Planning Successful Rural Broadband Networks

White Paper

July 2, 2009

Introduction & Purpose

One of the challenges to providing broadband service to rural America is the uncertainty of achieving a return on investment given the high cost of deployment. The American Recovery and Reinvestment Act (ARRA) has allocated more than $7 billion in grants to spur broadband deployment, significantly reducing the risk to upfront capital. However, the new broadband system must still generate sufficient revenue to cover the cost of ongoing operating expenses such as leases, maintenance, electrical power, backhaul, etc. A wireless broadband system covering a lightly populated area must be designed efficiently to adequately cover the population, and minimize coverage of unpopulated areas. As the number of sites to cover a given population increases, the operating costs increase accordingly, and the future profitability of the network declines. The key to efficient system design is the granularity of population data, conveying an accurate understanding of population location.

In short, it is critical to plan networks that will generate the revenue needed to cover operational expenses, and this can be done by covering areas in which adoption of the network is most likely.

The purpose of this white paper is to show the value of using the most detailed census data available, Block Level data, for defining the areas of a rural market to be targeted for wireless broadband coverage. The paper further illustrates how this level of analysis can help to ensure a stimulus applicant's future success, both in obtaining grant money as well as long term success of the network.

US Census Data

As shown in Figure 1 below, population data is available from the US Census Bureau at several summary levels that have various resolutions due to the relative size of the geographic areas. For example, the 2000 Census divided the roughly 3,200 US counties into a total of about 66,000 "Census Tracts", then divided these Tracts into about 230,000 "Block Groups", and finally divided these Block Groups into about 8.2 million "Blocks". Another popular summary level is Zip Code Tabulated Areas (ZCTAs) of which there about 32,000. ZCTAs are roughly equivalent to postal zip codes but are changed less frequently. They provide about half the resolution of Census Tracts on average, but since they were designed for a very different purpose than Tracts, the geographies of each can vary dramatically.

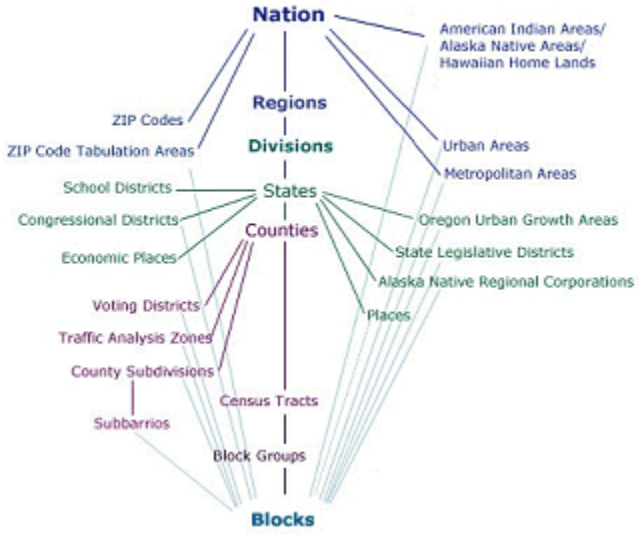

Figure 1: Geographic Data Types available from the US Census Bureau

Analysis Methodology

This paper selected a sample Rural Service Area (RSA) in Missouri to compare the use of three levels of population data in developing a high level broadband wireless design suitable for a grant application. The three levels are Census Tract, Block Group, and Census Block.

For each geographic level, we assumed a minimum population density of 50 pops per square mile as the trigger for building a site. Furthermore, an isolated pocket must have a reasonable size and number of pops such that a new site will likely be profitable. Note that the specific criteria can be adjusted up or down to match a particular business objective, and that this process may be iterative. But for illustrative purposes, a threshold of 50 pops per square mile produces reasonable results.

Using these criteria, targeted coverage areas were developed using each level of population data as a basis. These targeted coverage areas are shown in Figures 2, 3 and 4 below:

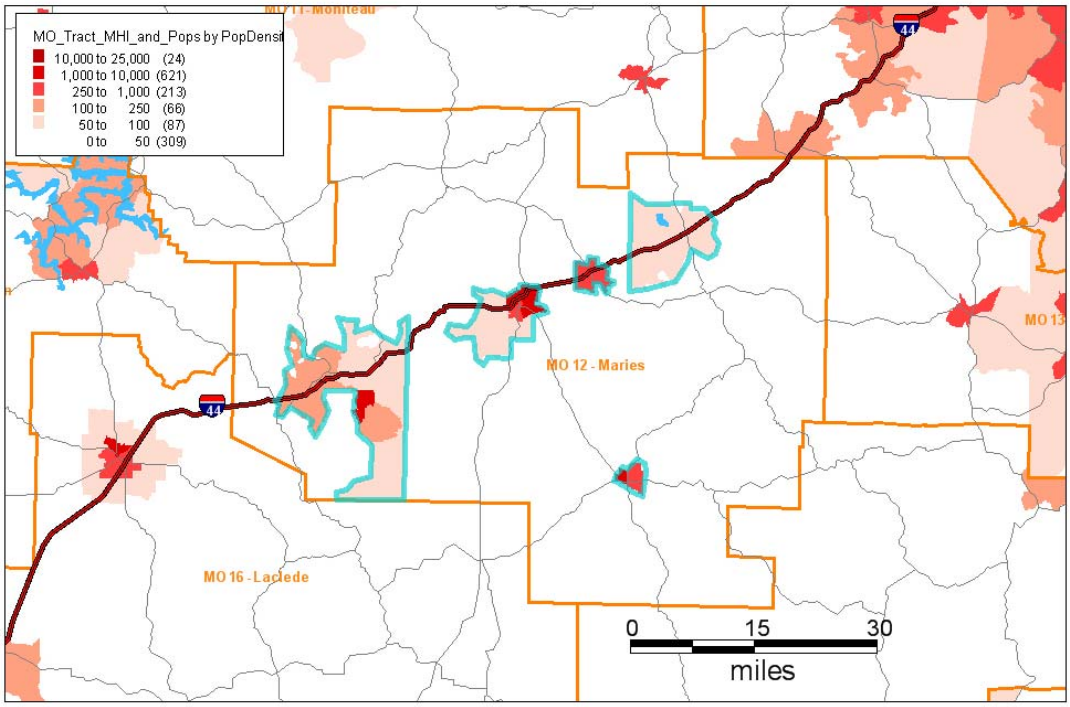

Figure 2: Pop Density and Coverage Objectives by Census Tract

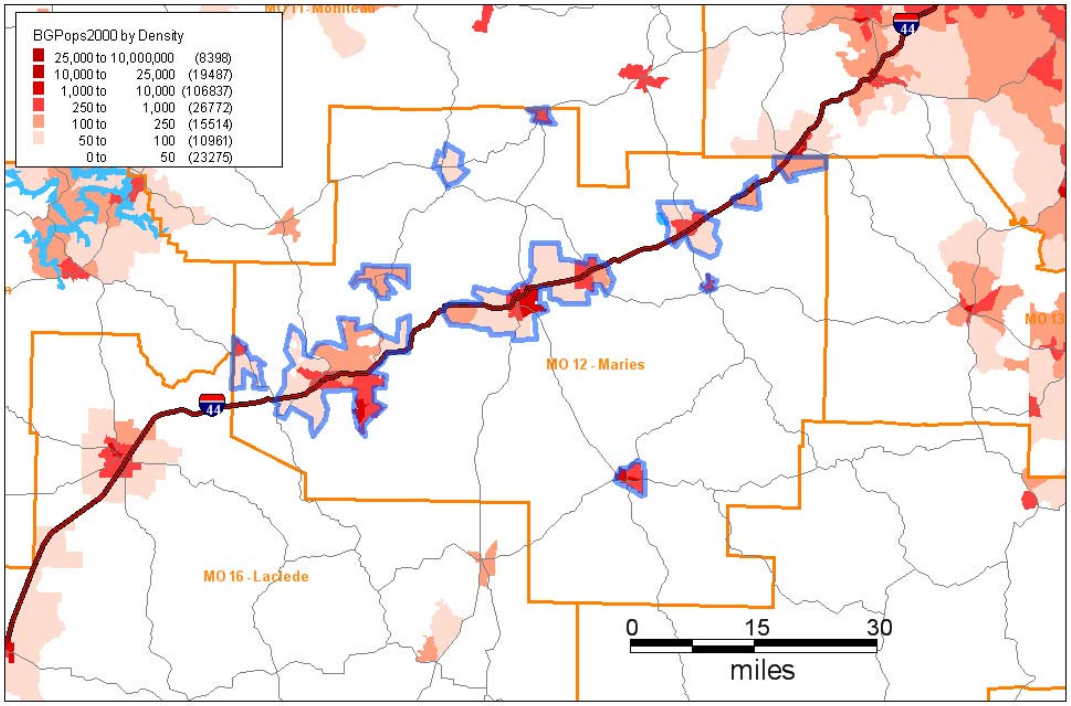

Figure 3: Pop Density and Coverage Objectives by Block Group

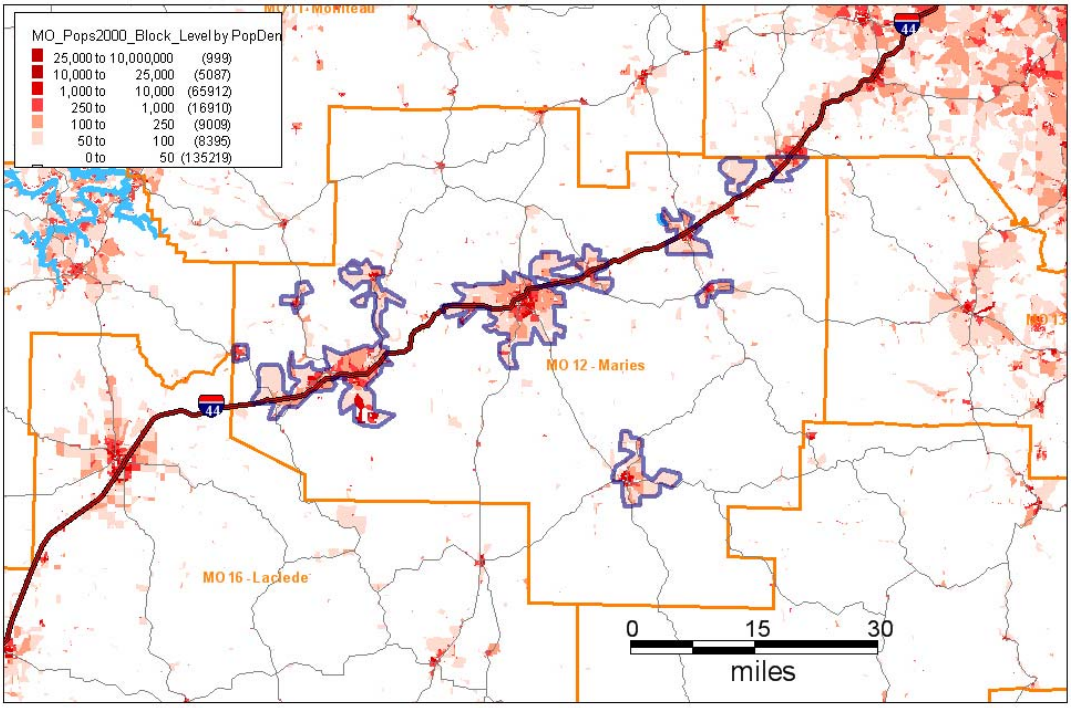

Figure 4: Pop Density and Coverage Objectives by Census Block

Note that the targeted coverage area tightens to a greater degree of precision as the resolution of population data increases, allowing for more accurate site placement and fewer total sites. This effect is better seen in the following table:

Data Source used for Targeting Coverage	*Pops in Targeted Area*	*Area of Target (sq mi)*	*Pop Density of Targeted Area (pops/sq mi)*	*# Sites*	*Pops per Site*	*% Increase*
Tract	64,829	361	180	19	3,412	0%
Block Group	74,221	322	231	17	4,366	28%
Block	82,143	292	281	15	5,476	60%

Table 1: Statistical Comparison of Three Geographic Data Sources

That is, using Block level population data allows the applicant to specifically target areas of high population, increasing the number of covered pops while simultaneously reducing the total area to cover. Thus the optimal areas to cover are targeted, which significantly increases the number of pops that are covered by each site.

In the table above, the number of sites is based on the area to be covered, using an estimate of the coverage area per site. For illustrative purposes we have made an arbitrary assumption that the average cell radius will be about 2.5 miles, which leads to an average coverage area of about 20 square miles per site. In reality, this

calculation will be based on several factors including terrain, technology, frequency band, tower height, link budget, type of service to be offered, targeted data rates, etc. This is a critical calculation that will significantly affect the accuracy of budgetary site estimates and therefore the business model, and it is worth noting that this is another area in which Wireless Strategy can provide valuable expertise and assistance. But for the purposes of this paper, the details of this calculation are both case-specific and out of scope.

Conclusion

Using Block level population data to determine coverage objectives and to calculate covered pops greatly improves the accuracy and detail of business plans and grant applications. Wireless Strategy has developed the capability to quickly generate maps and analysis using Block level Census data. Less granular data sources will produce less accurate results, with potentially negative business impacts.

Population density is only one of several factors to consider. Other factors that may be used to prioritize areas to cover could include Median Household Income and the number of other broadband options that consumers have in each area. As demonstrated in Figure 5, these additional analyses can help to further streamline the areas in which to offer coverage, and help guarantee success. Winning applications will include detailed maps and market analysis that clearly support the need and viability of a broadband wireless network, because they will have the highest probability of generating jobs and opportunities via sustained long term success. Wireless Strategy is equipped with the skills, expertise, and capabilities to help optimize your wireless broadband network design, and is ready to help your firm generate high-quality, successful applications.

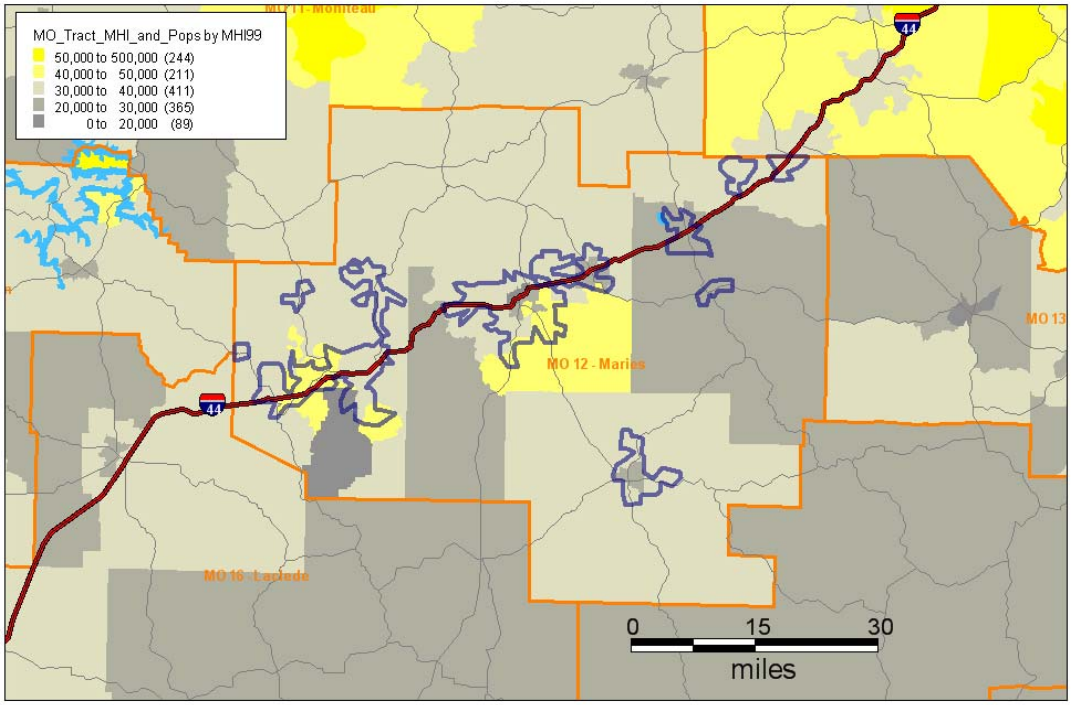

Figure 5: Targeted Coverage vs. Median Household Income