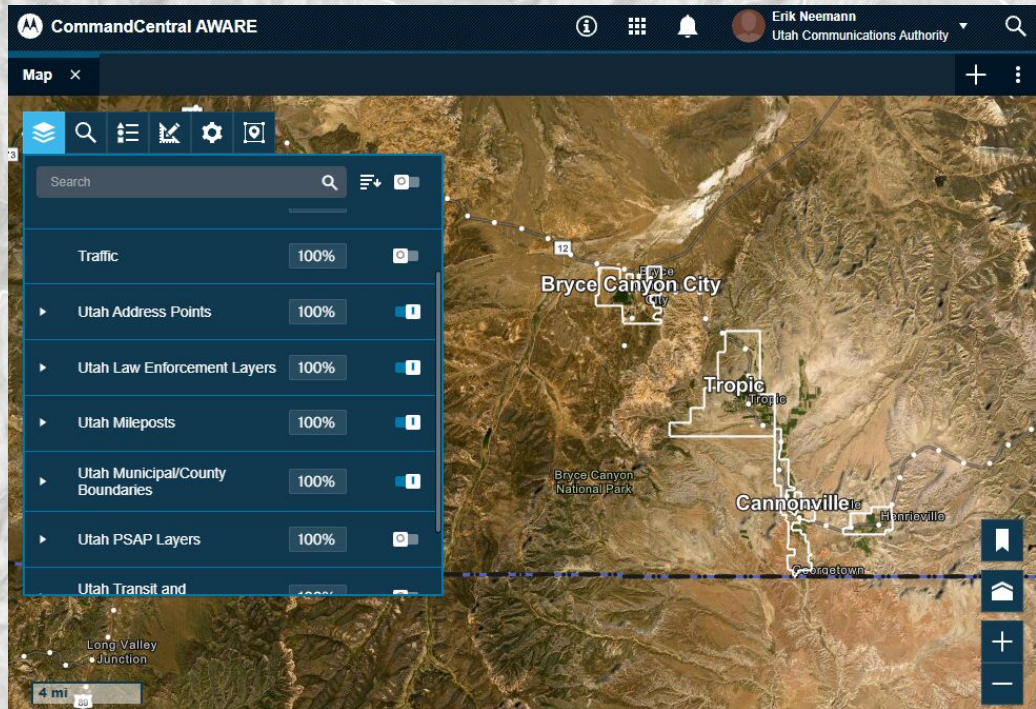
Utah NG911 Project: Current Status

Infrastructure and software

- ESInet
  - IP-based communications backbone
- PSAP call-handling equipment
  - Hardware upgrades
  - Mapping Interface changes
    - Motorola CommandCentral Aware
- NG911 Core Services
  - GIS-enabled routing and call services
    - Vesta Router
  - NG911 GIS Database from UGRC



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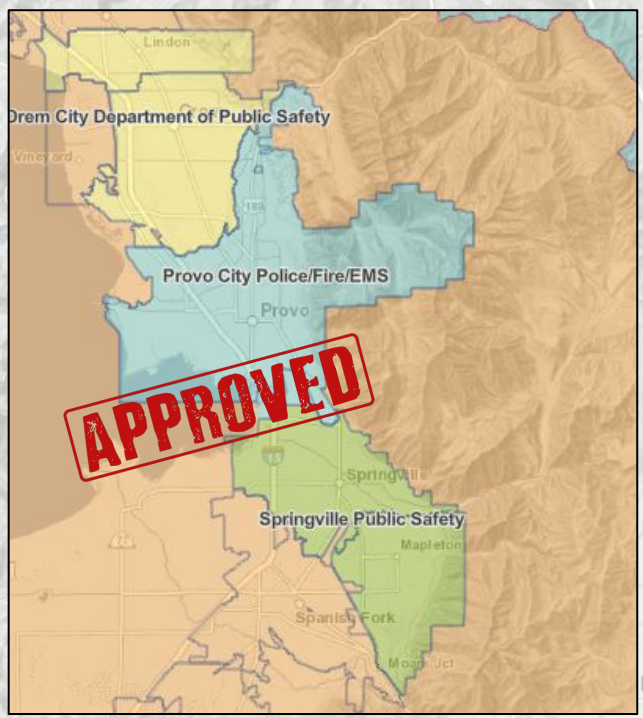
Utah NG911 Project: Current Status

Data Creation

- Formalize official PSAP boundaries ✓
- Compile civic location data
  - Address Points (APs) ✓
  - Road Centerlines (RCLs) ✓
- Build emergency service boundaries
  - Law ✓
  - Emergency Medical Services (EMS) ✓
  - Fire (in-work)



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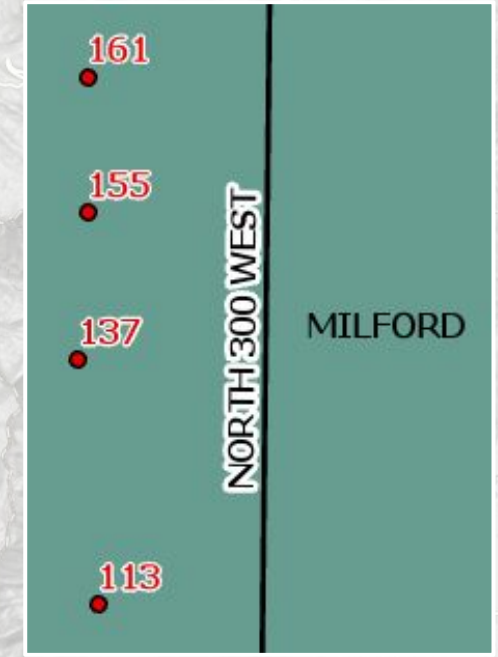
Utah NG911 Project: Current Status

Data Validation & Cleanup

- Quality-control each GIS dataset (ongoing)
- Compare ALI/MSAG with GIS data (upcoming)
  - Verify address point exists for each ALI entry
  - MSAG streets represented in GIS format
  - Vendor tools used for these comparisons

ESN	HOUSE	SUFF	DIR	STREET	COMMUNITY	TELCO
525	161		N	300 WEST	MILFORD	SEU
525	155		N	300 WEST	MILFORD	SEU
525	137		N	300 WEST	MILFORD	SEU
525	113		N	300 WEST	MILFORD	SEU

ALI Table



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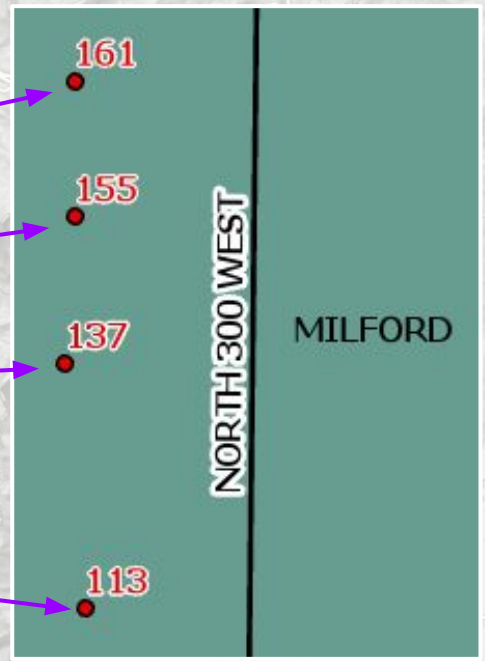

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Utah NG911 Data Processes

- **Road Centerlines and Address Points**
  - Aggregated SGID data ETL'd into the NG911 schema (C# script)
    - Mapping fields from SGID schema in to NG911 fields
    - Converting data to a different representation
      - Zip codes into MSAG community names
      - County FIPS codes into county names
    - Project into WGS84
- **PSAP Boundaries**
  - Python script builds boundaries based on SGID data
- **Emergency Service Boundaries**
  - Law Enforcement
    - Python script builds boundaries based on SGID data
  - Emergency Medical Services (EMS)
    - Boundaries built manually from Bureau of EMS descriptions
  - Fire Response
    - Boundaries built manually from state tax entities and piecing together dispatch center datasets (CAD)

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Utah NG911 Data: Law Boundaries

- **Built with python script**
  - **Fast, repeatable, and decreases maintenance**
  - **Minimizes gaps/overlaps with ArcPy Erase/Append workflow**
- **Basic logic**
  - **Generate sheriff's office jurisdictions from county boundaries**
  - **Generate police department jurisdictions from municipal boundaries**
    - **Only build boundaries for municipalities that have their own police department (read from text file)**
    - **Merge boundaries of municipalities that share a police department**
  - **Insert police department boundaries into sheriff's office boundaries to create a combined boundaries layer**
  - **Insert unique jurisdiction boundaries into combined boundaries layer**
    - **Tribal police, Hill AFB, etc.**

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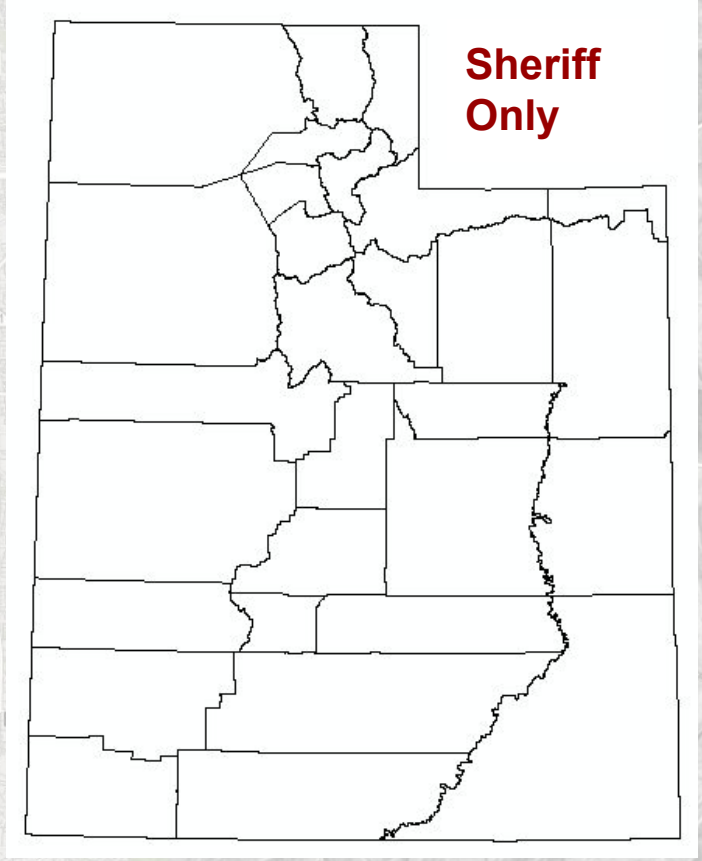
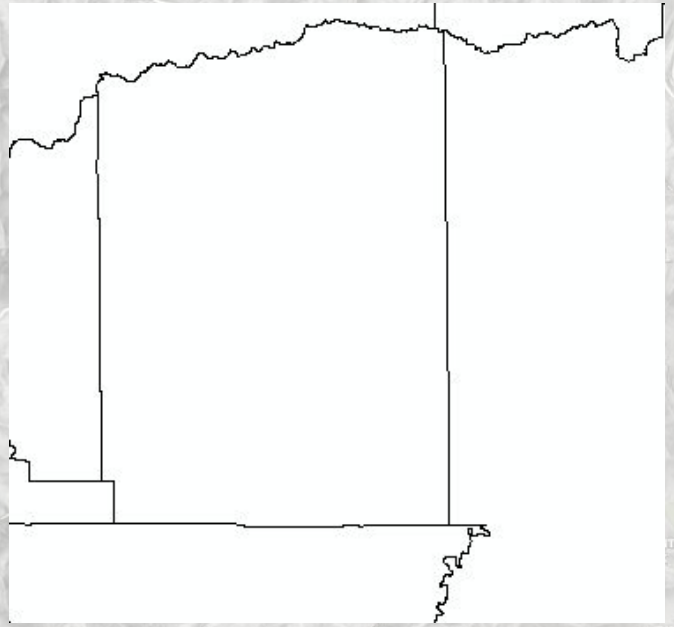
Utah NG911 Data: Law Boundaries





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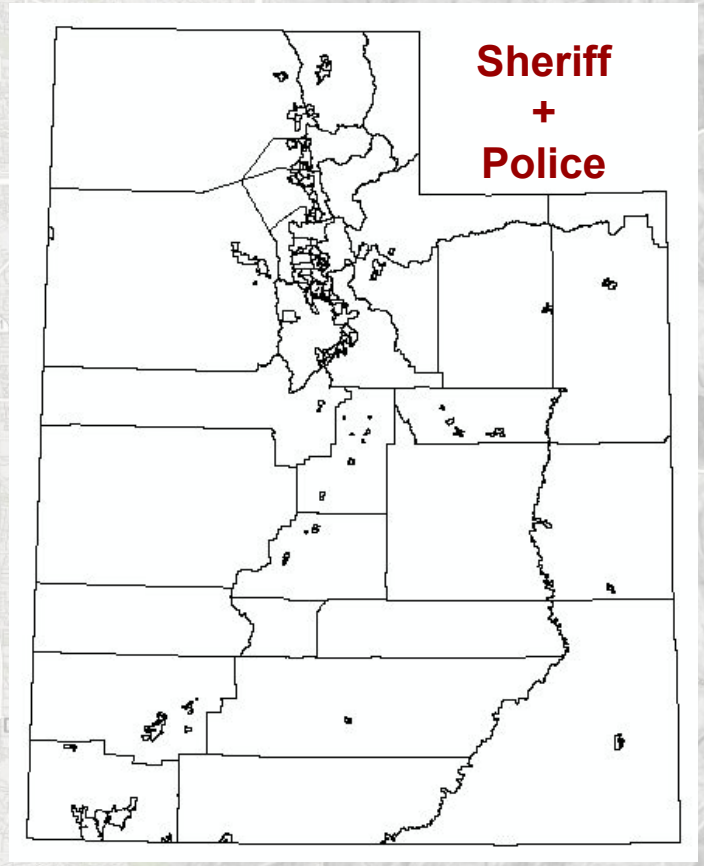

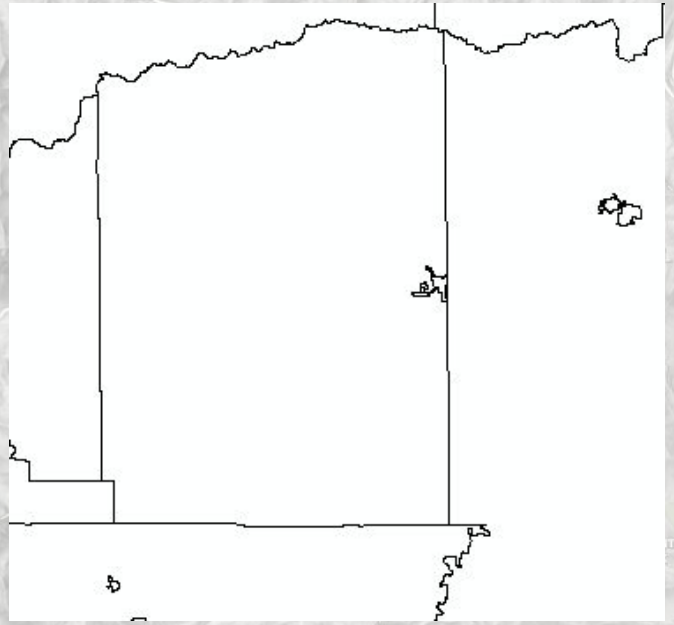

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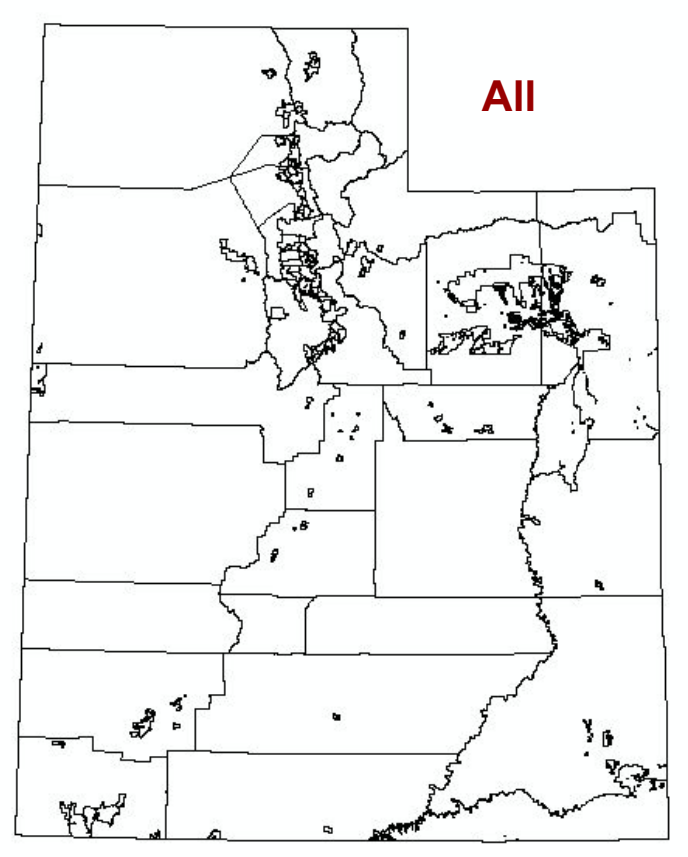

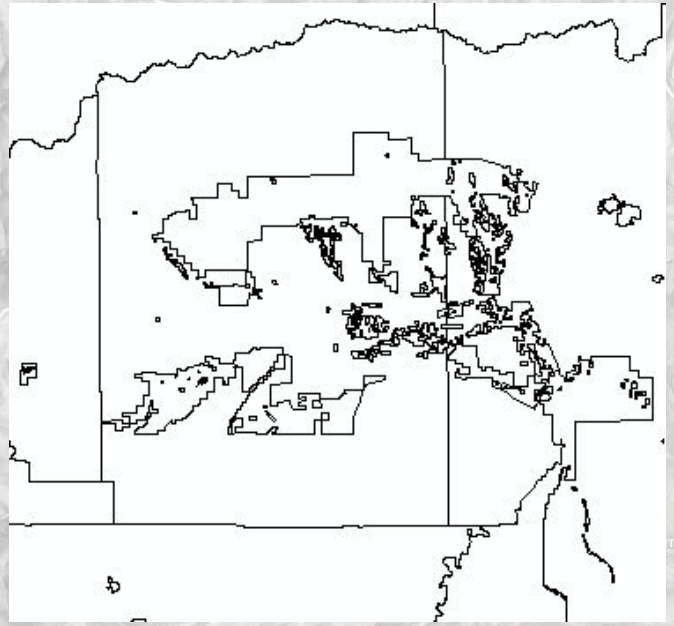

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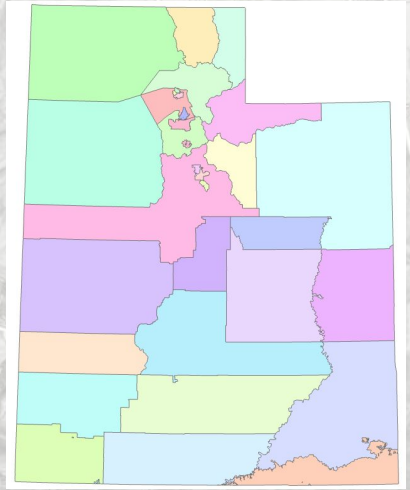
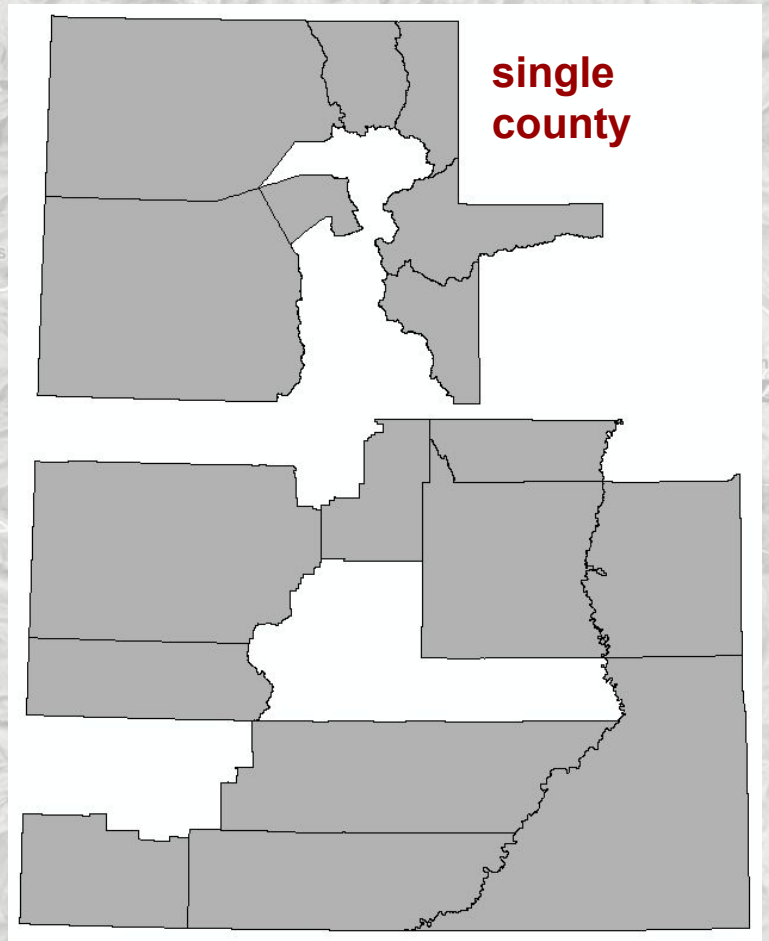
Utah NG911 Data: PSAP Boundaries

- **Basic Python script logic**
  - Similar to law boundaries, but a little more complicated
    - Each PSAP may be:
      - single county
      - multi-county
      - a combination of cities and counties (mixed)
      - single city
      - multi-city
      - unique
    - PSAP "type" and participating entities are read from csv, placed in dictionaries
    - Munis and counties appended into the same layer
      - Dissolve performed on PSAP field to create intermediate layer
    - ArcPy Erase/Append workflow combines intermediate layers together



	A	B	C	D
1	PSAP	Type	Counties	Munis
2	Beaver County Sheriff's Office	single county	BEAVER	
3	Bountiful City Police Department	multi muni		BOUNTIFUL, WEST BOUNTIFUL, NORTH SALT LAKE, WOODS CROSS, CENTERVILLE
4	Box Elder Communications Center/State DPS	single county	BOX ELDER	
5	Cedar Communications Center/State DPS	mixed	IRON	NEW HARMONY
6	Central Utah 911	multi county	JUAB, UTAH	
7	Clearfield City Police Department	single muni		CLEARFIELD

Utah NG911 Data: PSAP Boundaries



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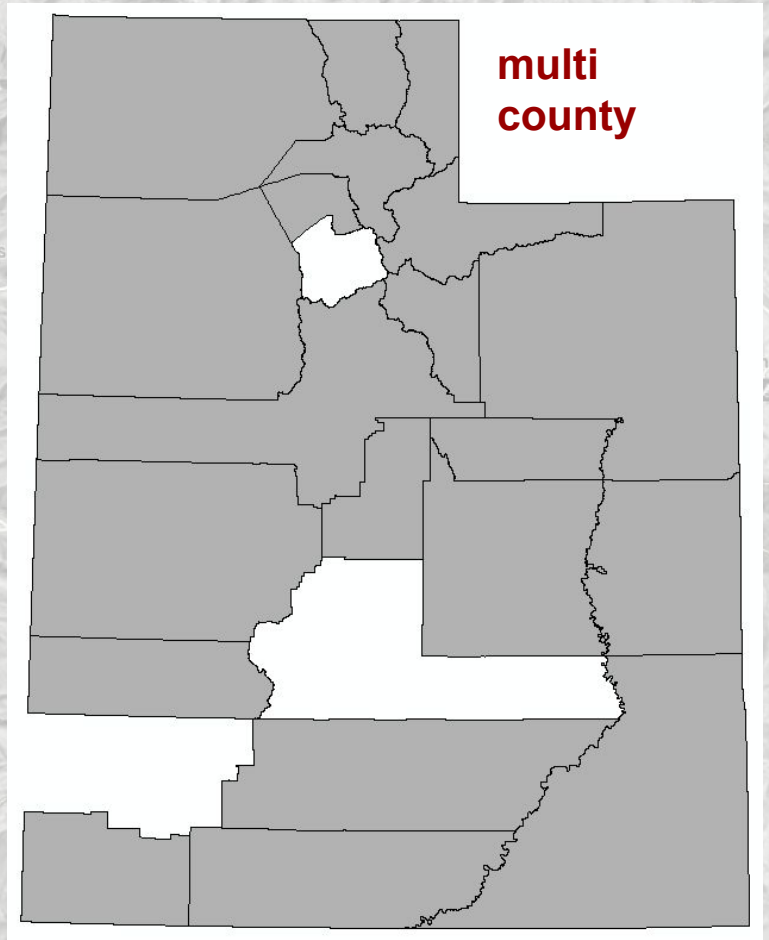

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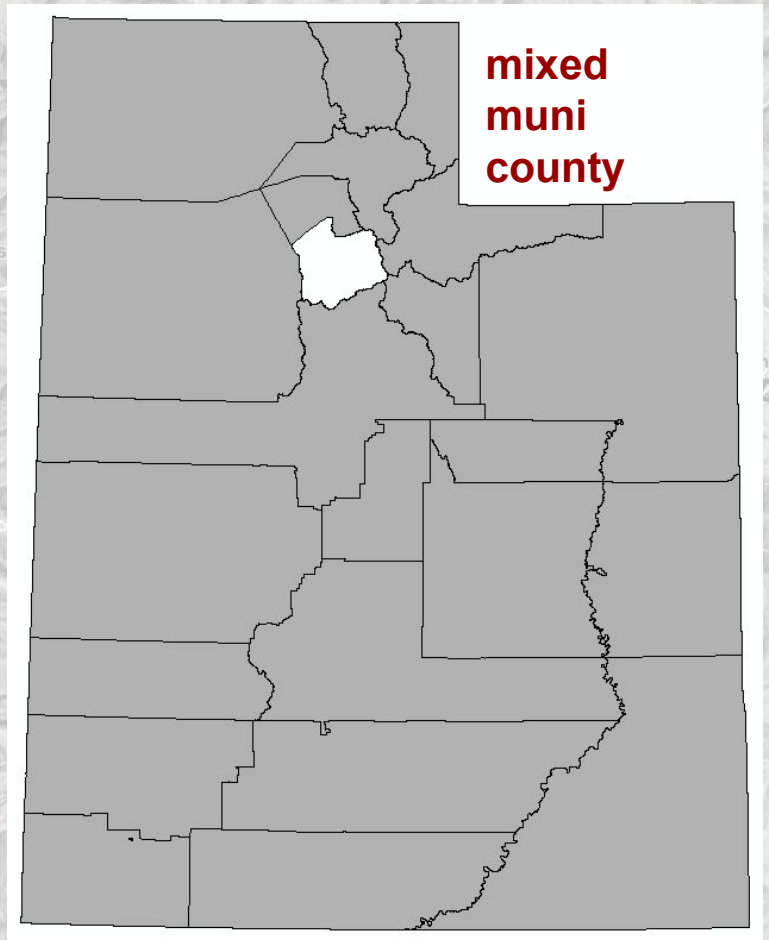

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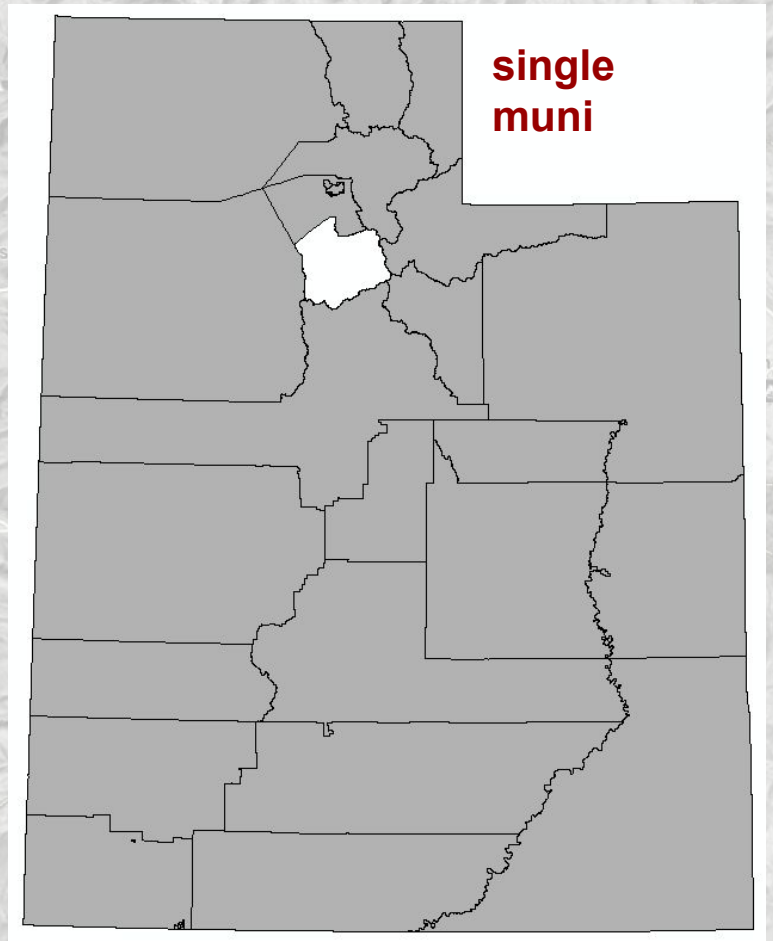

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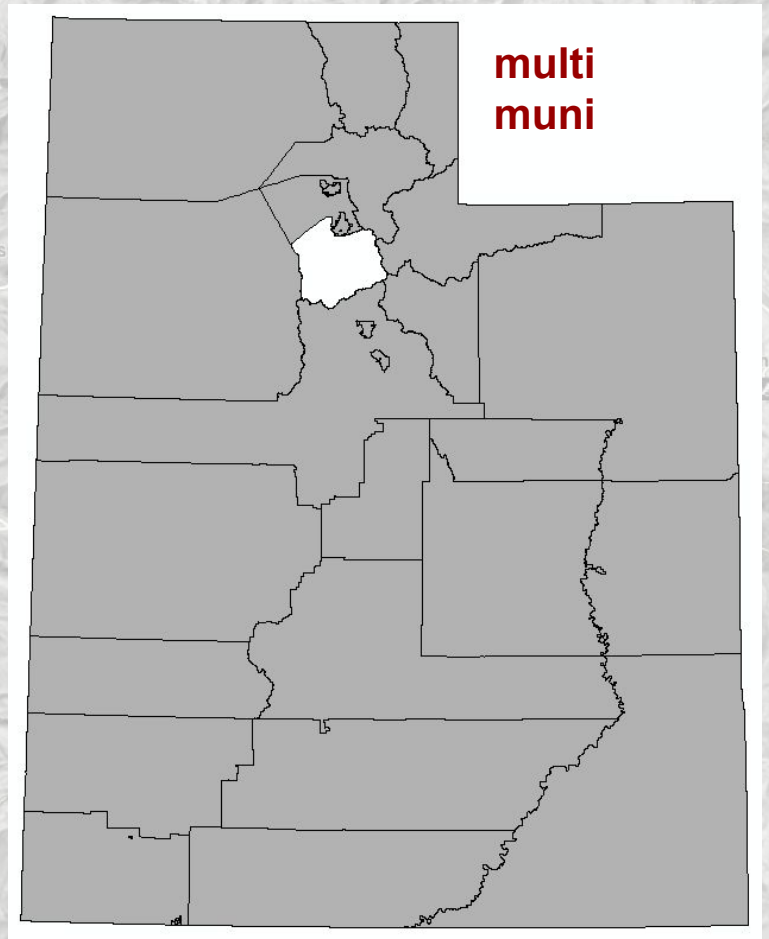

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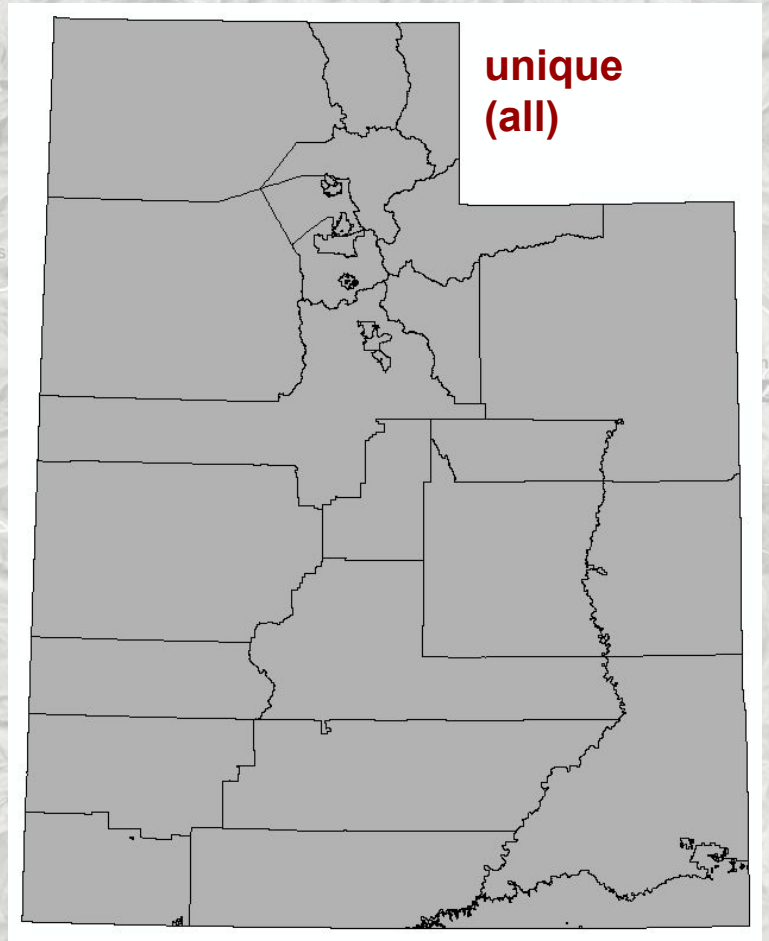
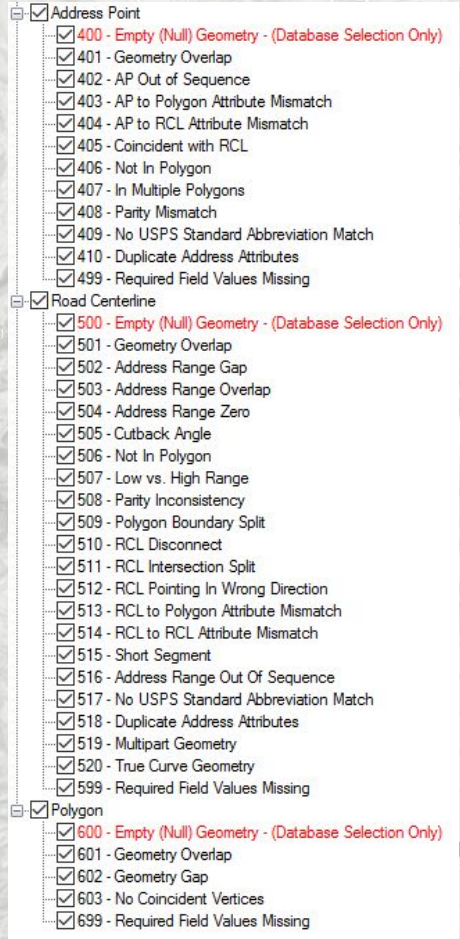


UGRC Data, Challenges, & Solutions

- Statewide data is big data - this creates a problem for scaling up quality checks
  - 1.3+ million address points
  - 400,000+ road centerlines
- Robust quality checks available in vendor tools, but they seem built for smaller, single-PSAP projects
  - Quality checks run interactively in an ArcMap GUI
    - Dozens of check can be run at once (APs, RCLs, polygon topology)
  - Tools abort after reaching error limit (1000)
  - Would take months of non-stop processing to QC statewide data



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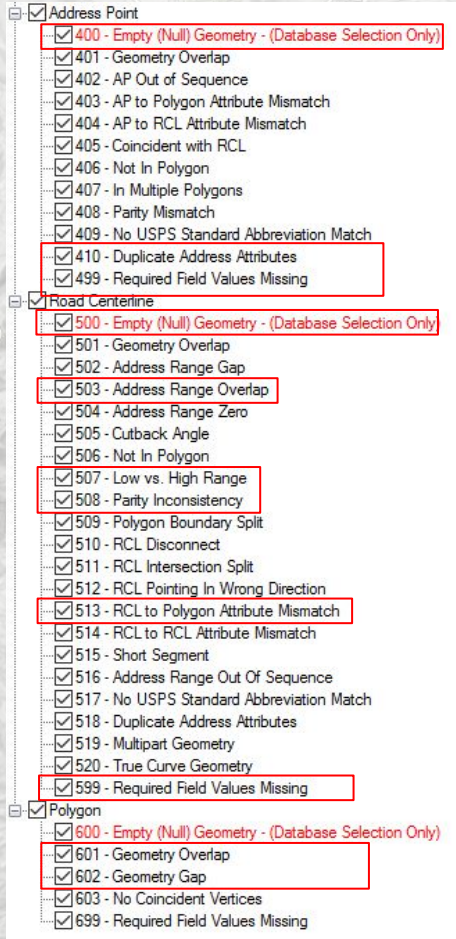
UGRC Data, Challenges, & Solutions

- UGRC has needed to get creative to attack such a large data volume
  - Python!
- Focus on issues that could most directly affect call-routing
  - Polygon geometry gaps and overlaps
  - Road centerline range overlaps
  - Address point duplicates
- Scripts flag identified errors
  - Some issues will be corrected by UGRC
  - Other issues will be provided as feedback to data stewards at the local level
- Scripts complete in a few minutes! ⚡



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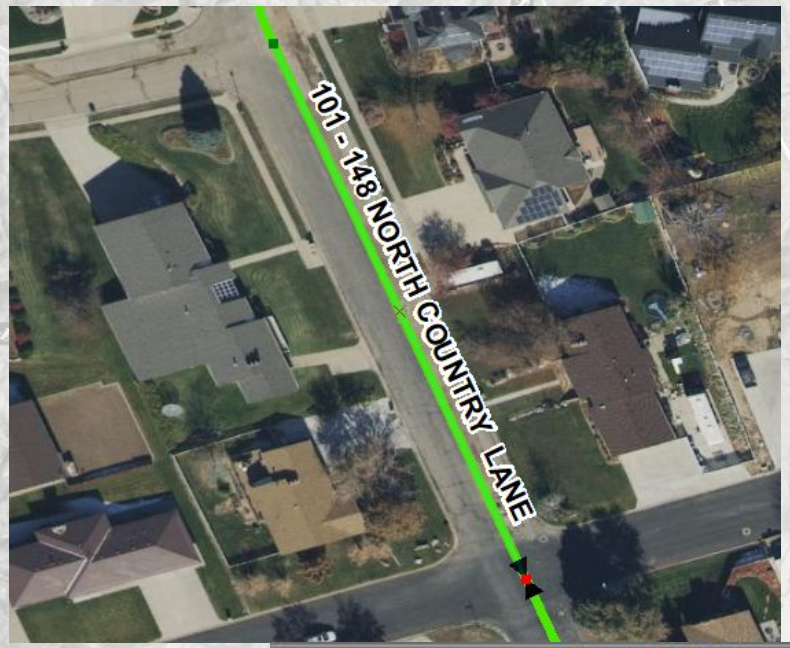
Utah NG911 Data QC: Road Centerlines

- Python scripts used to flag and (in some cases) fix issues
  - Address range low vs. high problem
  - Address range parity inconsistency
  - Mandatory fields missing data
  - RCL pointing wrong direction



Error_Detail
python flipped NORTH 154.7

In Python, calculate angle and perform direction check:

```
if predir == 'N' and (angle > 100 and angle < 260):
    is_reversed = True
elif predir == 'S' and (angle > 280 or angle < 80):
    is_reversed = True
elif predir == 'E' and (angle > 190 and angle < 350):
    is_reversed = True
elif predir == 'W' and (angle > 10 and angle < 170):
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If segment is reversed, reorder the segment's vertices

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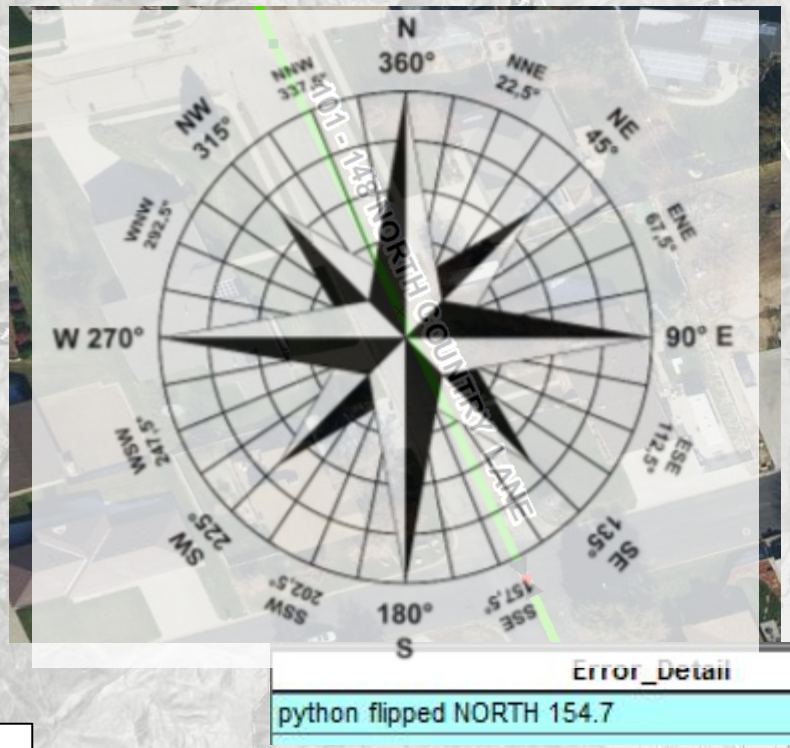

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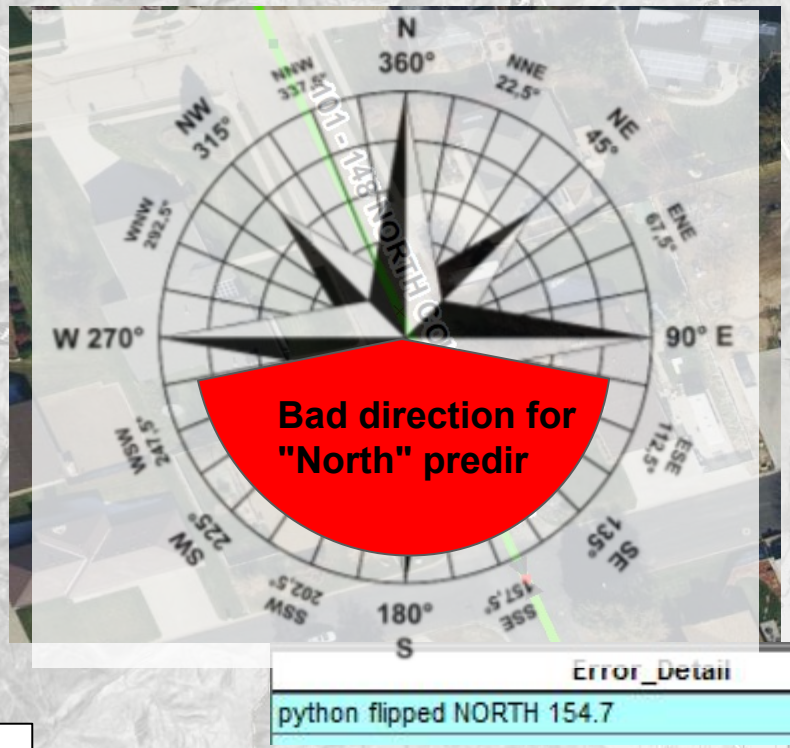

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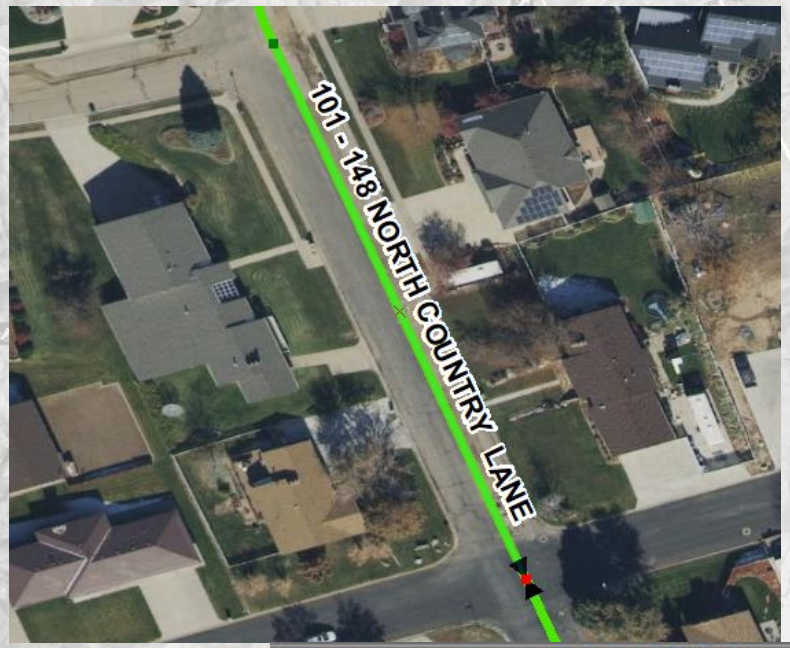

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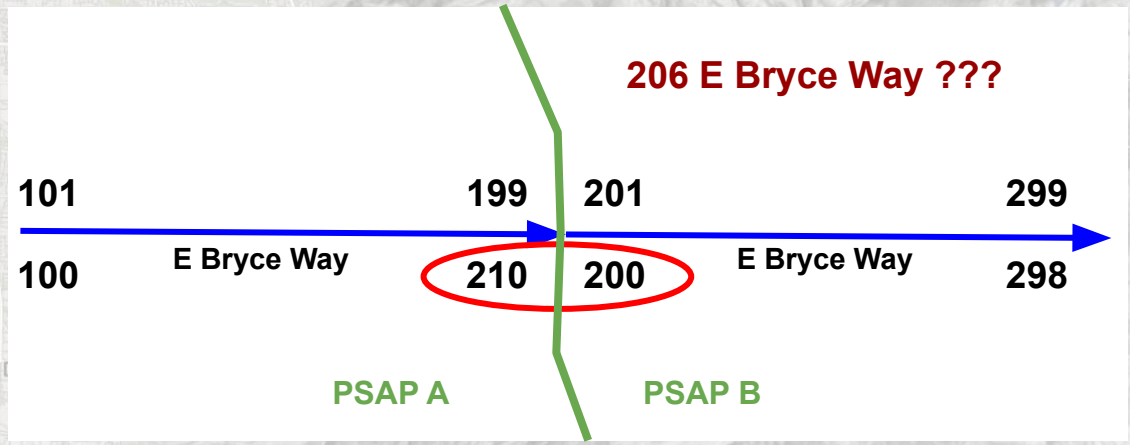
Utah NG911 Data QC: Road Centerlines

- Address range overlap problem
  - Adjacent segments (or distant ones) overlap
    - Ambiguous address locations
    - Where does the call get routed?
  - Working on possible Python solution or brute force approach with vendor tools



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Utah NG911 Data QC: Address Points

- Python scripts used to flag issues
  - Attribute duplicates
  - Mandatory fields that are missing data
    - Includes: `[None, 'none', 'null', '', ' ', '  ']`

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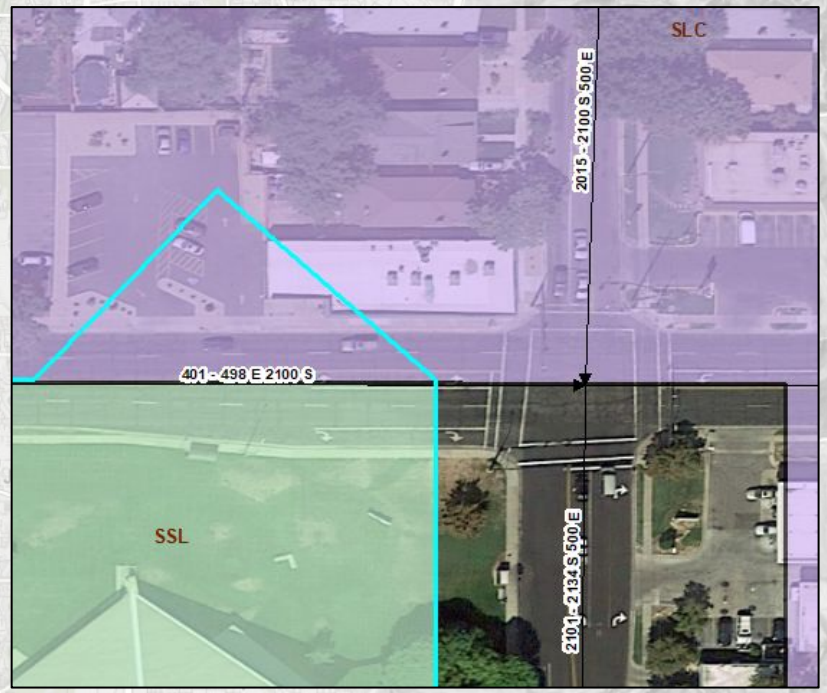
Utah NG911 Data QC: Boundaries



- Gaps and overlaps are primary concerns
  - Can lead to call-routing problems
- Vendor tools and Geodatabase topology used to flag gaps and overlaps
  - Building boundaries from Python scripts help avoid gaps/overlaps
  - Manually built polygon layers more prone to error
    - Snapping problems
    - Aggregating from multiple datasets/projections

Utah NG911 Data QC: ALI and MSAG

- Motorola has been validating MSAG data
  - Worked with PSAPs to make corrections
- Vendor tools will compare ALI/MSAG to GIS data
  - Waiting for full/final data to be loaded in system
- Previous UGRC ALI geocoding efforts
  - ALI snapshot provided by CenturyLink
    - Hideous text file that was cleaned up with a Python script
  - Valid addresses were geocoded against UGRC web API (158,321)
    - score > 90: very good geocodes
      - 134,784 (95.3%)
    - score 70-89: okay geocodes
      - 635 (0.4%)
    - scored = 0: not located
      - 6,864 (4.3%)

Questions?

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