Bell Labs Consulting

Going the extra mile with BEAD intelligence: Assessing the incumbent advantage

White paper

Contents

The incumbent advantage

With the advent of programs such as the Broadband Equity, Access and Deployment (BEAD) program, unserved and underserved communities throughout the United States are now benefiting from a massive broadband transformation. This transformation will help spur the development of states and territories into vibrant digital economies that can serve the needs of people and businesses.

To ensure affordable access and lower costs for consumers, states must make every effort to promote competition among service providers. In areas without existing served locations, deployments to unserved and underserved locations may automatically be considered as greenfield deployments. In such scenarios, every service provider is essentially a new entrant and the costs of optimally connecting these locations are similar across providers. However, this is no longer the case in brownfield scenarios where unserved and underserved locations are interspersed with served locations, and incumbent providers may have a significant cost advantage over new entrants.

To achieve affordable universal coverage while making optimal use of available funding, states must understand and assess the incumbent cost advantage to appropriately incentivize new entrants or incumbents based on the applicable situation. One alternative for states to promote competition in brownfield areas is to ignore the existing served locations and treat the unserved and underserved locations as a greenfield deployment. However, this may drive up the total costs, and a higher provider cost share may be required to offset the costs incurred by the state.

The de facto alternative that relies on incumbents' fiber expansion may also pose a problem for states in certain scenarios. For example, incumbent providers may be unwilling or reluctant to extend fiber from served locations to unserved and underserved locations due to a lack of an attractive business case. In other scenarios, the incumbent providers may ask states to consider deployments from ongoing or previous projects to be considered as "in-kind" cost share contributions, which would implicitly drive-up subsidies by the states and in turn drive up the total expenditure.

In this paper, through detailed techno-economic modeling and analysis, we investigate the cost of optimized fiber (FTTx) broadband deployments to unserved and underserved communities across a specific representative state, North Carolina, assuming disparate greenfield and brownfield deployment scenarios. Specifically, we derive key insights related to the gap between the cost incurred by new service provider entrants (greenfield deployments) and the incremental cost incurred by incumbent service providers for expanding coverage to new locations by extending fiber from existing served locations (brownfield deployments). We then identify counties within the state that are good candidates for promoting competition between new entrants and incumbents to achieve universal coverage while creating opportunities to reduce costs borne by the state.

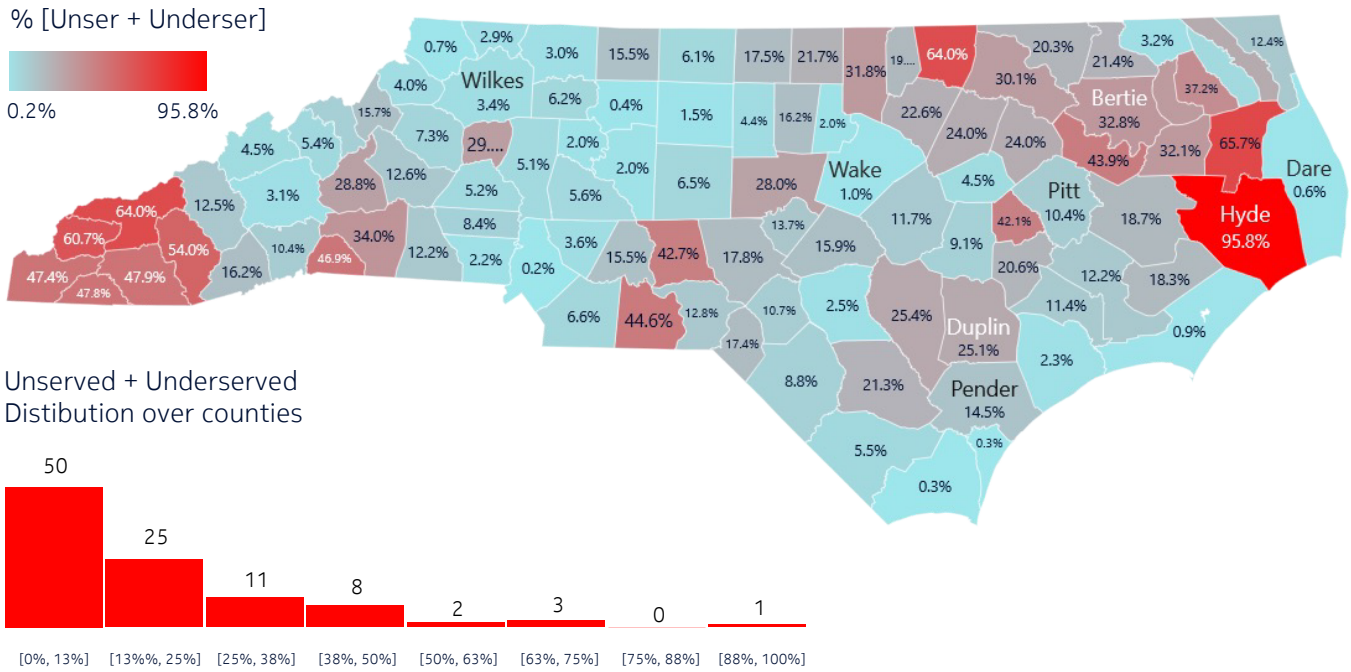
Assessing the incumbent advantage

In the following, we analyze the incumbent advantage by considering the distribution of unserved and underserved locations across the state of North Carolina and by analyzing different deployment scenarios and provider cost share methodologies. The analysis is based on data extracted from the FCC national broadband fabric where locations were identified by Hexbins (hexagonal geographic units corresponding to h3_res8 granularity from the H3 Geospatial Indexing System and spanning approximately 0.74 sq km area) as well as census tract and census blocks.

North Carolina unserved and underserved landscape

The data extracted from the FCC broadband fabric shows a total of 4.33 million locations in North Carolina of which approximately 90% are served, 7% are unserved and 3% are underserved. However, mapping these locations reveals a large disparity between unserved/underserved locations among counties (see Figure 1). The fraction of unserved and undeserved locations ranges from 0.2% at the low end (Mecklenberg county) to 95.8% at the high end (Hyde County). Note that one out of every four counties shows that at least 25% of locations are unserved/underserved.

Figure 1. Distribution of unserved/underserved locations per county

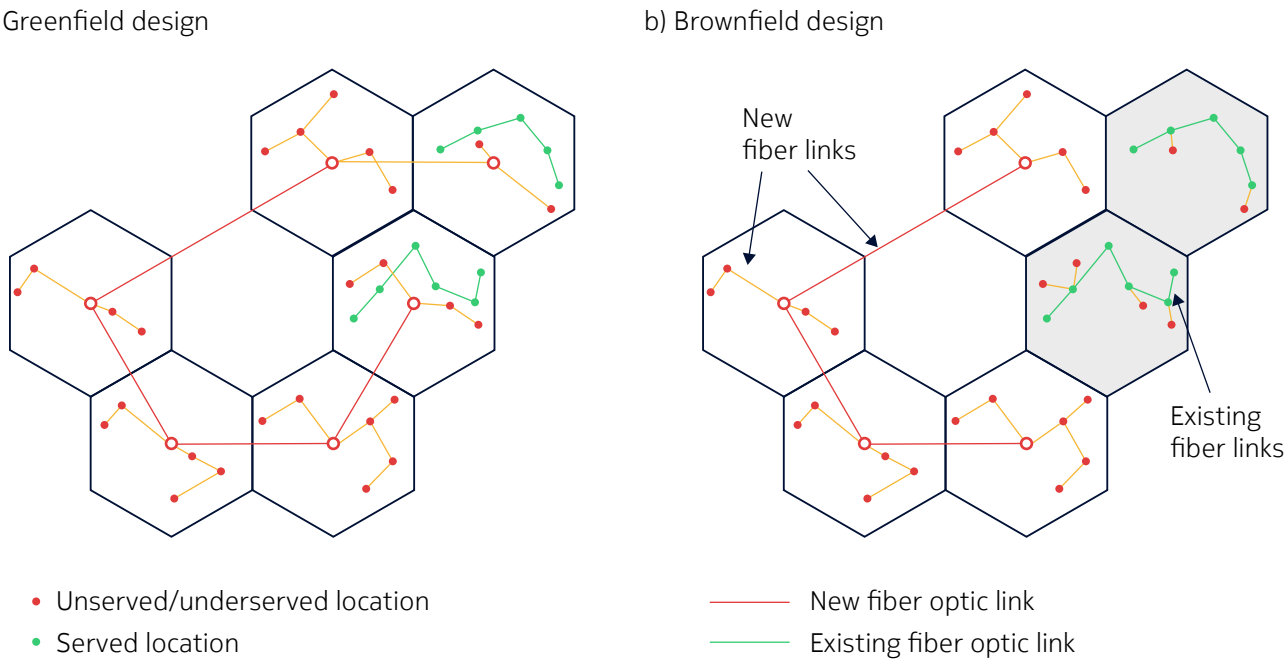


Total cost for new entrant vs. incumbent expansion

As illustrated in Figure 2, we first consider the total cost of fiber optic network deployments to unserved and underserved locations under the following design scenarios:

- Greenfield scenario (new entrant)—the greenfield design assumes that all new unserved/underserved locations must be connected with new fiber optic infrastructure regardless of any existing deployments in close proximity. This comprises determining feeder and distribution networks that interconnect different Hexbins and all locations within each Hexbin.
- Brownfield scenario (incumbent expansion)—the brownfield design is performed as follows:
  - All Hexbins with only unserved/underserved locations are interconnected with new fiber as in the greenfield design scenario
  - All Hexbins (shown in purple in Figure 2) with a mix of served, unserved, and underserved locations will just extend existing fiber to unserved/underserved locations. Shorter fiber lengths will be needed to connect these locations compared to the greenfield case.

Figure 2. Greenfield and brownfield design approaches



Under these design assumptions for both the greenfield and brownfield scenarios, the required fiber lengths are derived and the costs of deploying the fiber optic networks are estimated assuming a deployment cost of $6 per foot. The brownfield scenario leads to substantial cost savings of approximately $1 billion for the entire state. Figure 3 maps the percentage of fiber optic network cost savings for brownfield deployments relative to greenfield for each individual county. Figure 4 shows the distribution of actual cost savings in millions of dollars. Cost savings range from 2% ($0.4M) to 63% ($26.8M). The average cost saving delivered by brownfield deployments relative to greenfield is approximately 30% or $9.8 million per county.

Figure 3. Cost savings (Capex) of brownfield deployments over greenfield range in each county from 2% to 63%

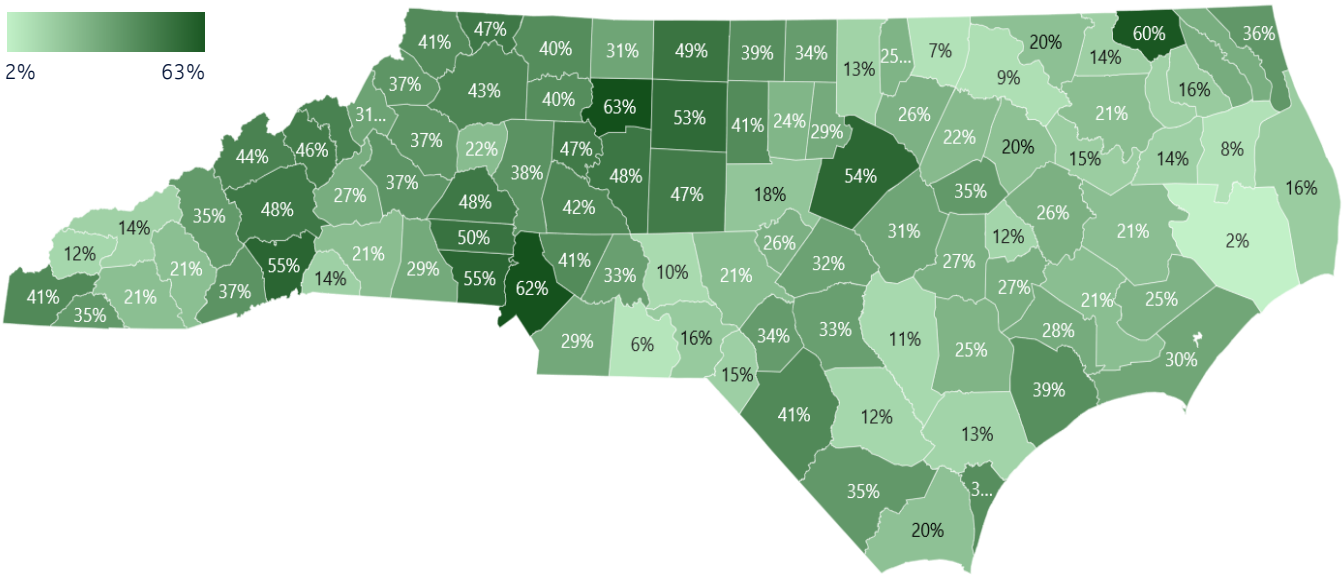
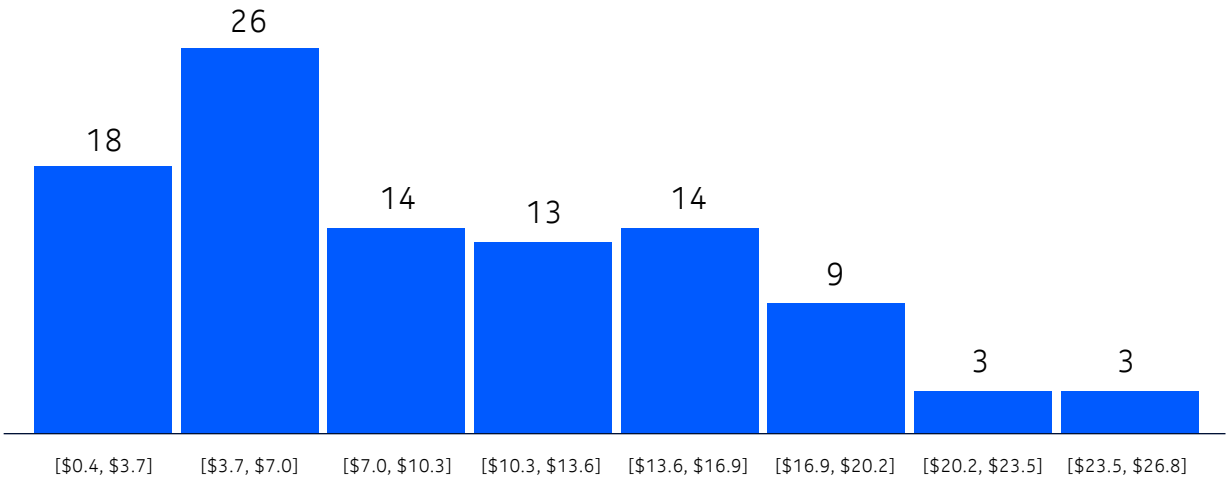


Figure 4. The distribution of cost savings (Capex) of brownfield deployments over greenfield range in each county from $0.4 million to $26.8 million



While these cost savings are substantial, they do not provide much insight into the economic feasibility for service providers (i.e., in terms of achieving payback over a reasonable time period) or whether there are any real opportunities for states to promote competition. In order to understand these aspects better, we dig a little deeper into the provider cost share and resulting payback periods in both brownfield and greenfield scenarios.

The business case analysis assumes that $60/subscriber/month is allocated for investment recovery. The subscriber take rate is based on North Carolina “affordability” rates for each county (approximately 82% when averaged over all counties).

Provider cost share and payback period

To realize the goals of nationwide deployment of fiber broadband, federal programs such as BEAD have proposed nominal matching of at least 25% of the costs by service providers. On one hand, from the service providers' perspective, an important consideration is their ability to recover their investment over a reasonable payback period. On the other hand, from the states' perspective, they would like to encourage high provider participation in the program and open bidding to as many new and incumbent service providers as possible. To achieve this, they need to manage the cost share burden so that payback periods are more or less similar among the awarded project areas.

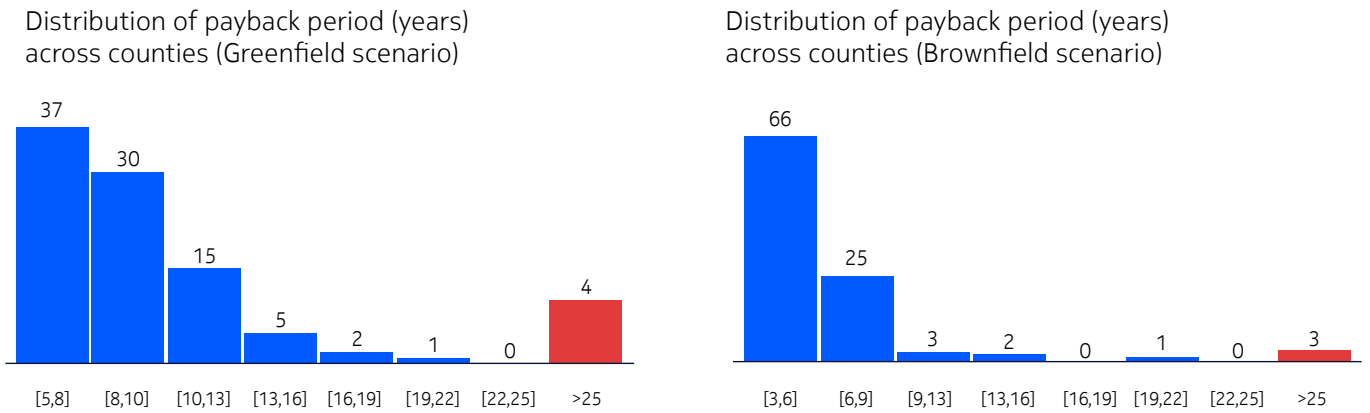
Fixed cost share

One approach for sharing costs between the state and service providers is to require a fixed provider match or cost share of 25% with the state bearing 75% of the fiber optic network deployment costs, which is consistent with the objectives of the BEAD program for broadband deployments in the United States. With a fixed 25% cost share for service providers, the payback period varies dramatically for each county given the wide spread of network cost results obtained for greenfield and brownfield scenarios.

Under a greenfield design assumption (for new entrants), the payback period ranges from 4.7 years to beyond 25 years with 10 counties requiring payback periods of more than 25 years (see payback period distribution in Figure 5). In these 10 counties, the state will need to bear the full cost of the fiber network deployment due to the lack of a feasible business case for service providers. Note that we limit the maximum payback period to 25 years based on the estimated lifetime of the fiber network.

The brownfield design assumption (for incumbents) reduces the fiber network costs by leveraging existing infrastructure. This automatically results in smaller payback durations. In contrast to greenfield deployments, only three counties do not achieve payback in less than 25 years (see Figure 5). In addition, the average payback period for brownfield deployments is only 6.9 years which is significantly lower (a 39% reduction) than the 10.6 year average payback that we observe in greenfield deployments across the state.

Figure 5. Payback period distribution (25% fixed service provider cost share)



To alleviate the significant variability in payback durations and the unacceptably long payback periods created by fixed cost share for some counties, one could resort to a different strategy referred to as "variable cost share", which we discuss below.

Variable cost share

With a variable cost share strategy, the payback period is set to a target value. The provider cost share (as a fraction of the total fiber network cost, which would require that payback duration) is then estimated considering the expected revenues, which in turn depend on the take rates and subscription costs. This will produce a different cost share for each county while maintaining the fixed payback period selected.

For determining the variable cost share for each county in the greenfield and brownfield scenarios, we propose to fix the target payback period to match the average payback period determined from the fixed 25% service provider cost share for greenfield and brownfield scenarios, respectively.

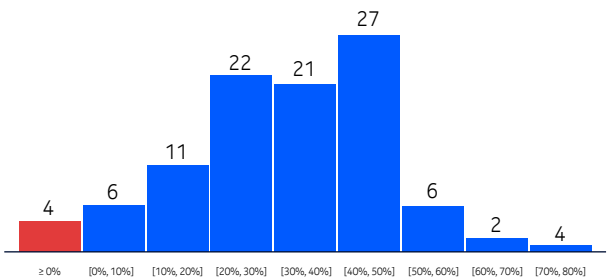
The 25% fixed cost share assumption yielded an average payback period of 10.6 years for the greenfield design and 6.9 years for the brownfield design. Fixing the target payback period to 10.6 years for each county, we determine the individual cost share for each county such that the investment is recovered in the 10.6 years. The same exercise is repeated for the brownfield design but with a target payback period of 6.9 years. Figure 6 captures the distribution of the resulting service provider cost share for both the greenfield and brownfield scenarios.

For the greenfield design, the service provider cost share varies from 0% to 75% across the counties with an average of 32%. In addition, the introduction of variable cost share reduces the number of counties requiring 100% state funding from ten down to four. The variable cost share also lowers the overall state cost subsidy from 75% to 62% while it increases the service providers' overall cost share from 25% to 38%.

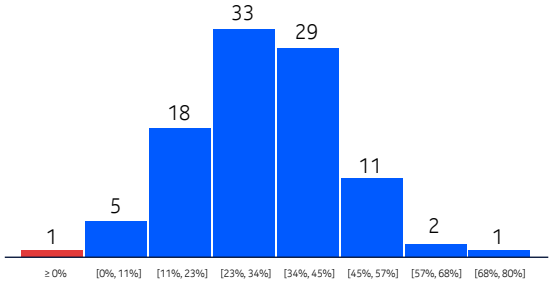
For the brownfield design, the service provider cost share varies from 0% to 80% with only one county requiring 100% funding from the state. The redistribution of cost with variable cost share for a target payback period of 6.9 years decreases the state's overall contribution by 13% and increases the service providers' share by 38%.

Figure 6. Service provider variable cost share distribution with a payback period of 10.6 years for greenfield and 6.9 years for brownfield, respectively

Distribution of provider cost share across counties for average payback period of 10.6 years (75% state subsidy, Greenfield)



Distribution of provider cost share across counties for average payback period of 6.9 years (75% state subsidy, Brownfield)

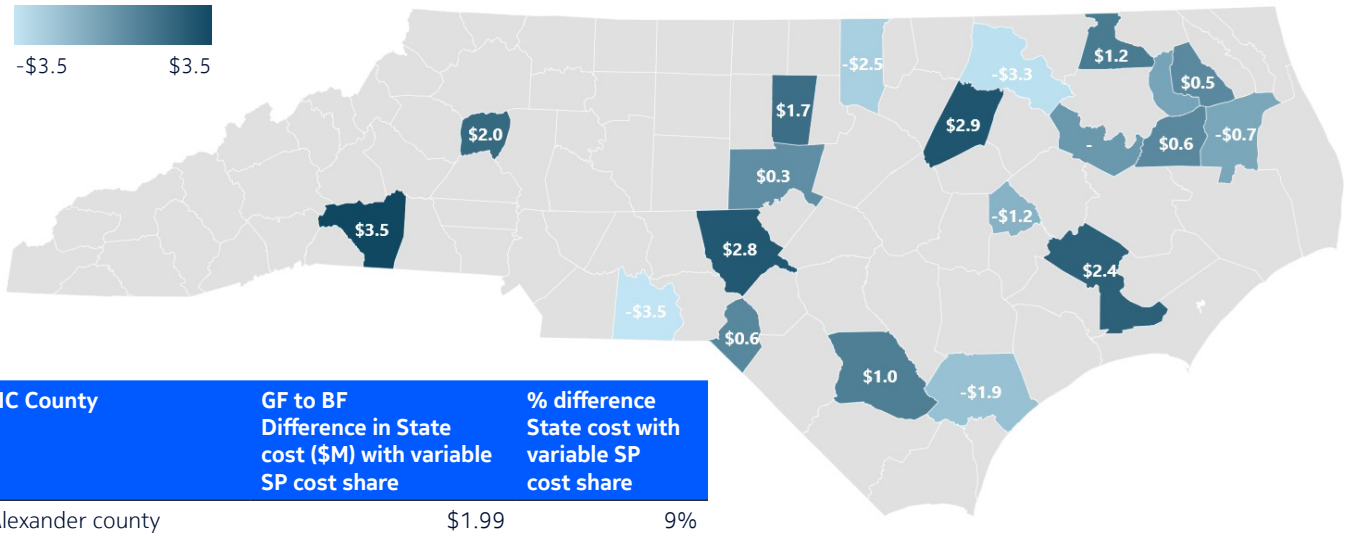


Impact of variable cost share on new entrant vs. incumbent expansion

An interesting observation from our variable cost share investigations for the fiber optic network design is that the state cost contribution for a subset of counties lies within +/- 10% when we compare greenfield to brownfield. This is illustrated in Figure 7.

As observed from the table included in Figure 7, the gap with respect to greenfield is either positive or negative but small (< +/-10%) for all the counties listed. From a state subsidy perspective, it could favor either scenario, greenfield or brownfield.

Figure 7. Counties with +/- variation in state cost contribution



NC County	GF to BF Difference in State cost ($M) with variable SP cost share	% difference State cost with variable SP cost share
Alexander county	$1.99	9%
Anson county	-$3.47	-9%
Bladen county	$1.05	3%
Chatham county	$0.32	1%
Chowan county	-$0.62	-5%
Craven county	$2.38	9%
Granville county	-$2.54	-6%
Green county	-$1.23	-7%
Halifax county	-$3.25	-7%
Hertford county	$1.24	7%
Martin county	-$0.07	0%
Moore county	$2.78	7%
Nash county	$2.88	8%
Orange county	$1.74	7%
Pender county	-$1.87	-7%
Perquimans county	$0.54	3%
Rutherford county	$3.47	7%
Scotland county	$0.64	4%
Tyrrell county	-$0.72	-7%
Washington county	$0.58	4%

This opens up an opportunity for new entrant providers (greenfield) to compete with incumbents (brownfield) for a similar amount of state funding. The state is faced with two possibilities:

- Promote competition—with a similar subsidy, the state is now able to open up to 20% of the counties to new entrants. This has the potential to foster competition that drives down the costs of broadband in those counties and improves overall affordability.
- Reduce state subsidy through negotiation with service providers—the threat of bringing in new entrants gives the state negotiating power to request higher cost share contributions from incumbents who seek to defend their service area. This will create a different form of competition between incumbents and new entrants, which could reduce the burden on the state. Any funds that are freed up can then be used in areas where the state must provide additional subsidies to ensure universal broadband coverage to all unserved and underserved locations.

Key insights

Our detailed studies on fiber optic network design and economic modeling highlight the cost incurred and the impact of provider cost share strategies on economic sustainability in greenfield and brownfield scenarios. Several key observations and insights are summarized below:

1. Significant disparities among counties in terms of the fraction of unserved and underserved locations and their densities raise questions about the required service provider cost share and the economic sustainability of broadband networks in terms of achieving reasonable payback periods.
2. With several previous programs (Rural Digital opportunities Fund, Connect America Fund, Capital Projects Fund, Reconnect, American Rescue Plan Act, etc.) that have funded broadband deployments in the United States, unserved and underserved locations are often located in areas where there are also served locations in close proximity, and it is advantageous to consider brownfield designs in these cases. This provides a significant advantage to incumbent service providers.
3. Brownfield designs can lead to significant reductions (30%) in total costs.
4. Fixed cost share leads to significant variability in payback periods for new entrant and incumbent service providers and unacceptably long payback durations (even longer than the network lifetime) in some counties; the number of counties with extremely long payback durations is reduced with brownfield deployments.
5. Project areas with unacceptably long payback durations provide no opportunity for service provider investment, and states will have to bear the entire cost of network deployment in these areas to achieve universal coverage.
6. Fixed cost share benefits the incumbent service providers and provides a 28% cost savings to the state but limits new entrants, giving rise to non-competitive environments.
7. Introducing variable cost share based on a reasonable payback period reduces the state cost subsidy in most counties.
8. Variable cost share reduces the difference in state subsidies between greenfield designs (new entrants) and brownfield designs (incumbents) in several counties (20% of the counties in our analysis scenario). These counties are candidates to bring in new service provider entrants.
9. Variable cost share provides the state with means to create a more competitive environment for new entrants and leverage for negotiating higher cost share from incumbent service providers. This has the potential to either improve affordability for broadband consumers or reduce the state cost subsidies and increase availability of funds for connecting additional unserved and underserved locations.

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Abbreviations

BEAD	Broadband equity, access and deployment program
FTTx	Fiber to the home, curb, antenna, building, premises, node, etc.
Hexbin	Hexagonal geographic units corresponding to h3_res8 granularity from the H3 Geospatial Indexing System and spanning approximately 0.74 sq km area

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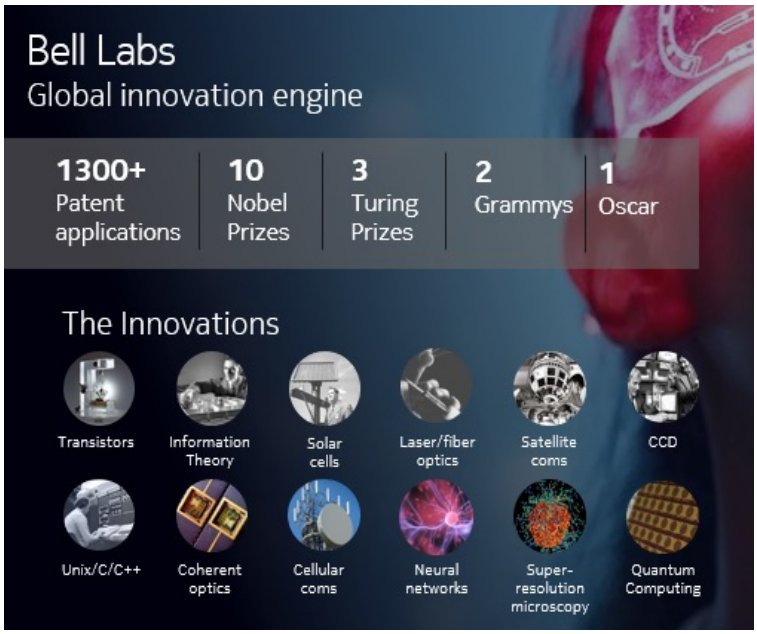

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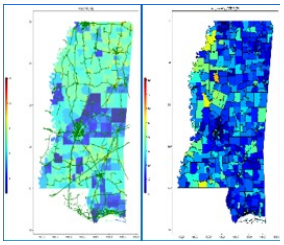
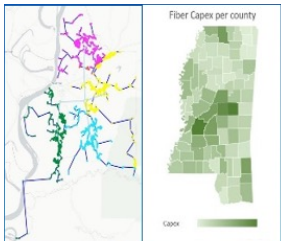
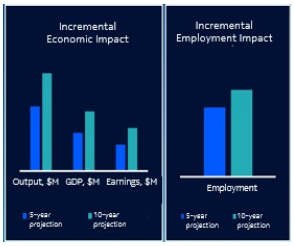


Data modelling and classification



Optimal fiber network design and prioritized zones of investment



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