RDOF
Perspective

Locations : running the numbers
and performing due diligence
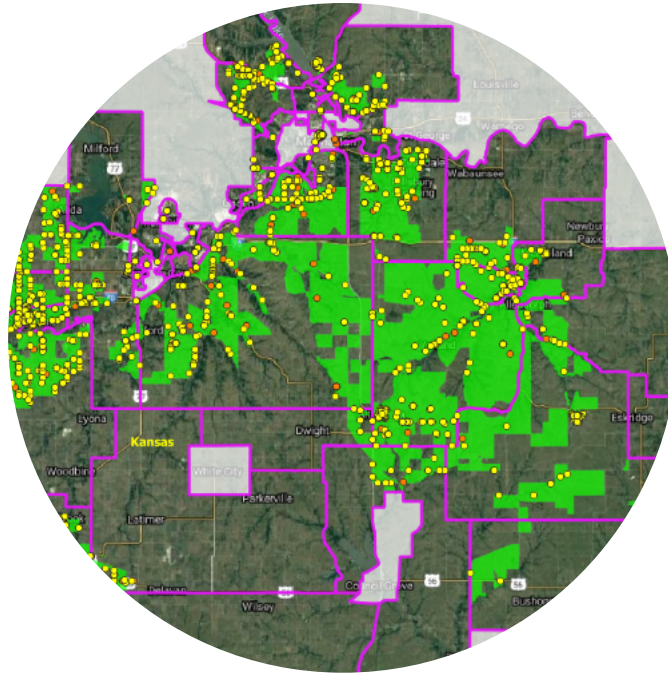
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Introduction

The FCC's Rural Digital Opportunity Fund (RDOF) auction is underway. Every participant is bidding on geographic areas that are defined by a physical area, a reserve price, and a number of "locations".

What exact is a "location"? Where does the number come from? How is it used? How confident should an auction participant be in its accuracy?

Impressionist Art to Rural Broadband

Every auction includes a description of the property being auctioned, a set of rules and – in many cases – a reserve price, to protect the interests of the seller, in case participation is low or the bidding fails to reasonably reflect the value of the asset. This is true whether the items being auctioned are impressionist paintings, pieces of real estate, or spectrum.

A city government auctioning property would develop a set of auction rules, list the property, offer some degree of disclosure, provide a reserve price, and then let bidders determine the outcome.

The FCC has a rich history of running auctions (https://www.fcc.gov/auctions-summary), with 95 traditional spectrum auctions and 3 "reverse" auctions, since 1994. In a spectrum auction the FCC provides a geographic description (a license area) and a set of rules pertaining to the use of the spectrum. It also typically discloses grandfathered incumbents and other factors that might impair the value of the license.

The FCC has conducted several universal-service-oriented fixed and mobile reverse auctions . The most recent, the Connect America Fund Auction Phase II (CAF II), serves as a template for RDOF.

Understanding "Locations"

An interesting attribute of CAF II and RDOF is that the FCC has introduced an additional piece of information, "Locations". A location, in theory (attempting to carefully interpret the various disclosure documents), represents the sum of housing units (a.k.a. homes passed) and small businesses. One could think of it – very roughly – as an estimate of the addressable market. It is generous of the Commission to disclose to bidders their view of the size of the market. The FCC (and most regulators worldwide) in auctioning radio spectrum doesn't provide such guidance. An auction participant is normally left to value the asset on its own, with the potential for large wins and large losses.
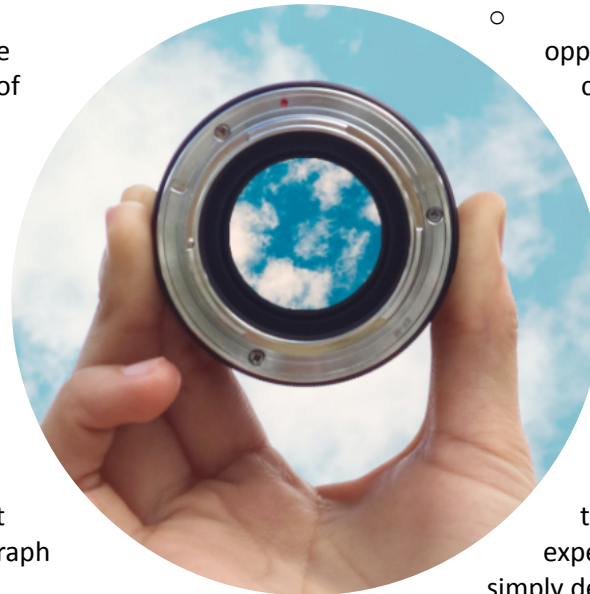
Imagine if a city government auctioning a piece of commercial property said "If you launch a restaurant here you should expect the following amount of foot traffic on a Saturday night …". Bidders might be pleased (amazed that the government would offer such insight) and at the same time skeptical (Who came up with the number? How accurate is it? What if I bid based on the estimate then discover that it is wrong?).

Participants in the RDOF auctions may wrestle with similar competing emotions. On the one hand it is very helpful to have additional information. On the other hand, what if the numbers are wrong?

The FCC includes several important caveats:

- *Disclaimer:* …there may be some disparity between the number of locations identified before the auction occurs and the "facts on the ground" (Fund Order, paragraph 47)

- *Fewer Locations than Expected*: if there are fewer than 65% of the estimated number of locations (a.k.a. "CAM location count") in a carrier's area within a state then the carrier "shall have their support amount reduced on a pro rate basis by the number of reduced locations" (Fund Order, paragraph 51)

- *More Locations than Expected*: if there are more than 135% of the expected number of locations in a carrier's area within a state then the carrier will "have the opportunity to seek additional support from the Commission" (Fund Order, paragraph 40).

In simple terms:

- The FCC might be close or not-so-close in its estimate (caveat emptor).

- If the number of locations fall significantly short (<65%) of the CAM location count then the FCC's funding obligation will shrink proportionally. The bidder will nevertheless be obliged to build out the area.

  o A bidder that assumes that the CAM location count is correct in developing its business plan may discover post-auction that the number of locations were overstated and that its compensation will be reduced.

    o If the bidder relies heavily on the subsidy (as opposed to monthly ARPU) to make its business case work, the bidder might be in trouble.

    o Those building Greenfield terrestrial networks (fiber, cable, fixed wireless access) are at the greatest risk. They will be obliged to cover the area, but might not receive the expected compensation. Those extending existing terrestrial networks (e.g. a cable or fiber provider that covers an adjoining area) will be in better shape, because their investment is incremental. Satellite providers will be in the best shape. They will lose some of their expected support, but their technicians will simply deploy hardware elsewhere. They won't have stranded assets.

- The FCC promises to consider the situation of a carrier whose locations greatly exceed the CAM location count, but makes no guarantee of additional compensation.

- The process of reconciliation provides a degree of comfort. The calculation is done on all of the properties of the carrier within a single state. If a carrier wins a large number of RDOF block groups within a state then it is likely that the portfolio

Figure 1: Quantifying the Likely Accuracy of Location Estimates
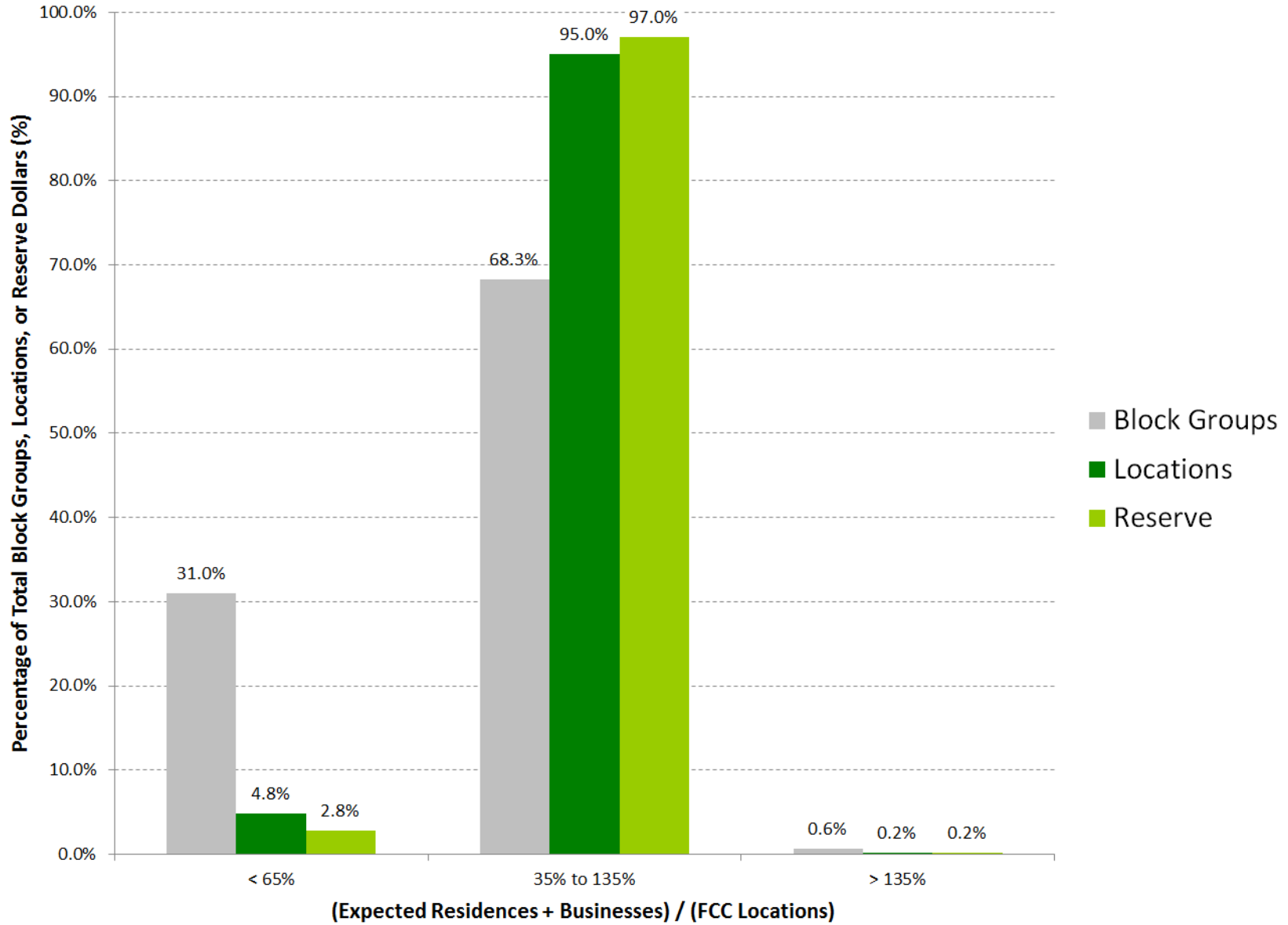
will include favorable and unfavorable surprises. An operator that wins a small number of block groups within a state faces greater uncertainty.

- Implication: do your homework.

How Accurate Are the Provided Numbers?

We'll know definitively in a few years when each winning bidder counts the actual locations and reports them to USAC.

One can make an educated guess as to the accuracy of the location numbers by comparing each CAM location count to what one would reasonable expect given all the public information (which doesn't end in 2014) available today.

In preparing to write this paper we have done exactly that (stay tuned for a discussion of the methodology), by comparing high resolution Census data, adjusted for growth, and including businesses, to the CAM estimates.

In any particular block group it is possible that someone has embarked on a massive residential construction project then reported it to the FCC. In such a scenario the CAM model would be correct. However, it is unlikely that this has happened in a majority of the 61,766 eligible block groups.

One can therefore handicap each CAM forecast as being likely or less likely based on a comparison with Census-derived data. Specifically, on can categorize individual block groups as "likely to be have fewer than 65% of the stated number of locations", "likely to fall within the 65% - 135% range", and "likely to fall within the "over 135%" range."

Figure 1 shows the results of such an analysis. It turns out that 31% of the block groups may have significantly overstated CAM location counts. 68.3% fall within the "65% to 135%" range, and 0.6% fall within the "over 135%" range. We can do the same calculations for the number of locations (as opposed to the number of block groups) and the total reserve dollars. These numbers appear in Figure 1 as additional sets of bars.

Several conclusions jump out of the analysis:

- 31% of all block groups are at risk of having less than 65% of the stated location count. On the surface, this is an alarming statistic.

- On a more comforting note: 95% of the locations reside within block groups that fall in the "35% to 135%" range. Similarly 97% of the reserve dollars are associated with block groups that fall within the "35% to 135%" range.

- The math suggests that most of the blocks groups at greater risk have relatively few locations and a relatively small percentage of the total reserve dollars.
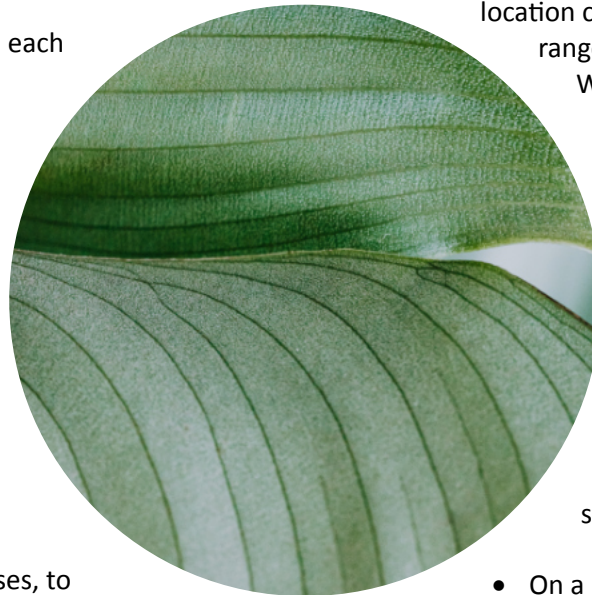
Figure 2: Three Views of the Number of Locations

- Measured - Businesses, Residential*
- Measured - Businesses, Non-Residential*
- Measured - Households*
- Census - Businesses
- Census - Empty Housing Units (HUs - HHs)**
- Census - Households (HHs)**
- FCC Locations

* Using update shape files released by the FCC on 10/21/2020.

** Block-level 2010 census data has been adjusted to refelect county-level population growth through 7/1/2020.
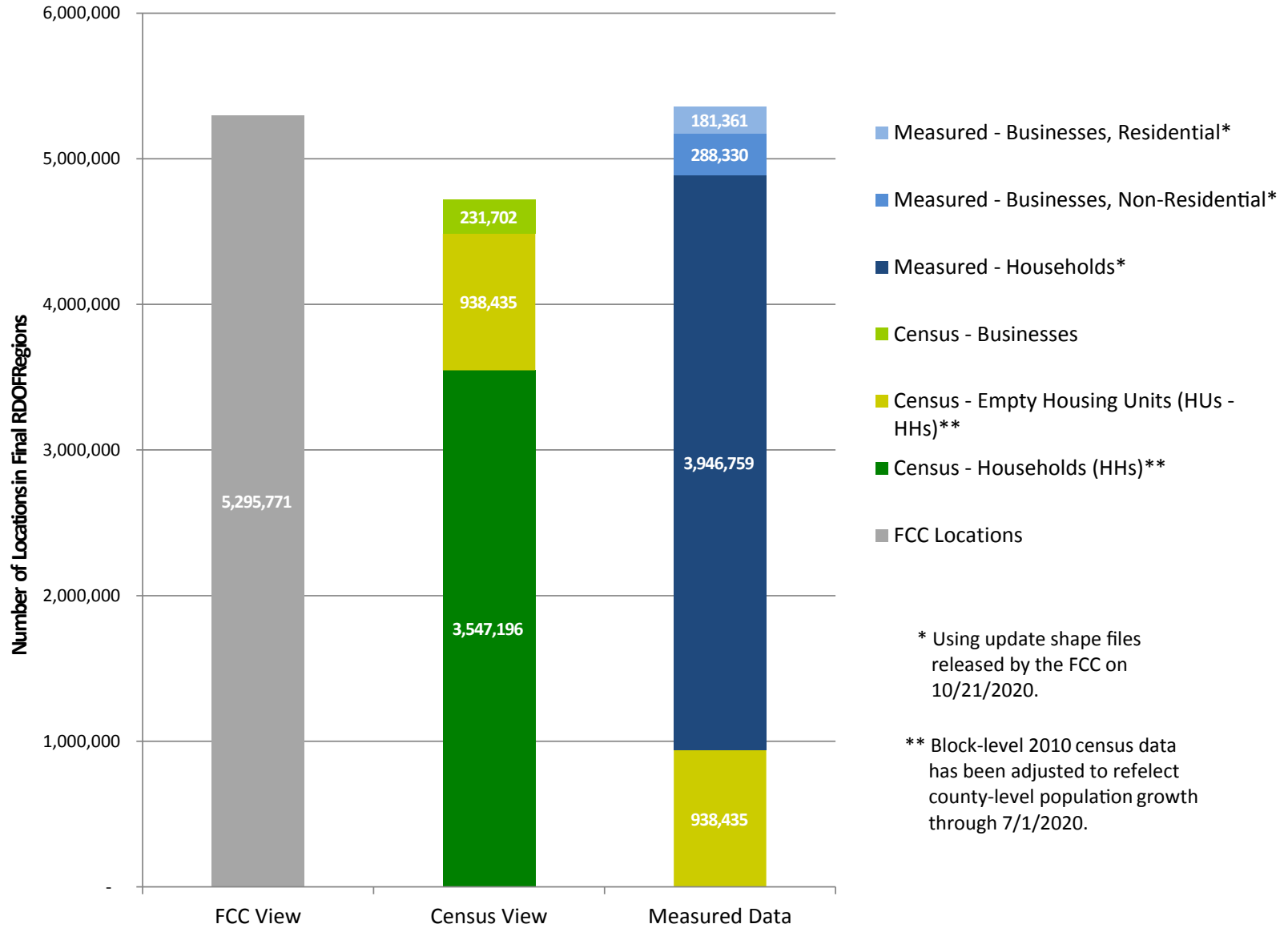
- It is advantageous for *every auction participant* run the numbers on the blocks groups where they are actively bidding. We'll discuss how to do this shortly.

- Auction participants at the greatest risk are those that are bidding on relatively few properties, especially properties that have few CAM locations.

- Auction participants at the least risk are those that are bidding on many properties (where underestimates and overestimates are likely to offset one another), including properties with a lot of locations per block group. Also participants deploying satellite technology are at low risk because their up-front costs are largely proportional to the number of locations.

- While there is conceptually an upside for the bidder (a situation in which a winning bidder has a case for increased compensation) the number of block groups, locations, and reserve dollars where locations appear to be significantly understated are few. The FCC has no legal obligation to provide additional funds. The uncertainties associated with the accuracy of location counts are therefore largely a downside risk to auction participants.

How is the Location Count Computed?

The CAM Methodology had its origin in the days of the National Broadband Plan. The methodology was later used in the CAF II reverse auction. It is now being used in the RDOF auction. Many of the reference documents point back to CAF II. The latest published report on CAM methodology is dated 2014, suggesting that the numbers themselves might or might not reflect the growth of the population and the economy since 2014.

Interestingly, when one compares the CAM location counts to numbers derived using other methodologies using more recent data, the CAM results, if anything, are on the high side.

We have used the following methodology in this report to assess the CAM location counts:

- Start with populations, households, and housing units at a block level from the 2010 census.

- Calculate, the growth in population by county through July 1st, 2020 using other high quality survey-based census studies.

- Assume that households and housing units grow over the decade in proportion to the population.

- Use the latest estimate of businesses in the US from the US Census Bureau. The study, which resolves to a county level and breaks down businesses by industry sector and number of employees per location, is extremely detailed. When we look nationally at the ratio of businesses to households we arrive at a ratio of 6.5%.

- To keep things simple we have applied the business to household ratio using a national KPI. It will vary by county and by block group and by block, although the US Census Bureau has not published business counts by block group or by block. We have therefore taken the number of households at a block level and multiplied them by 6.5% to estimate the number of businesses in that block.

Figure 3: Address-Level Location Data with Residences (yellow), Businesses (orange), and Reserve Prices ($)
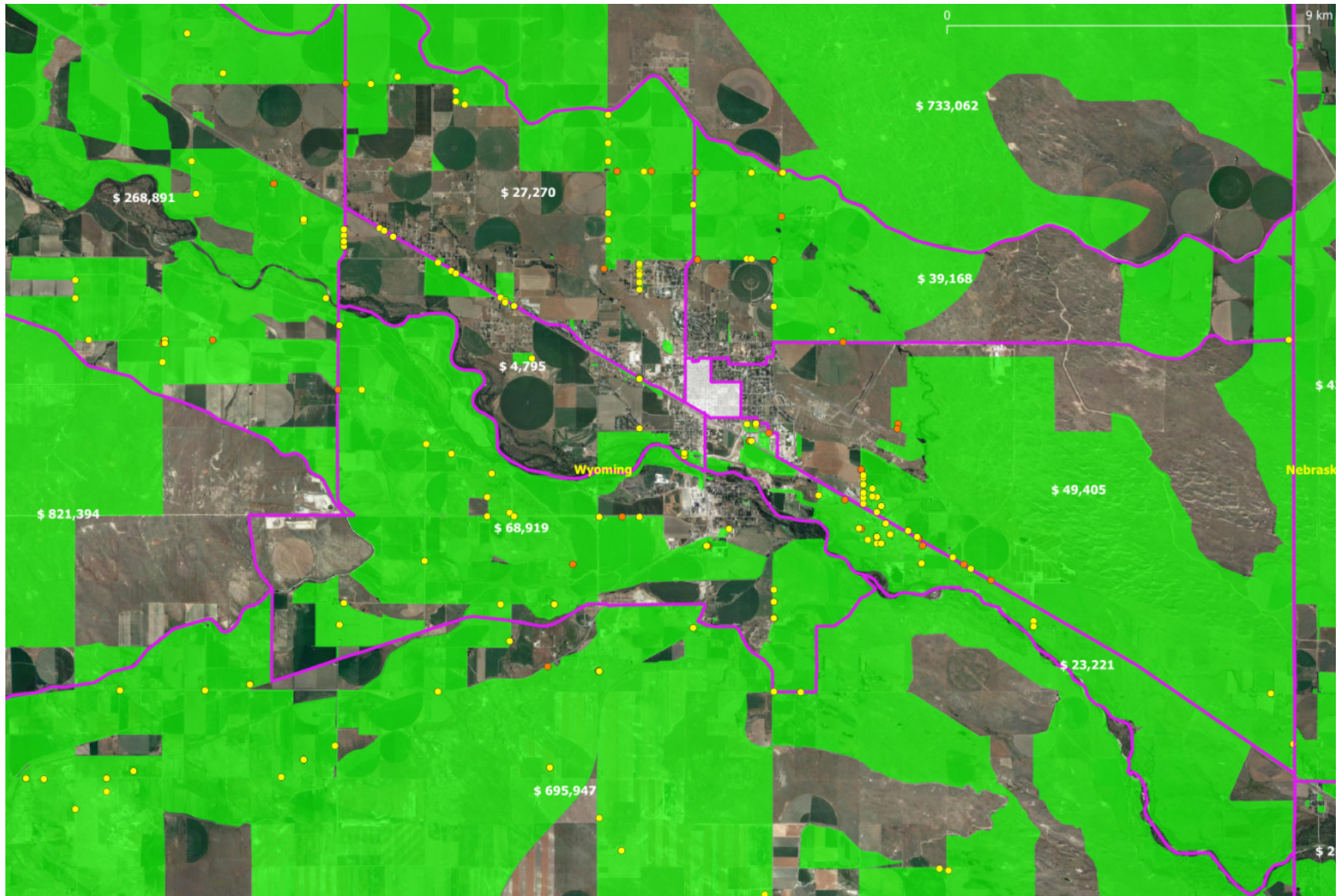
This methodology has the following limitations:

- Estimates of the number of businesses in the United States vary widely, depending upon how a "business" is defined. The US Census Bureau takes a conservative approach, arriving at just over 7.9 million businesses in the US in its most recent study. Other sources estimate the number to be as high as 30 million. The differences are largely definitional.

- The FCC defines the relevant business segment as "small business" that might purchase a consumer-grade best efforts internet connection. A factory with 1,000 workers or a large professional services firm would require a much more robust connection. By including all businesses (the 6.5% of households) we are overstating the number slightly. However, the vast majority of businesses are extremely small. While large businesses employ a lot of people they are few in number. Also, the US Census Bureau methodology produces an estimate of the number of businesses that is much lower than that produced by more inclusive definitions, so the overall result is lower that one might calculate using other methodologies.

As a case study, imagine the following household:

- A family of 4 lives in a single family home.

- The husband is a traditional employee of a corporation located elsewhere.

- The wife is a real estate agent, operating out of her home. She is an independent contractor affiliated with a larger entity and is compensated via a 1099-Misc. Her computer and work files sit on her desk at home, and she takes a home office deduction on her tax return.

- The daughter just graduated from college and is working temp-to-perm, but is being compensated via a 1099-Misc.

- The son drives for Uber and is considered an independent contractor and is also compensated via a 1099-Misc. The depreciating physical asset used in his business (his car) is parked on the property when not in use.

- The parents own an LLC that is a paper entity that holds rented real estate property elsewhere. They file a schedule C for their LLC on their 1040.

To the IRS the situation is clear:

- There is one physical home.

- There are four tax-paying businesses operating out of that one home (each filing a schedule C).

  Does the property represent 1 location or 5 locations or some other number?

In the example above an ordinary person would say "There is one location". However, if one defines locations as housing units plus small businesses one would arrive at the answer of "5 locations". However, it is unlikely that the household would purchase more than a single internet connection.

This highlights a potential concern. If the methodology for including businesses is too generous then one ends up with a

situation where the theoretical number of locations greatly exceeds any realistic estimate of market size.

Also, it is important to distinguish between addressable market and the realistic serviceable market. The engineering team needs to design to cover every current and future physical structure and to allow for the possibility of multiple subscriptions (a business plus a residence) in one physical location. Conversely, the marketing team needs a realistic number, one that probably assumes that a home-based business does not have a separate subscription, one that allows for competition, and one that allows for people to say "no thanks". Some people simply don't need fixed broadband or don't want to pay for it.

In the unlikely event that there is a residential and a business subscription in the case study above USAC would allow it, as long there are "separate facilities (drop/line) and separate equipment (e.g. modem) and the business must separately subscribe (get its own bill) to at least the minimum speed required." (USAC HUBB FAQ, page 4).

Finally, let's consider an empirical approach to estimating the number of locations. Here's a proposed methodology:

- Calculate the number of unoccupied housing units at a census block level, using the methodology described above.

- Add to that number the actual number of households, using a high quality commercial database of residential addresses, similar to the database used by the FCC's CAM consultant, but reflecting 2020 numbers.

- Add to that number the actual number of non-residential

businesses, using a high quality commercial database of residential addresses.

- Optionally, add to that number the residential businesses, using a high quality commercial database of residential addresses.

The result is shown in Figure 2. The "FCC View" is the sum of the CAM-estimated locations listed in the final RDOF data set. The "Census View" is the calculation described in previous pages that uses various census data sources. The "Measured Data" view is the empirical approach described by the bullet points above.

One can see that the three approaches produce, in aggregate, similar but not identical results. At a block group level the variation is much greater.

Figure 3 shows actual physical locations of residences and businesses. It is a tiny snapshot of the large data set used in the empirical approach.

Conclusions / Next Steps

A savvy auction participant will want to run the numbers for themselves. If the number of FCC locations associated with a particular block group is high relative to the expected number, based on Census data, then a warning flag should appear.

The RDOF Toolkit (state or national) is a powerful tool that includes a comprehensive set of data that calculates this ratio for every RDOF block group in the United States (but not the Northern Mariana Islands). Version 1.10 and beyond includes an Excel file called "Data – BG-RDOF". Column U of that spreadsheet includes a metric called "LocRatio" this is further described in the data dictionary. It represents the number of locations estimated based on census sources divided by the FCC locations. If the number is 65% or less for a block group, extreme caution is appropriate.

The RDOF Toolkit also includes a vast array of other data and visualization capabilities to help the auction participant make informed decisions.

The RDOF Location Analyzer (division-level or national) is a comprehensive data set plus the visualization tool used to produce Figure 3. It includes the exact street address of every known residence and every known business (subject to the limitation of any empirically-derived data set) in RFOF-eligible areas in the United States (but not the Northern Mariana Island).

The RDOF Toolkit and the RDOF Location Analyzer are described in detail in supporting documentation and tutorial videos at: https://cbrstoolkit.com/pages/rdof.

Have any questions? We'll be happy to discuss the nuances of this whitepaper and as well as your other data analysis needs. We'll also be happy to give you a Zoom demonstration of some powerful but easy-to-use tools. You can reach us at support@cbrstoolkit.com.

FCC Resources

The following documents speak directly to the topics discussed in this whitepaper:

Rural Digital Opportunity Fund Order (paragraphs 45-55)
https://docs.fcc.gov/public/attachments/FCC-20-5A1_Rcd.pdf

CAF II Resources
https://www.fcc.gov/document/wcb-guidance-location-reporting-carriers-receiving-caf-support

USAC / HUBB Resources
https://www.usac.org/wp-content/uploads/high-cost/documents/Tools/HC-HUBB-FAQ.pdf
https://www.usac.org/high-cost/annual-requirements/submit-data-in-the-hubb/

CAM Methodology
https://transition.fcc.gov/wcb/CAM%20v.4.2%20Methodology.pdf