

Hands-on with GIS software

Brian Webster
Cameron Crum



Introduction

Cameron Crum

- RF Engineer/Software Developer
- Started in wireless in 1995 with Sprint Cellular
- Designed over 1000 cell sites in 12 cities and 3 different countries
- Developed GIS based Propagation Software Athena for the cellular industry
- Started a Wisp in 2003 which I sold to JAB (RISE) in 2010
- Developed Wispmon billing and OSS software starting in 2004 and sold to Sonar in 2017
- Currently COO/CTO and Founder of Regulatory Solutions, and CTO for Visp.net

Regulatory Solutions, Inc – Booth 420

Visp.net – Booth 421



Introduction

Brian Webster

- RF Engineer / GIS Specialist
- Data directory for Broadband IL
- Own and operate wirelessmapping.com
- Notable RF Projects include Earthlink Muni Wifi,
- Consulted to Ericsson on Google Fiber project in CA
- Currently President and Founder of Regulatory Solutions

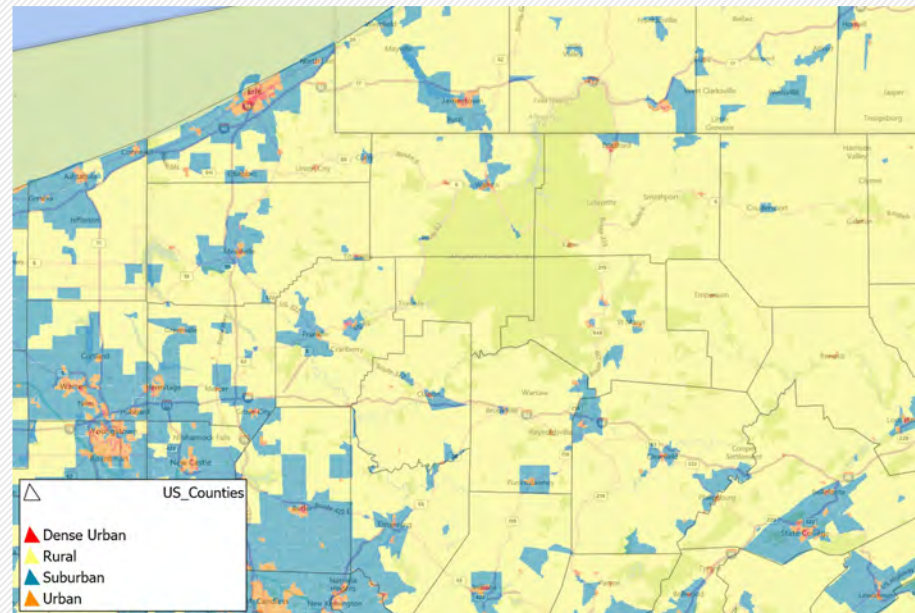
Regulatory Solutions, Inc – Booth 420



Geographic Information Systems

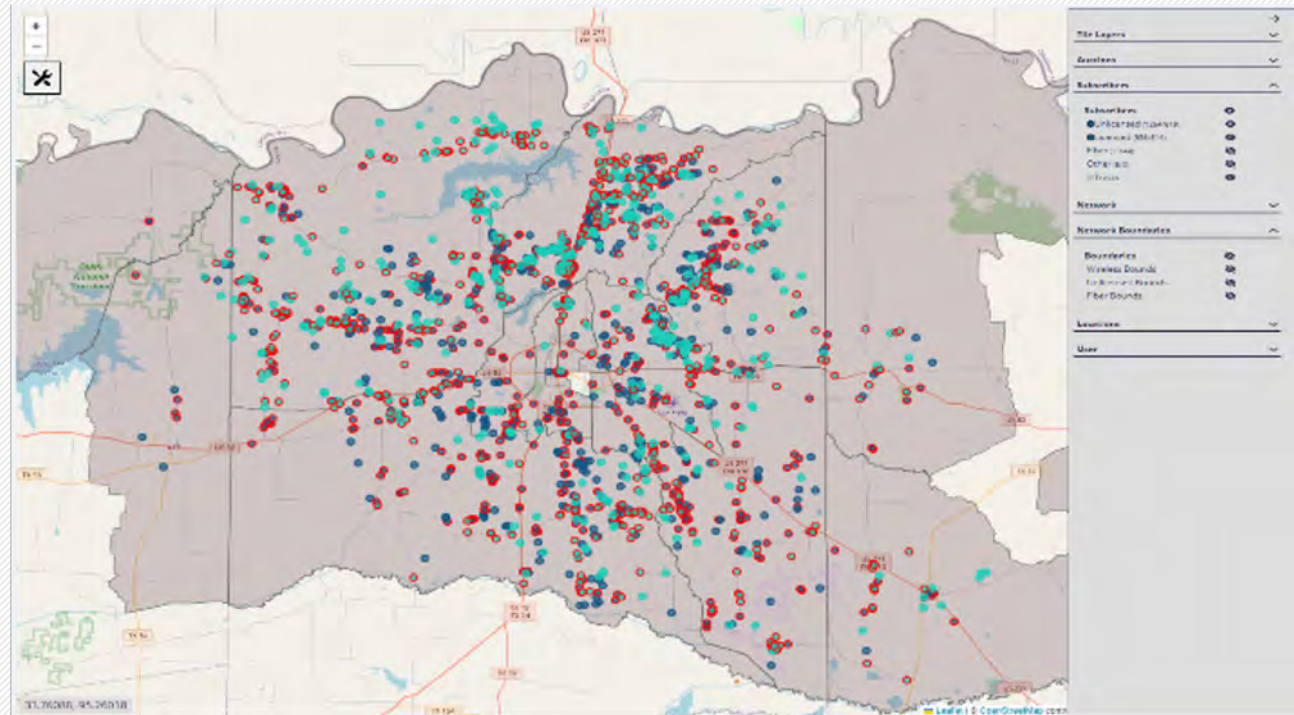
Definitions:

- A spatial system that allows you to display, analyze, manage, and map all types of data
- A computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface
- Very powerful tools
- As simple as a map from a spreadsheet to complex relational databases.
- More than just maps.
- Data is thought about as layers.



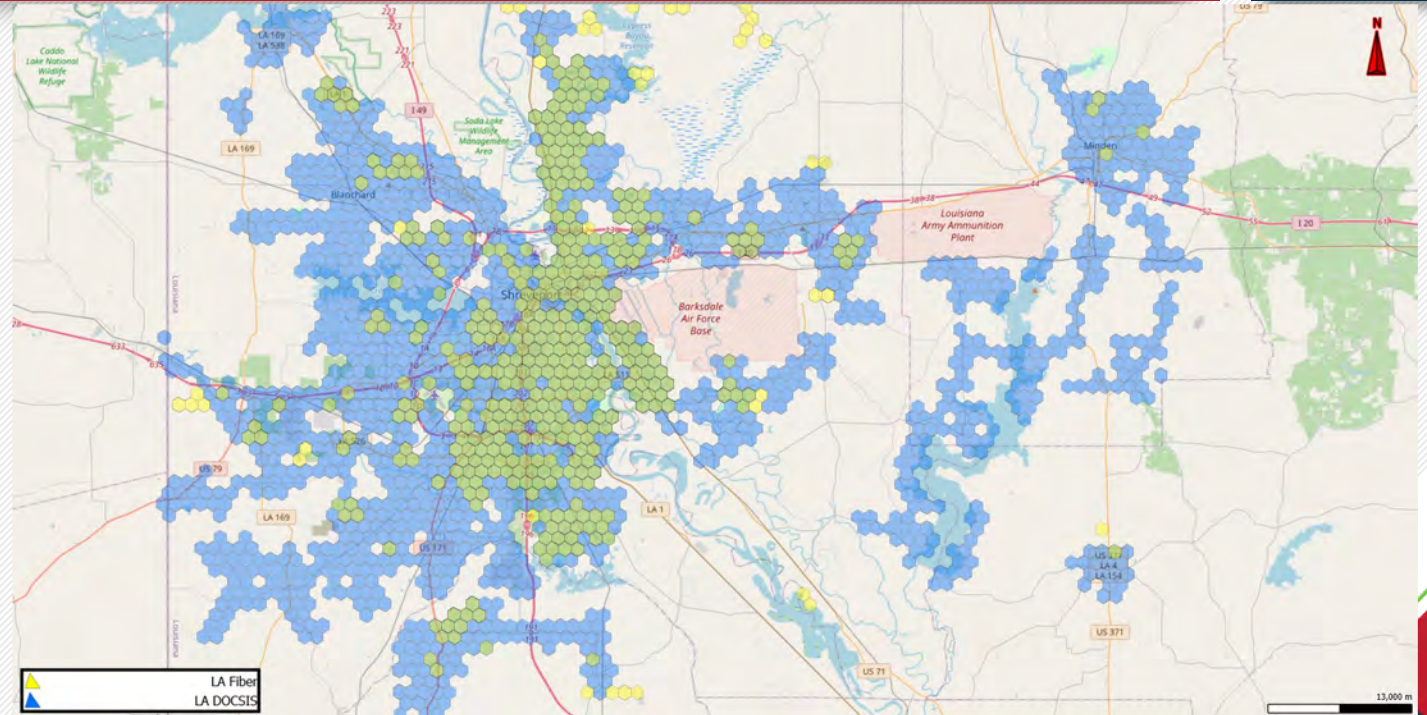
Think of pivot charts, but location based

- Just like charts and graphs, GIS data is displayed using location information.
- This can be as simple as a customer address list, or as complex as market studies of FCC BDC data.
- Many sources have location data such as a zip code, coordinates, tracts, blocks, counties, etc.
- You can map this data!



Competition research matters

- GIS systems can help you bring together multiple sources of information.
- This can be a combination of your own proprietary and public data.
- This map shows BDC data by the hex grid



Map layers have associated data tables

- In GIS all map layers have tables of data associated with them.
- You can search, query and sort these tables like any other data and “see” the results in both the table and map.
- You do very complex with queries across multiple layers.

trctid	id	GISJOIN	STATEFP	COUNTYFP	TRACTCE	GEID	NAME	NAMESAD	ANL0001	ANL0002	PercentPoverty	Geom (1)	%Poverty
736.12	736.12	G720140959000	72	141	959000	72141959000	9599	Census Tract 9599	870	493	0.5666666269...	<geom_area>	57
736.13	736.13	G720140957000	72	141	957000	72141957000	9570	Census Tract 9570	1145	462	0.4034346399...	<geom_area>	40
736.14	736.14	G720140957000	72	141	957000	72141957000	9571	Census Tract 9571	998	471	0.4718187775...	<geom_area>	42
736.15	736.15	G720140957000	72	141	957000	72141957000	9572	Census Tract 9572	1022	463	0.4424484016...	<geom_area>	44
736.16	736.16	G720140957000	72	141	957000	72141957000	9573	Census Tract 9573	821	354	0.4311814902...	<geom_area>	43
736.17	736.17	G720140957000	72	141	957000	72141957000	9574	Census Tract 9574	406	223	0.5506699723...	<geom_area>	55
736.18	736.18	G720140957000	72	141	957000	72141957000	9575	Census Tract 9575	655	376	0.5744679766...	<geom_area>	62
736.19	736.19	G720140957000	72	141	957000	72141957000	9576	Census Tract 9576	826	286	0.3462469875...	<geom_area>	35
736.20	736.20	G7201409550100	72	143	550100	72143550100	5501	Census Tract 5501	2682	768	0.2862343689...	<geom_area>	29
736.21	736.21	G7201409550200	72	143	550200	72143550200	5502	Census Tract 5502	1099	575	0.5213839470...	<geom_area>	52
736.22	736.22	G7201409550300	72	143	550300	72143550300	5503	Census Tract 5503	1167	574	0.4918946583...	<geom_area>	49
736.23	736.23	G7201409550400	72	143	550400	72143550400	5504	Census Tract 5504	1041	588	0.5648415089...	<geom_area>	56
736.24	736.24	G7201409550500	72	143	550500	72143550500	5505	Census Tract 5505	1217	653	0.5322287468...	<geom_area>	57
736.25	736.25	G7201409550601	72	143	550601	72143550601	5506.01	Census Tract 5506.01	895	517	0.5778536464...	<geom_area>	58
736.26	736.26	G7201409550602	72	143	550602	72143550602	5506.02	Census Tract 5506.02	868	528	0.6078801858...	<geom_area>	58
736.27	736.27	G7201409560100	72	145	560100	72145560100	5601	Census Tract 5601	946	591	0.6252984772...	<geom_area>	63
736.28	736.28	G7201409560201	72	145	560201	72145560201	5602.01	Census Tract 5602.01	1267	602	0.4729491887...	<geom_area>	52
736.29	736.29	G7201409560204	72	145	560204	72145560204	5602.04	Census Tract 5602.04	883	373	0.4242425154...	<geom_area>	42
736.30	736.30	G7201409560300	72	145	560300	72145560300	5603	Census Tract 5603	846	330	0.3900709152...	<geom_area>	39
736.31	736.31	G7201409560402	72	145	560401	72145560401	5604.01	Census Tract 5604.01	749	227	0.3030707381...	<geom_area>	30
736.32	736.32	G7201409560402	72	145	560402	72145560402	5604.02	Census Tract 5604.02	1406	395	0.2809388395...	<geom_area>	38
736.33	736.33	G7201409560500	72	145	560500	72145560500	5605	Census Tract 5605	296	90	0.3040549363...	<geom_area>	30
736.34	736.34	G7201409560600	72	145	560600	72145560600	5606	Census Tract 5606	1511	631	0.4193333546...	<geom_area>	44
736.35	736.35	G7201409560701	72	145	560701	72145560701	5607.01	Census Tract 5607.01	1392	304	0.2183908070...	<geom_area>	22
736.36	736.36	G7201409560702	72	145	560702	72145560702	5607.02	Census Tract 5607.02	1404	598	0.4259299027...	<geom_area>	43
736.37	736.37	G7201409560801	72	145	560801	72145560801	5608.01	Census Tract 5608.01	527	209	0.3940941567...	<geom_area>	31
736.38	736.38	G7201409560900	72	145	560900	72145560900	5609	Census Tract 5609	753	369	0.4900288524...	<geom_area>	49
736.39	736.39	G7201409560900	72	145	560900	72145560900	5609	Census Tract 5609	1297	453	0.3494610214...	<geom_area>	38
736.40	736.40	G7201409590000	72	147	950000	72149590000	9500	Census Tract 9500	633	221	0.3491110733...	<geom_area>	35
736.41	736.41	G7201409590000	72	147	950000	72149590000	9506	Census Tract 9506	570	284	0.4982462568...	<geom_area>	50
736.42	736.42	G7201409720100	72	149	720100	72149720100	7201	Census Tract 7201	1180	561	0.4754272345...	<geom_area>	48
736.43	736.43	G7201409720200	72	149	720200	72149720200	7202	Census Tract 7202	1322	625	0.4727845515...	<geom_area>	47
736.44	736.44	G7201409720400	72	149	720400	72149720400	7204	Census Tract 7204	449	157	0.3482572742...	<geom_area>	44
736.45	736.45	G7201409720502	72	149	720502	72149720502	7205.02	Census Tract 7205.02	808	399	0.4938118758...	<geom_area>	49
736.46	736.46	G7201409720503	72	149	720503	72149720503	7205.03	Census Tract 7205.03	1142	405	0.3546409940...	<geom_area>	35
736.47	736.47	G7201409720504	72	149	720504	72149720504	7205.04	Census Tract 7205.04	972	380	0.3909460745...	<geom_area>	39
736.48	736.48	G7201510950000	72	151	950000	72151950000	9506	Census Tract 9506	1217	565	0.4629531864...	<geom_area>	43
736.49	736.49	G7201510950700	72	151	950700	72151950700	9507	Census Tract 9507	1255	548	0.4366533786...	<geom_area>	44
736.50	736.50	G7201510950800	72	151	950800	72151950800	9508	Census Tract 9508	709	375	0.5289139747...	<geom_area>	53
736.51	736.51	G7201510950900	72	151	950900	72151950900	9509	Census Tract 9509	1135	372	0.3297849176...	<geom_area>	32
736.52	736.52	G7201510951000	72	151	951000	72151951000	9510	Census Tract 9510	729	414	0.5679012530...	<geom_area>	57
736.53	736.53	G7201510951100	72	151	951100	72151951100	9511	Census Tract 9511	504	233	0.4622018920...	<geom_area>	46
736.54	736.54	G7201510951200	72	151	951200	72151951200	9512	Census Tract 9512	794	446	0.5608779379...	<geom_area>	57
736.55	736.55	G7201510951300	72	151	951300	72151951300	9513	Census Tract 9513	1143	481	0.4245766526...	<geom_area>	42
736.56	736.56	G7201530790101	72	153	790101	72153790101	7901.01	Census Tract 7901.01	482	360	0.7468879839...	<geom_area>	75
736.57	736.57	G7201530790102	72	153	790102	72153790102	7901.02	Census Tract 7901.02	656	437	0.6661585693...	<geom_area>	67
736.58	736.58	G7201530790201	72	153	790201	72153790201	7902.01	Census Tract 7902.01	514	274	0.5330790218...	<geom_area>	53
736.59	736.59	G7201530790202	72	153	790202	72153790202	7902.02	Census Tract 7902.02	632	354	0.5592741720...	<geom_area>	56
736.60	736.60	G7201530790300	72	153	790300	72153790300	7903	Census Tract 7903	798	227	0.2844611406...	<geom_area>	28
736.61	736.61	G7201530790400	72	153	790400	72153790400	7904	Census Tract 7904	759	202	0.2692100153...	<geom_area>	26
736.62	736.62	G7201530790501	72	153	790501	72153790501	7905.01	Census Tract 7905.01	1147	296	0.2582494670...	<geom_area>	35
736.63	736.63	G7201530790502	72	153	790502	72153790502	7905.02	Census Tract 7905.02	398	121	0.3042010679...	<geom_area>	30
736.64	736.64	G7201530790601	72	153	790601	72153790601	7906.01	Census Tract 7906.01	361	111	0.3042010679...	<geom_area>	31
736.65	736.65	G7201530790602	72	153	790602	72153790602	7906.02	Census Tract 7906.02	878	333	0.3792740022...	<geom_area>	38
736.66	736.66	G7201530790602	72	153	790602	72153790602	7906.02	Census Tract 7906.02	499	295	0.5911823111...	<geom_area>	59



Tools available from simple to complex

- Google Earth Pro - <https://www.google.com/earth/versions/#earth-pro>
 - Simple, free, can view most any data type. Limited when creating data with complex data tables
- QGIS - <https://www.qgis.org/en/site/>
 - Super powerful, free, Open Source, great on line help, Plug-ins of all kinds to add features, steep learning curve. Support for linking to large databases.
- ArcGIS - <https://www.esri.com/en-us/arcgis/about-arcgis/overview>
 - Expensive, powerful, closed source, very recognized and mature software. It what to colleges train students to operate. Heavy in government use.
- Map Info - <https://www.precisely.com/product/precisely-mapinfo/mapinfo-pro>
 - Expensive, powerful, used to be defacto standard in cellular.
- Manifold - <https://manifold.net/>
 - Mature, inexpensive, commercial software, very powerful, very fast, coded specifically for multi-processor hardware support.



BDC Data and the H3 Grid System

- The public data from the BDC web site has location information.
- It's all based on the H3 Grid system.
<https://h3geo.org/docs>
- The hex grid ID's actually draw the hexagons on a map.
- One of the easiest ways is with a QGIS plugin
https://plugins.qgis.org/plugins/h3_to_olkit/

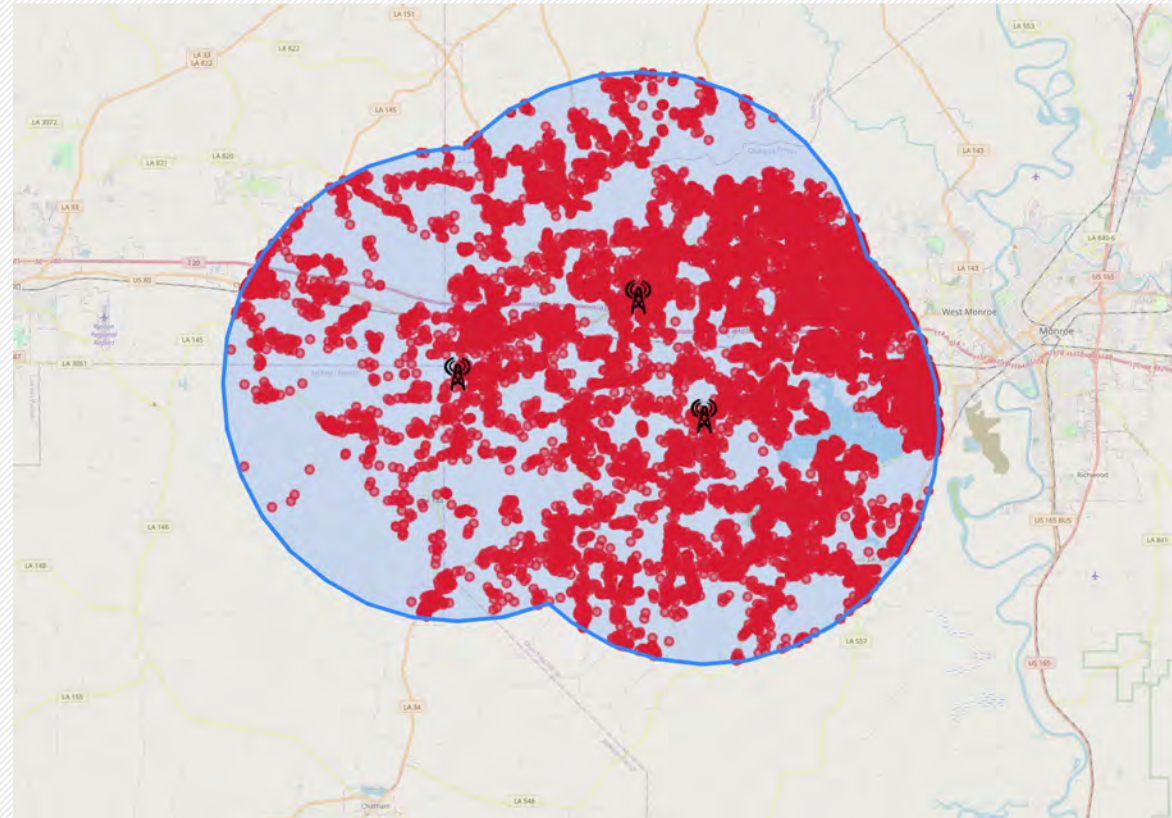


Analysis with BDC Data

BDC Locations clipped against an ISPs Coverage Boundaries

Using Data downloaded from the broadband map, you can use simple sql type queries to create things like:

1. Competitive Analysis
2. Combine data to find specific unserved or underserved locations (i.e. for grant applications) *make sure you have the appropriate license
3. Determine ineligible addresses (i.e. addresses that already fall within other grant or program boundaries.
4. Create complex polygons for areas still eligible for other programs like USDA



Analysis with BDC Data

- From the previous map image, we can run a query against the published Broadband Map data and determine how many addresses in that same region are covered by competition.
- Useful for determining percentage of addresses that may be un- or underserved.
- Useful for responding to the FCC about why you only have 2-5% of the addresses as customers

Example Query Results for Determining Competition within a given ISPs Wireless Service Area:

16967 Total BDC addresses in area

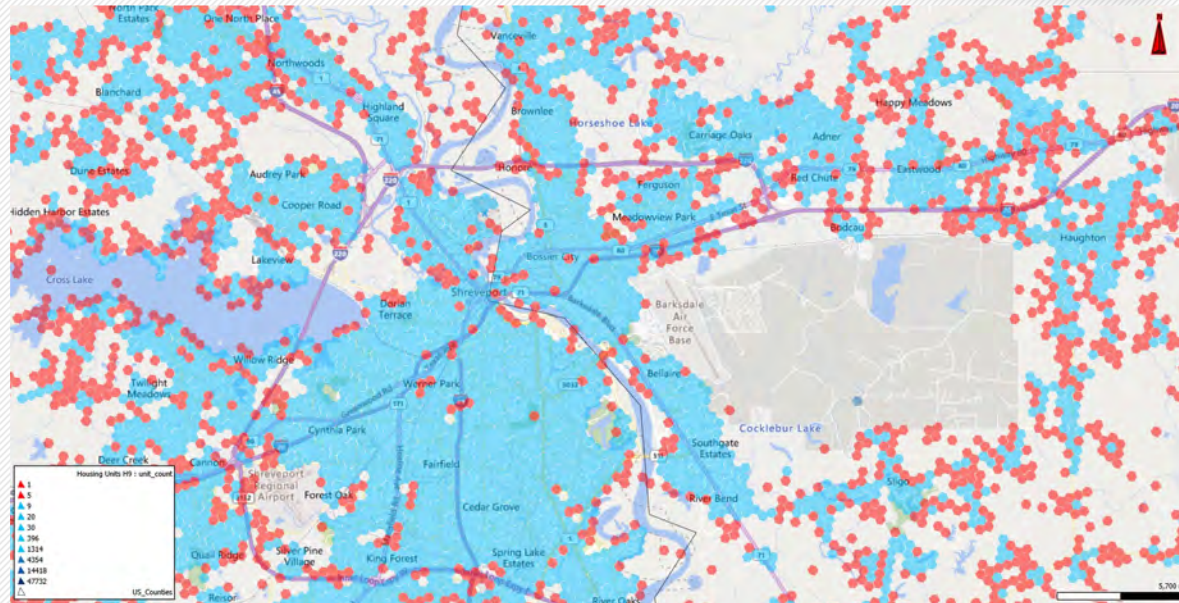
Brand Name,Technology,Count

AT&T Inc,	50,	1781
Hunt Telecommunications,	50,	2
Optimum,	40,	82
SkyRider Communications LLC,	50,	141
Southern Light, LLC,	50,	4
Sparklight,	40,	134
Starlink,	61,	10254
T-Mobile US,	71,	850
US WiFi LLC,	70,	629
VERIZON,	71,	5
Xfinity,	40,	6793



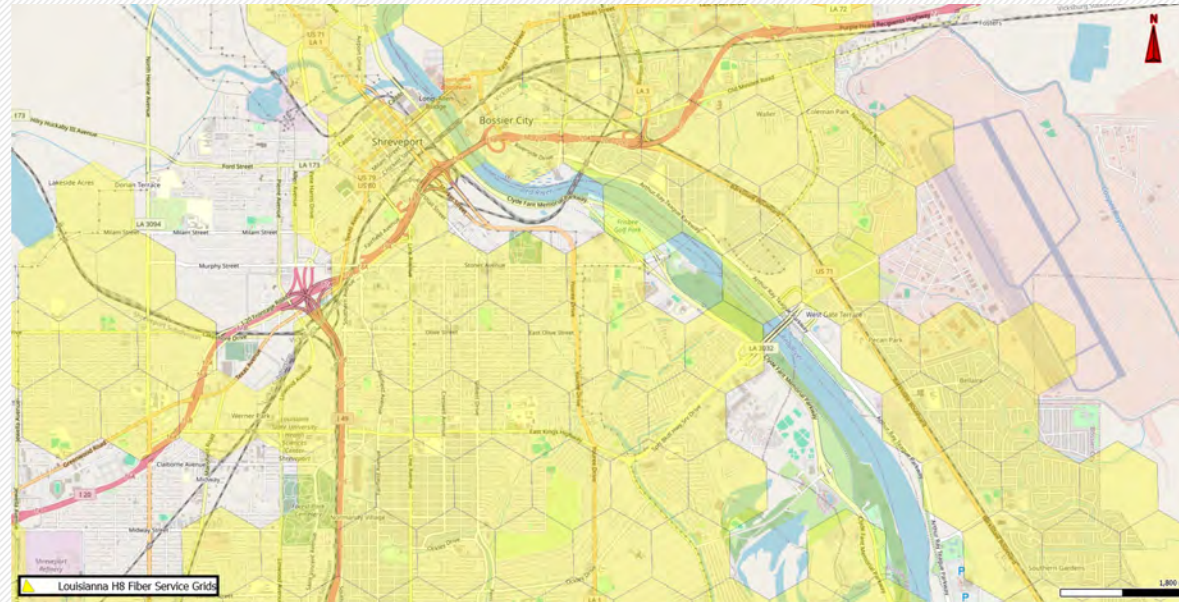
You can analyze the data with database queries

- Examine household densities
- Investigate business location density
- See reported serviceable locations by other carriers to see their footprint accurate to within a 250 meter diameter grid size



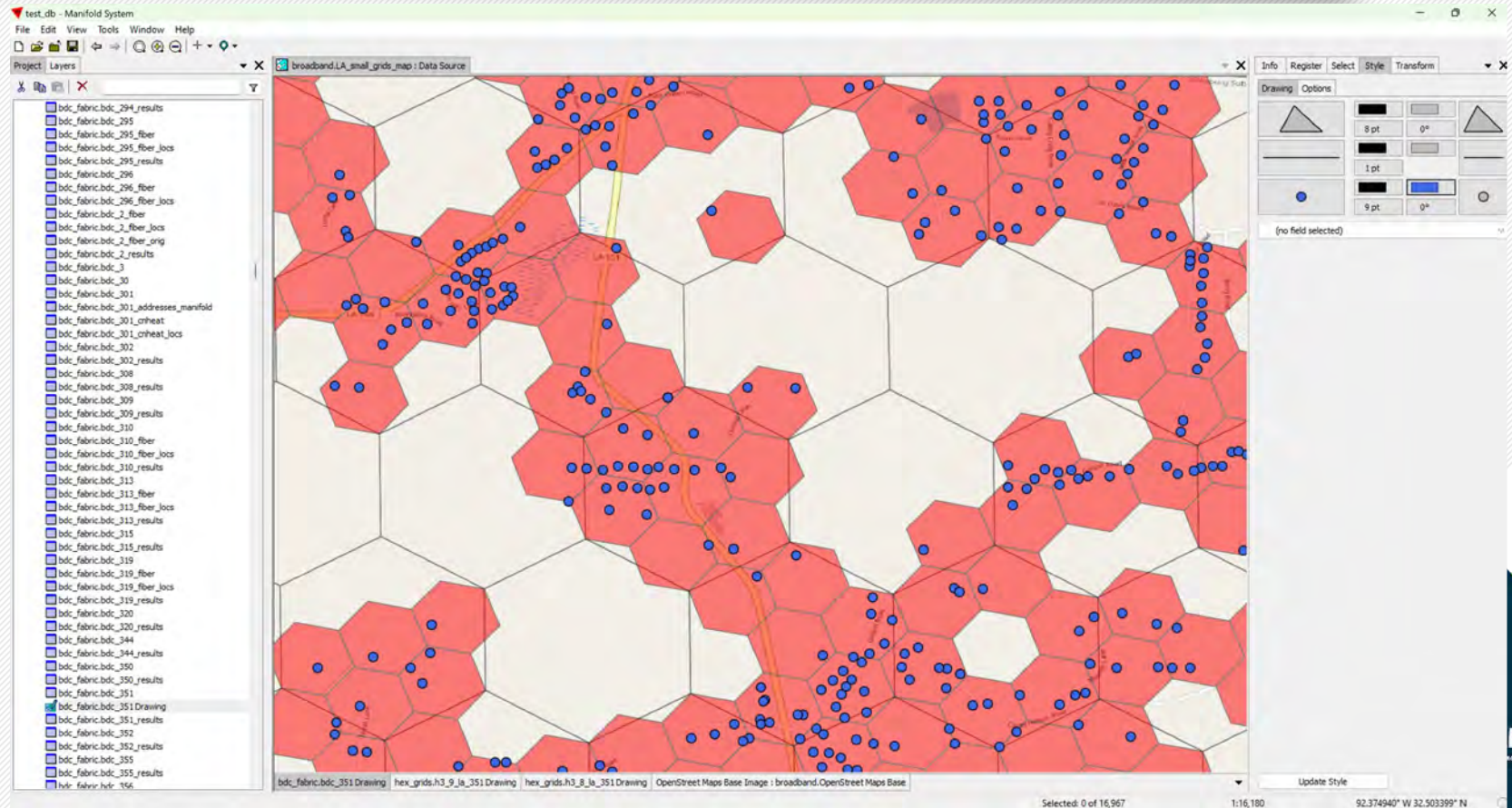
For BDC data there are 2 different grid sizes

- H8 grid size is 1 KM in diameter and how most service is reported by carrier and technology.
- You can get service by address location ID's but the only location data is the hex grid g level.
- That is a grid size that is 250 meters in diameter.



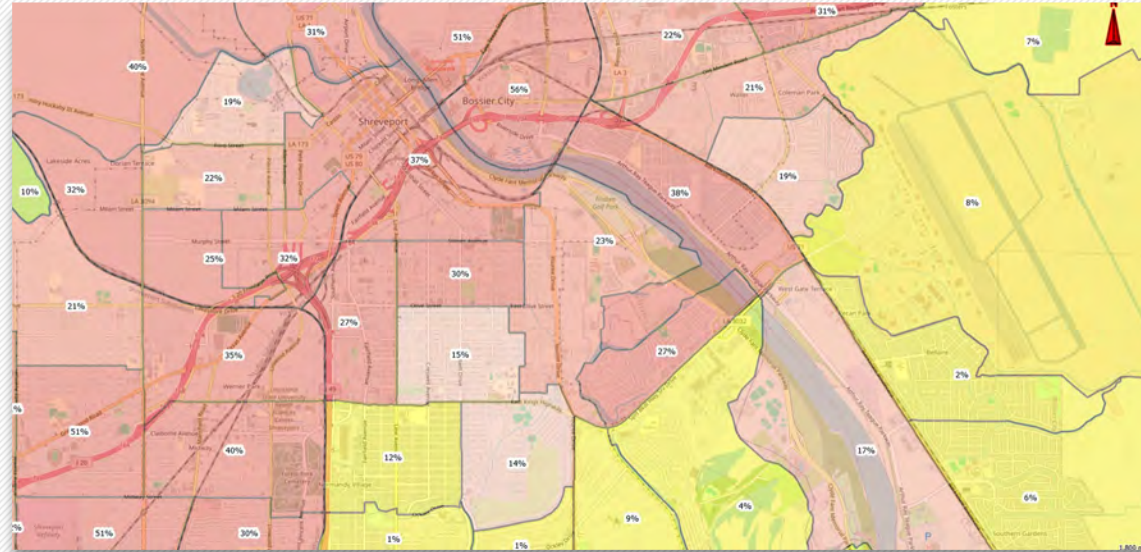
For BDC data there are 2 different grid sizes

Here is a visual of the difference between H8 and H9 grids with address points overlaid to show the difference in resolution and how many addresses you can expect to find within the H9 grids.



Other important data can be studied as well

- Data such as survey results or demographic information can be displayed and overlaid
- Information from your state broadband office can be included such as address location that are unserved



Contact information

Brian Webster bwebster@regulatorysolutions.us

Cameron Crum ccrum@regulatorysolutions.us



THANK YOU

