Will BEAD Funding Close the Digital Divide with Fiber?

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BACKGROUND

This white paper explores whether BEAD funding from the Broadband Equity, Access, and Deployment (BEAD) Program[1] will be sufficient to connect all unserved locations in the United States with fiber.[2] Based on an analysis of ten exurban-to-rural counties in Georgia where housing density is low (less than 5 locations per mile) this paper concludes that it will be challenging for many states to connect all unserved homes with end-to-end fiber networks.

There are approximately 8.2 million locations that are "unserved," i.e., that lack access to broadband networks that offer at least 25 Mbps download and 3 Mbps upload speeds.[3] The U.S. National Telecommunication and Infrastructure Administration (NTIA) will soon provide $42.45 billion in BEAD Program funding to the states for deploying broadband networks to unserved and underserved locations and community anchor institutions.[4] The BEAD Program prioritizes unserved locations first, followed by underserved locations and then community anchor institutions. This means that a state must ensure that all unserved locations have broadband access before funding underserved locations. The program also prioritizes projects that deploy end-to-end fiber-optic networks over hybrid or fixed wireless networks. For state planners, the key question is whether the funding will be enough to provide fiber access to all unserved locations in their state.

To answer this question, states need to know whether BEAD funding plus matching funds from private investment will be sufficient to cover the cost of fiber deployment. Calculated on a nationwide basis, and assuming a (generous) 50% funding match from service providers for all projects, there will be $10,350 available to bring fiber to each unserved location.[5]

Without knowing the cost to build fiber, however, it is impossible to conclude that $10,280 per location will be enough to deploy fiber to all unserved locations nationwide. It is likewise impossible to accurately calculate fiber deployment costs per unserved location on a nationwide basis due to wide variations among the states, including the amount of BEAD funding available per unserved location,[6] deployment costs, geography, and other factors.

After doing capex analyses for fiber deployments in over 800 counties in the United States, Wireless 20|20 has concluded that it is critical to have accurate data regarding the minimum number of fiber access miles needed to serve the set of locations to be analyzed. This requires an analysis of the shortest (though not necessarily most direct) or most economical paths connecting locations on a county-by-county (or smaller geographic area) basis. It is inadvisable to generalize the number of fiber miles based on non-linear data metrics (e.g., location density over a given area) or to apply a linear analysis of one area to another dissimilar area. Each area requires its own fiber mile analysis based on an actual network design.

[1] *The BEAD Program was authorized by the Infrastructure Investment and Jobs Act of 2021, Division F, Title I, Section 60102, Public Law 117-58, 135 Stat. 429 (November 15, 2021) (codified at 47 U.S.C. § 1702) (Infrastructure Act).*

[2] *This is the first part of a series. Part will analyze how pending and in-progress federal and state grants from other programs would impact the analysis.*

[3] *According to the FCC's National Broadband Map, as of February 16, 2023, there are 8,258,056 million unserved broadband serviceable locations in the United States (including eligible territories).*

[4] *For purposes of BEAD funding, the term "states" includes District of Columbia, Puerto Rico, American Samoa, Guam, the United States Virgin Islands, and the Northern Mariana Islands. See Infrastructure Act § 60102(a)(1)(M) and 47 U.S.C. § 942.*

[5] *This simple analysis divides the total BEAD funding by the total number of unserved homes and multiplies the result by 2 to account for the assumed 50% in match funding: $42,450,000,000 / 8,258,056 * 2 = $10,280. When the amount per home is calculated on a state-by-state basis, 26 states will have less than $10,280 per unserved home.*

[6] *The actual amount of BEAD funding per unserved location varies by state. Because each state will receive a minimum of $100,000,000 in funding ($25 million each for the territories except Puerto Rico), states with the most unserved locations will receive the least amount of funding per unserved location. For the 23 states with at least 100,000 unserved locations, the average amount per unserved location is only $9,926 (including an assumed 50% funding match).*

Wireless 20|20 uses the following methodology to determine whether available grant funding will support a fiber build:

1. Estimate the blended cost per mile for fiber deployment in the state, broken down by areas with similar deployment costs.
2. Calculate the number of fiber access miles required to pass all unserved locations in each area using the shortest or most economical paths.
3. Determine the total cost of access fiber by multiplying the fiber access miles for each area by the estimated cost per fiber mile in that area.
4. Subtract the result from the total funding available for the area (including estimated match funding) to calculate the total funding surplus or shortfall.

The fiber cost can also be determined on a per-location-basis by dividing the total cost of fiber by the number of unserved locations. Subtracting the result from the available funding per location then yields the funding surplus or shortfall on a per-location basis.

Wireless 20|20 has used this methodology to support hundreds of real-world deployments.

CASE STUDY – RURAL GEORGIA ANALYSIS

Wireless 20|20 applied this methodology to ten counties in Georgia to determine whether the funding available would be sufficient to provide fiber to all unserved locations in these counties.[7] The chosen counties, which are generally south of Atlanta, represent a typical mix of exurban and rural areas with an average of 1,795 unserved locations each.

Table 1

Total Funding Surplus or Shortfall

County Names	Unserved Locations	Fiber Miles	Fiber Cost	BEAD + Match Funding	Surplus or Shortfall
Bleckley	1,486	256	$ 18,946,960	$ 14,238,852	$ (4,708,108)
Crisp	1,805	332	$ 24,562,820	$ 17,295,510	$ (7,267,310)
Dodge	3,170	599	$ 44,326,000	$ 30,374,940	$ (13,951,060)
Dooly	1,485	360	$ 26,673,300	$ 14,229,270	$ (12,444,030)
Macon	1,853	434	$ 32,127,100	$ 17,755,446	$ (14,371,654)
Pulaski	976	291	$ 21,551,020	$ 9,352,032	$ (12,198,988)
Schley	1,155	214	$ 15,865,600	$ 11,067,210	$ (4,798,390)
Sumter	3,258	531	$ 39,257,000	$ 31,218,156	$ (8,038,844)
Taylor	985	294	$ 21,762,660	$ 9,438,270	$ (12,324,390)
Wilcox	1,781	431	$ 31,913,980	$ 17,065,542	$ (14,848,438)
TOTALS	17,954	3,743	$ 276,986,440	$ 172,035,228	$ (104,951,212)

Table 2

Per Location Funding Surplus or Shortfall

County Names	Unserved Locations	Fiber Miles	Fiber Cost	BEAD + Match Funding	Surplus or Shortfall
Bleckley	1,486	256	$ 12,750	$ 9,582	$ (3,168)
Crisp	1,805	332	$ 13,608	$ 9,582	$ (4,026)
Dodge	3,170	599	$ 13,983	$ 9,582	$ (4,401)
Dooly	1,485	360	$ 17,962	$ 9,582	$ (8,380)
Macon	1,853	434	$ 17,338	$ 9,582	$ (7,756)
Pulaski	976	291	$ 22,081	$ 9,582	$ (12,499)
Schley	1,155	214	$ 13,736	$ 9,582	$ (4,154)
Sumter	3,258	531	$ 12,049	$ 9,582	$ (2,467)
Taylor	985	294	$ 22,094	$ 9,582	$ (12,512)
Wilcox	1,781	431	$ 17,919	$ 9,582	$ (8,337)
AVERAGES	1,795	3743	$ 16,352	$ 9,582	$ (6,770)

The analysis resulted in a total funding shortfall of $105 million with an average shortfall of $10 million per county. The average shortfall per location is $6,770.

This analysis should not be construed as proof that BEAD funding will not support fiber connections for all unserved locations in every county or state. For example, because the minimum initial allocations are provided to each state without regard to current broadband access, the District of Columbia will receive more than $1 million per unserved location.

The analysis should instead serve notice that many states will face difficult decisions when deciding where and how to distribute BEAD funding in ways that maximize the number of unserved homes that ultimately receive broadband access.

[7] *Details regarding the methodology and the data and the assumptions underlying the analysis are provided in Section 3.*

METHODOLOGY

Unserved Homes

The number and locations of unserved homes were sourced from the FCC's National Broadband Map Fabric data, as of February 16, 2023. According to this source data, there are 341,905 unserved homes in the State of Georgia. An Interactive Dashboard with unserved locations for all states is available on the Wireless 20|20's website.[8]

Funding per Location

According to the Fabric, Georgia will receive a total of $ $1,638,106,638 in BEAD funding: $175,754,042 in high-cost funding,[9] $100,000,000 in minimum funding,[10] and $1,362,352,595 in remaining funding.[11] For the sake of simplicity, the analysis used the total amount of ~$1.6 billion to calculate the funding available (i.e., the analysis did not consider high-cost funding separately or the potential use of funding for planning purposes).

The analysis assumed BEAD funding will be made available on a pro-rata basis—i.e., the amount of BEAD funding per location was determined by dividing the total BEAD funding allocated to Georgia by the number of unserved locations in the state.

This resulted in $ $4,791 per location in BEAD funding,[12] which equates to $9,582 in total funding per location with an assumed 50% in match funding from the service provider.

The total funding available for each county was calculated by multiplying the number of unserved locations in the county by the $9,582 in total funding available.

Fiber Mile Costs

The cost to build one mile of fiber varies depending on several factors, including the cost of labor, availability of contractors, and the cost of materials.

The most significant impact on fiber deployment costs is whether it can be installed on existing utility poles (aerial fiber) or must be buried underground (buried fiber). Buried fiber typically costs $150K to $300K per mile, while aerial fiber typically costs between $40K to $100K per mile. For this analysis, we assume that 90% of the fiber is aerial (at an assumed average cost of $60K per mile) and 10% is buried (at an assumed average cost of $200K per mile), resulting in an average cost of $74K per blended mile.[13]

Number of Access Fiber Miles

Calculating the number of access fiber miles required to cover a specific set of unserved locations requires sophisticated geospatial optimization software or field surveys to determine the minimum cost paths among the locations. The analysis made this determination for the Fabric's unserved locations using Wireless 20|20's WiROI™ db

[8] *See* Interactive Dashboard.

[9] *See Infrastructure Act § 60102(c)(1).*

[10] *Id. § 60102(c)(2).*

[11] *Id. § 60102(c)(2).*

[12] *The calculation is as follows: $1,656,317,169 / 341,905 = $4,844.*

[13] *The calculation is as follows: (.90 * $60,000) + (.10 * $200,000) = $74,000. A more accurate approach would automatically classify the number of aerial and underground miles using our AI software.*

software, which automatically designs access fiber networks using road data from the U.S. Census Bureau. An example of the software's output is provided in ***Figure 1***, which depicts the access fiber design for Crisp County. Interactive maps of all ten counties are available on the Wireless 20|20 website.

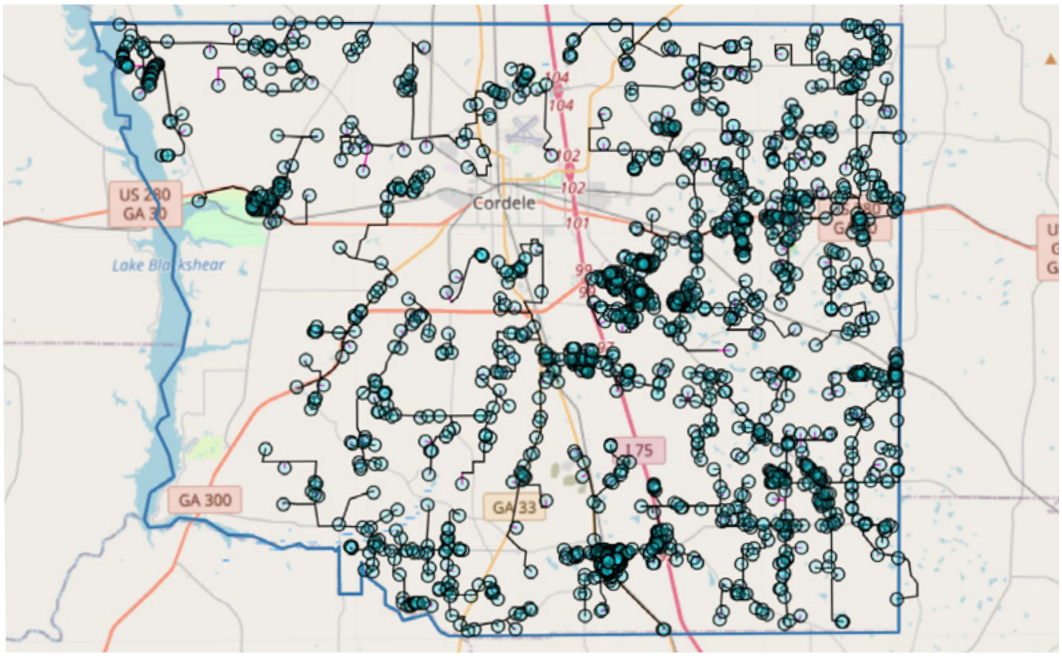
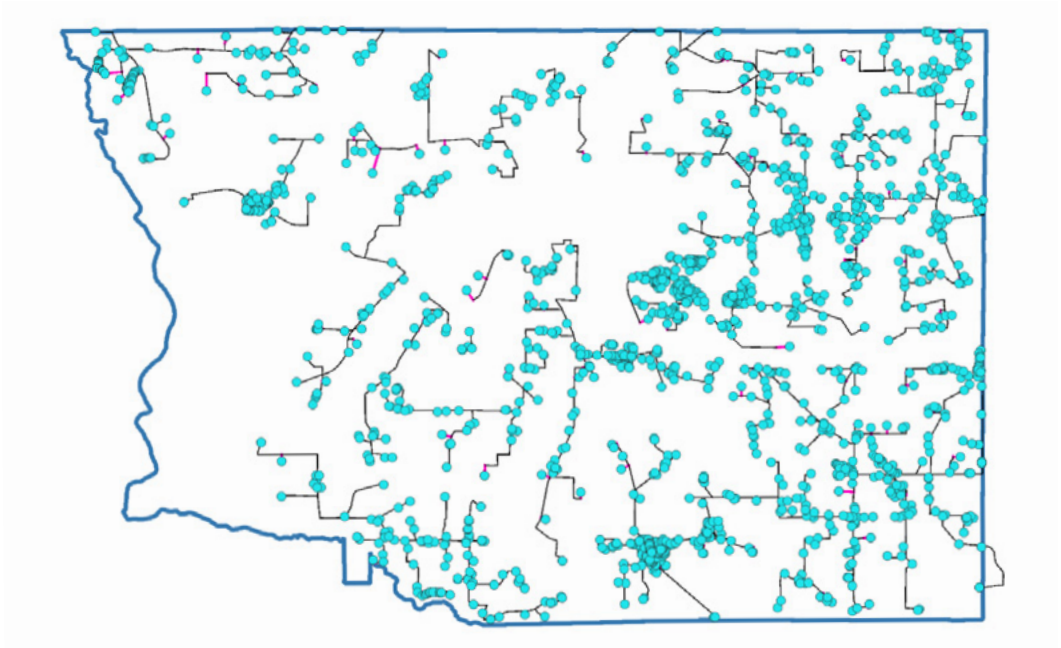


Figure 1
Fiber Route Miles Needed to Connect All Unserved Locations in Crisp County, GA



Incumbent Fiber Provider's Advantage

An analysis of a large number of US counties reveals the number of fiber-miles needed to connect a given set of unserved locations varies greatly based on the assumed service provider, and that incumbent fiber providers typically have an advantage since they have existing fiber networks within close proximity of unserved locations. For example, if the service provider doing the analysis is an incumbent service provider in the target county, it will generally take them fewer miles to connect the unserved locations compared to another service provider who has no existing infrastructure in the county. For the Georgia, 10-county case study, our fiber miles analysis assumes incumbent service providers will deploy fiber to the unserved homes, i.e., the endpoints of the fiber mile network terminate at the borders of incumbent services areas, as determined by reference to the FCC's National Broadband Map. This choice leads to the lowest cost option since an incumbent operator will have to install the least number of miles to connect the unserved location.

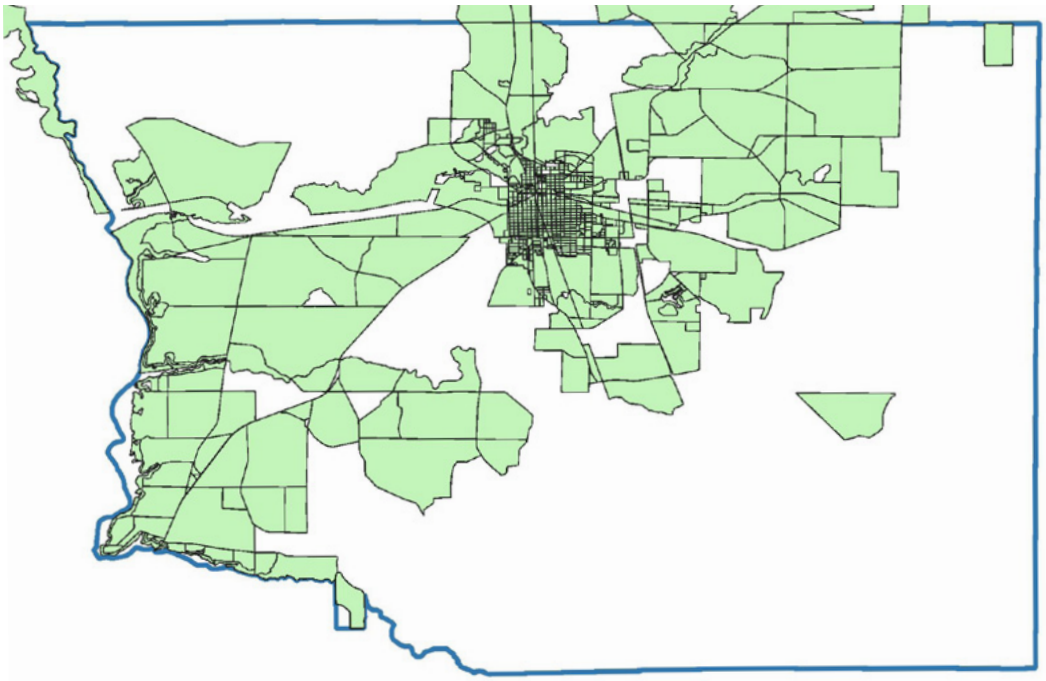


Figure 2

Served Areas of Incumbent Fiber Providers in Crisp County, GA.

"While BEAD funds are allocated on the basis of the number of unserved locations, the CapEx needed to serve these unserved locations is calculated by the number of fiber miles."

CONCLUSION

While BEAD fund are allocated on the basis of the number of unserved locations, the CapEx needed to serve these unserved locations is calculated by the number of fiber miles. The number of fiber miles needed to cover a certain area of unserved locations requires sophisticated fiber design tools. The traditional method of conducting field surveys was time-consuming and expensive and the existing fiber design tools were not fast enough to produce a massive amount of fiber designs for each county and state. A new approach was needed to fiber design estimate which would allow bidders and state governments to quickly estimate the number of miles needed to connect the unserved areas in each county. Wireless 20|20 developed the WiROI™ db software which allows users to quickly calculate the number of miles needed to connect the unserved locations in a given county.

Our analysis of over 800 counties in the USA shows that most states may not have sufficient funding to bring fiber to every unserved location in each county. Therefore, service providers who plan to bid for BEAD funding and state agencies distributing BEAD funding will have to make some difficult choices, such as who gets funding, and how much funding is needed per area. Counties, locations, and technology choices have to be prioritized. These priorities and choices cannot be made effectively without a maps-based analysis that shows, among other things, the fiber route miles needed to connect the unserved locations.

The Wireless 20|20 WiROI™ db 2.1 Tool was used to search, categorize, map, and prepare this analysis.

Wireless 20|20 has developed tools and services for large-scale BEAD analysis, which include:

1. Fast fiber design and cost estimation process to calculate and map accurate fiber miles data
2. AI-based algorithms for automatic and fast Aerial/Underground classification.
3. Fixed Wireless design, cost estimation, and mapping tools for cellular coverage analysis.
4. Business case analysis tools and interactive dashboards help vary the assumptions and produce custom ROI analyses.

For a demo and more information, please visit our website.

This White Paper was authored by Fred Campbell, Berge Ayvazian, and Haig Sarkissian.

Wireless 20/20 helps mobile operators and their vendors develop their Wireless Network strategies, service offerings, marketing plans, technology roadmaps and business cases. Wireless 20|20 also leverages its WiROI™ Business Case Analysis Tools to assist clients in issuing RFPs and evaluating responses.

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