

If We Build It, Will They Come? Lessons From Open-Access, Middle-Mile Networks

Jordan Arnold & Jonathan Sallet

**Published by the Benton Institute for Broadband & Society
December 2020**

If We Build It, Will They Come?

Lessons from Open-Access, Middle-Mile Networks

by Jordan Arnold & Jonathan Sallet¹

Published by the Benton Institute for Broadband & Society
December 2020



Broadband Delivers Opportunities
and Strengthens Communities

727 Chicago Ave.
Evanston, IL 60202
www.benton.org

This work is licensed under the Creative Commons Attribution-Noncommercial 3.0 United States License. A copy of this license is available at <http://creativecommons.org/licenses/by-nc/3.0/us/>

Please include the following attribution when citing this report:

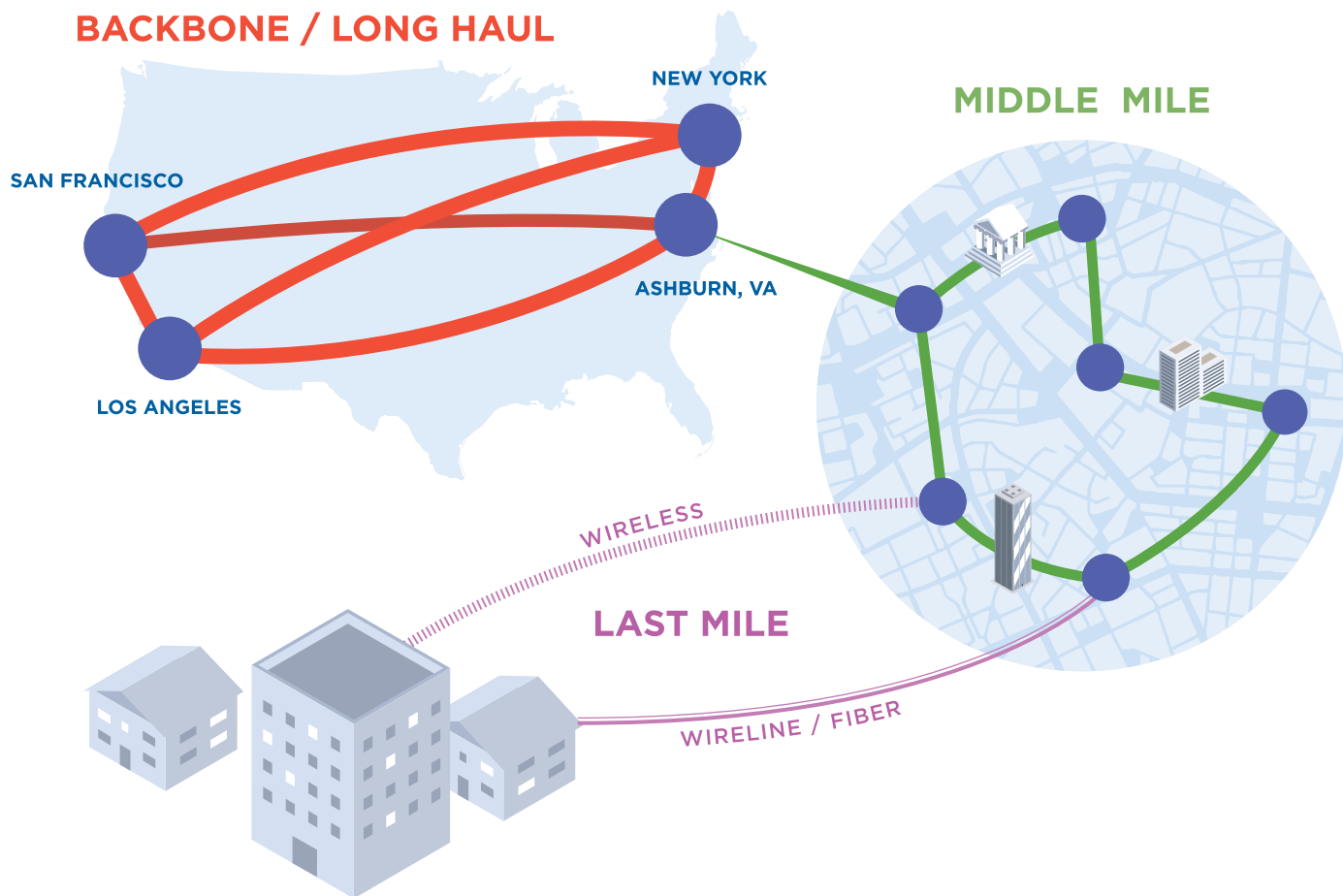
Arnold, Jordan & Sallet, John. "If We Build It, Will They Come? Lessons from Open-Access, Middle-Mile Networks" Evanston, IL: Benton Institute for Broadband & Society, December 2020. <https://www.benton.org/publications/middle-mile>

Introduction

Residential and small-business customers have too few options for fixed, robust broadband service, what we refer to as “High-Performance Broadband.”² Fixing our deployment and competition problems requires the construction of new broadband networks. In other words, we need more competition, and we need more broadband deployment. This policy brief concentrates on one solution—the construction of open-access, middle-mile networks.

“Open-access” means the network permits any broadband provider³ to connect to the network on nondiscriminatory terms and conditions.⁴ “Middle-mile” networks reach from national and major regional internet backbones to a local connection site (which could be a school or library but which could not be, by definition, a residence).⁵

Thus, middle-mile networks bring data to and from an internet backbone (like the large internet hub in Ashburn, Virginia) to a connection point in a city or town (like Arlington, Virginia) where, in turn, traffic is handed off to the “last mile” network that connects to, say, a home. Each blue dot denotes an “interconnection point,” where two networks can exchange traffic:



The fundamental economic principle is simple: Open-access, middle-mile networks can provide the savings that spur last-mile providers to build further and faster to reach residences. In this way, an open-access, middle-mile model promotes private investment and competition in last-mile service by reducing capital expenditures required to build last-mile connections.

And yet, when we talked to policymakers over the past two years about building open-access, middle-mile networks, county commissioners to members of Congress posed the same question again and again: If we build it, will they (the broadband providers) come?

The answer is that they have. Experience supports funding open-access, middle-mile networks—and federal backing of smart state and local strategies that include construction of such networks.

For example, Joe Freddoso, the former president and CEO of MCNC, which operates the North Carolina Research and Education Network, and Joanne Hovis, the president of CTC Technology & Energy, provide validation of the cost savings of middle-mile access:⁶

- **Providing Broadband Where Broadband Is Scarce:** In Nevada, Route 50 is so remote that it's been called the loneliest road in America.⁷ For 257 miles, cutting through the heart of gold- and mineral-mining territory, there is little if any fiber to which last-mile networks can connect. Communities rely on fixed wireless. But when new construction linked a school, the sheriff's office, and a local mine, the cost for connectivity for the school went down by more than 90 percent.
- **The High Cost of Monopoly Middle Mile:** Elko, Nevada, offers a different example. There, a single network is available to support last-mile service. Freddoso calculates that “costs on a monopoly route tend to be about 6X more expensive than on routes where there are competitive choices. Transport is now about 25-35 cents a Mbps on competitive routes for 10 Gigabytes...I have seen 10 Gigabyte transport prices at about \$1.20 per Mbps in monopoly markets.” Demand among business, the military, and last-mile providers other than the incumbents is strong for leased dark fiber on competitive routes, where competitive pricing can lead incumbent providers⁸ to halve their prices for middle-mile connections.
- **The Savings in Residential Deployment:** In Alford, Massachusetts, a rural town of roughly 350 residents, the presence of the MassBroadband 123 middle-mile network saved the town the cost of building fiber to the closest internet point-of-presence—20 miles away. The cost of building that middle-mile connection would have been more than the town's \$1.5 million cost to build fiber-to-the-premises to all residents of Alford.

In addition, savings can be achieved when open-access, middle-mile networks support service to multiple categories of customers, which can include community anchor institutions (such as schools, government buildings, hospitals, and libraries) as well as residential customers. A recent example comes from Minnesota, where a federal grant from the United States Department of Agriculture funded a local telephone company to provide fiber-to-the-home service to residential customers at a lower cost because the new construction would “leverage existing middle-mile infrastructure.”⁹ Similarly, the middle-mile network constructed in South Bend, Indiana, received its initial support as a means to connect governmental and large institutions, including the University of Notre Dame.¹⁰ Once built, such networks can serve as launching pads for local broadband expansion. The savings

in time and money for a last-mile provider can make more construction more affordable. From its review of state broadband efforts, the Pew Charitable Trusts (Pew) concludes that “investment in middle-mile infrastructure facilitates last-mile deployment.”¹¹ For example, the Three Ring Binder, a fiber network that runs over a thousand miles in rural Maine, has helped reduce the cost of providing broadband in both unserved and underserved communities.¹²

Not surprisingly, open-access, middle-mile networks have found support from state and local governments that are looking for ways to ensure that their residents have the chance to be served by scalable networks that meet future demand, especially given the increase in broadband usage triggered by the COVID-19 crisis.

As Kathryn de Wit and Anna Read have explained in a 2020 report from Pew, states are leading the way in demonstrating the practical impact of open-access, middle-mile networks.¹³ For example, Arizona and New Mexico have both identified the strategic importance of middle-mile to connect rural and Tribal communities moving forward.¹⁴ And Colorado provides funding and technical assistance for middle-mile infrastructure projects.¹⁵

This policy brief explains why and how the federal government should support the construction of open-access, middle-mile networks and how that support can be structured. Part II provides background on different kinds of open-access, middle-mile networks across the nation. Part III proposes the structure for a federal open-access, middle-mile grant program, incorporating the lessons we have learned about what boosts the chance for open-access, middle-mile success. Part IV focuses on the reasons the construction of open-access, middle-mile networks furthers deployment and competition.

Open-Access, Middle-Mile Networks: A Brief Overview

As Evan Feinman, the Virginia Governor’s chief broadband advisor, explains, “While not perfect for every setting, open-access, middle-mile networks, like Mid-Atlantic Broadband, are incredible assets for the communities that they serve.”¹⁶ Because they respond to state and local needs, open-access middle-mile networks are not all the same. In this section, we describe five common forms they can take.

Research and Education Networks

Almost 40 state research and education networks reach across the country and connect more than 900 institutions of higher education and thousands of community anchor institutions.¹⁷ Indeed, such networks “provide secure, high-capacity, high-performance network infrastructure and related technical and operational support” for entities that include governments (including public safety), schools, libraries, health care, and other community anchor institutions.¹⁸

The Illinois Century Network (ICN) is a leading example—providing reliable, affordable service for schools, libraries, and other anchor institutions, as well as access for broadband providers to reach people in Illinois who otherwise would lack service. ICN now connects more than 6,000 community anchor institutions with about 2,100 miles of fiber-optic network throughout the state.¹⁹ The presence of the ICN reduces the prices community anchor institutions pay for their broadband service.²⁰ As Lori Sorenson, chief technology officer of the State of Illinois Department of Innovation & Technology, explains, the network began by connecting educational facilities, but later, broadband providers approached the network about leasing fiber to them.²¹ Thus, starting in 2013, the network began selling service to commercial providers, lowering the cost of entry in rural and underserved regions of Illinois.²² Forty providers use ICN to deliver last-mile service.²³ For the Illinois Electric Cooperative, operating in a low-population-density part of Illinois—and serving some towns with populations numbering just in the hundreds—the ability to connect to ICN made it financially feasible to deploy fiber to the home, even as its rival, the local incumbent provider, continued to operate slow internet service over a traditional copper network.²⁴

Statewide Networks

In 2000, several public utility districts in the state of Washington formed the Northwest Open Access Network (NoaNet); it had, as a NoaNet executive explained, “ringside seats” to the digital divide.²⁵ In the past two decades, the network has grown to about 3,300 miles, touching every county in Washington and connecting 170 communities in both urban and rural areas.²⁶ The network also connects 2,000 community anchor institutions.²⁷ More than 60 broadband providers offer last-mile service using NoaNet.²⁸

Intra-State Regional Networks

The Mid-Atlantic Broadband Cooperative (MBC) was formed in 2004 to reduce the cost of providing last-mile service in rural Virginia and to give the region a needed economic boost.²⁹ CEO Tad Deriso says that with traditional industry leaving the region, MBC saw broadband as a necessity to attract new businesses, including technology companies.³⁰ With funding from sources that included the Virginia Tobacco Commission and the National Telecommunications and Information Administration's Broadband Technology Opportunity Program, established by the American Recovery and Reinvestment Act, the 1,900-mile network now connects 32 counties across southern and southeastern Virginia, and 45 service providers use MBC to deliver last-mile service.³¹ By its calculation, MBC has spurred \$2.1 billion in private investment and helped create 1,100 jobs for the region.³²

Project THOR is a relatively new middle-mile network in northwest Colorado, owned by a group of local governments and operated by a local broadband provider, Mammoth Networks. The region needed more middle-mile infrastructure because the existing networks lacked redundancy, and the region suffered through frequent, hours-long network outages, which affected not only residences but also schools, public-safety centers, and hospitals.³³ The initiative built new fiber and leveraged existing fiber to create a 400-mile network that connects 14 different communities.³⁴

Maine's Three Ring Binder and Utah's UTOPIA, which connects businesses in more than 50 cities,³⁵ are also important examples of intrastate, regional middle-mile networks.

Local Networks

Some middle-mile networks are local efforts, connecting a single county or community. One such network is the Medina County Fiber Network, located about thirty miles south of Cleveland. The Medina County Port Authority began to build the open-access fiber ring around the county in 2010 to connect businesses in the area.³⁶ The network has had dramatic economic impacts on the community. Bethany Dentler, executive director of the Medina County Economic Development Corporation, estimates that 1,000 new jobs and half of the capital investment in the county are the result of deploying the fiber network.³⁷

The Roanoke Valley Broadband Authority in southwest Virginia and ConnectArlington in northern Virginia are two more examples of local open-access, middle-mile networks.

Extending Existing Infrastructure

In 2019, Virginia passed legislation that would enable the state's two largest electric utilities, Dominion Power and Appalachian Power, to build extra fiber to rural substations as they modernize their electrical networks.³⁸ Appalachian Power has partnered with Grayson County in rural Virginia, where many people have no broadband access at all, to create a middle-mile network that will be open to all broadband providers, including one that has already expressed interest.³⁹ The recently approved pilot project will deploy 238 miles of fiber on Appalachian Power utility poles in Grayson County.⁴⁰ Brad Hall, an Appalachian Power executive, explained that the utility has a personal stake in seeing the region succeed economically—if the economy of the service area is shrinking, then the utility will shrink, too.⁴¹

How to Create Successful Open-Access, Middle-Mile Networks

In the past, significant funding for open-access, middle-mile networks came from the National Telecommunications and Information Administration’s Broadband Technology Opportunity Program (BTOP), established by the American Recovery and Reinvestment Act. BTOP required recipients to build open-access networks.⁴² Several of the open-access, middle-mile networks described in this report began or significantly expanded as a result of BTOP funding.

More recently, the Accessible, Affordable Internet for All Act, which the House of Representatives passed in July 2020 as part of a larger infrastructure package, would give a preference in federal funding of network expansion to broadband providers who promise to open up their newly deployed networks to other providers.⁴³

Any federal funding programs for open-access, middle-mile should actively incorporate state and local perspectives. Indeed, Larry Strickling, the former administrator of the National Telecommunications and Information Administration (NTIA), who oversaw earlier federal efforts to support open-access, middle-mile networks, says that “any future grant program should allow anyone to apply, including local governments.”⁴⁴ Also, in the second phase of the BTOP application process, NTIA asked that states be explicitly included in the evaluation process. The governor’s office for each state received a list of applications under consideration, and each state could offer its views on the highest priorities.⁴⁵

Any open-access, middle-mile grant-application process should be designed to find projects most likely to succeed. Program guidelines and evaluation criteria should favor projects that (a) adopt sustainable middle-mile strategies, (b) work with broadband providers toward realistic business strategies, and (c) build community support.

A. Adopting Sustainable Middle-Mile Strategies

A successful open-access, middle-mile network requires a sound financial plan, with an eye on existing resources, and a time horizon that allows for long-term success. Careful planning, including early recognition of foreseeable risks, helps boost success. And open-access requirements must be monitored and maintained by governments that create them.

Line Up Adequate Financial Resources

The state of Colorado’s grant program for middle-mile network construction requires a 50 percent local match to accompany state funding.⁴⁶ Minnesota requires a 50 percent match from participants in its middle-mile grant program.⁴⁷ Similarly, the NTIA’s middle-mile grant program focused specifically on the ability of applicants “to convincingly demonstrate” their financial sustainability.⁴⁸

Identify Available Existing Infrastructure to Lower Costs

States and communities can identify existing infrastructure to pinpoint gaps and save money. Project THOR, a 400-mile network, cost only \$2.6 million to build because it was created largely

from existing commercial and public fiber deployments, much of which is owned by the Colorado Department of Transportation.⁴⁹ When engineering the network design, the communities involved took stock of their own resources and infrastructure. Evan Biagi, an executive at Mammoth Networks, which operates Project THOR, describes this process as “peeling back the layers on what network infrastructure exists, who owns it, how [we] could use it, perhaps in a different fashion than it’s being used today.”⁵⁰

Plan for Sustainable Success

Many middle-mile networks began with an initial mission or purpose and then expanded to address new needs. The Illinois Century Network began as an education network, primarily oriented around service to community anchor institutions like schools and libraries, but a federal grant allowed the network to build hundreds of miles of fiber into underserved portions of the state.⁵¹

Demand measurements can be useful for determining when and where to expand a network. NoaNet’s expansion strategy is largely driven by such data and community input.⁵² That pairs the network’s expertise in broadband deployment with local leaders’ knowledge of their own communities. This ensures that decisions about expansion are data-driven, with local communities as strong partners.

Open-access, middle-mile networks do not happen overnight. Project THOR was the result of years of cooperative planning between local, regional, and state governments.⁵³ UTOPIA was, for a long time, considered a failure, with one newspaper calling it a “half-billion dollar fiasco menacing city budgets in four counties.”⁵⁴ Now, UTOPIA has found success as a middle- and last-mile network, building out to new communities in Utah and even expanding into Idaho.⁵⁵ Time horizons set by government programs should recognize the importance of long-term planning for long-term success.

Mitigate Foreseeable Risks

Careful planning in early stages, especially around environmental issues and easements, can help avoid unnecessary delays later on. Digital 395 is a 500-mile open-access, middle-mile network that runs through eastern California, from Reno, Nevada, to Barstow.⁵⁶ The network was completed in 2014,⁵⁷ though the project was significantly delayed by environmental concerns, including the endangerment of desert tortoises, archaeologically significant sites, and wetlands.⁵⁸ A 30-mile extension of the network in Kern County, funded through a California Advanced Services Fund grant, underwent a decade-long environmental review.⁵⁹ In reviewing its experience, Digital 395 encouraged other potential projects to “carefully develop a comprehensive environmental plan in the earliest stages of the project.”⁶⁰

Disputed property rights, too, can delay or hinder the process—or, as in the case of the Sho-Me Power Electric Cooperative, jeopardize the entire project. Sho-Me Power built hundreds of miles of open-access, middle-mile fiber with BTOP grant funding,⁶¹ but it became embroiled in legal trouble after Missouri landowners filed a class-action lawsuit against the cooperative for misuse of electrical easements for commercial purposes. After nearly seven years and two trials, the cooperative settled with the landowners for \$24 million to avoid yet another trial.⁶²

Ensure That Open Access Means Open Access

Open-access networks that commit to offering nondiscriminatory, commercially reasonable service will be better able to attract new providers to a community, region, or state. But federal support must also come with monitoring of open-access obligations and compliance. For example, in connection with BTOP, NTIA provided specific guidance on how to achieve interconnection and the core principle of nondiscrimination.⁶³ Open-access obligations for publicly funded networks should continue even if ownership of the network changes, as was the case when Maine's Three Ring Binder was purchased by FirstLight in 2019.⁶⁴

B. Working with Broadband Providers Toward Realistic Business Strategies

State and local governments have learned to welcome nontraditional providers, including, for example, rural electric cooperatives and local, independent telephone companies. These governments also have learned that effective partnerships must work for both the open-access, middle-mile networks and the participating broadband providers.

Reach Out to Nontraditional Providers

Large companies provide the great bulk of home broadband service today; the top sixteen providers account for about 96 percent of home subscriptions.⁶⁵

But operators of middle-mile networks observe that smaller and less traditional broadband providers can take advantage of their open facilities. Thus, broadband providers that connect to open-access, middle-mile networks can include rural electric cooperatives,⁶⁶ which have existing infrastructure, network routes, and customer relationships that can enable them to deploy High-Performance Broadband; as well as rural telephone companies, which similarly enjoy pre-existing customer relationships.⁶⁷

For example, Mid-Atlantic Broadband has worked with the Mecklenburg Electric Cooperative to bring fiber to the homes of residents of Halifax County, Virginia.⁶⁸ The electric cooperative will use MBC's middle-mile fiber to build last-mile fiber in six counties across southwest Virginia by the beginning of 2021.⁶⁹ Unlike most broadband providers, electric cooperatives are member-owned and not-for-profit, and many trace their roots back to the rural electrification movement of the 1930s. Especially in rural communities, electric cooperatives may be a valuable partner for middle-mile networks aiming to bring service to unserved areas, because electric cooperatives do not face the same profit imperatives that other broadband providers do, although they obviously face their own financial requirements.

Similarly, in Maine the Three Ring Binder offers, according to Peggy Schaffer, executive director of the ConnectME Authority, "an easier and less costly access for a build, allowing our small providers (who are not usually the incumbent providers) an option to tap in to a big fat pipe rather than negotiate lease-fiber arrangements with their direct competitors."⁷⁰

Indeed, such broadband providers can sometimes even start from scratch, as when Eathan Gleiner, a local IT professional in southwest Virginia, started his own company, dubbed MtnNet, to bring broadband to homes in a rugged mountain location that commercial broadband networks had not reached.⁷¹

The lesson is that communities should open the aperture wide to seek out broadband providers—even some not yet in existence—that can make use of their open-access, middle-mile networks to reach more broadband subscribers. Lit Communities is just such an example: a new company working to connect to open-access, middle-mile networks in places like New Orleans; Medina County, Ohio; and Salem, Virginia, with the Roanoke Valley Broadband Authority.⁷²

Provide Commercially Reasonable Terms and Conditions

Mid-Atlantic Broadband in Virginia decided early on that incumbents would not be treated any differently than small broadband providers, and all broadband providers would be able to access the network at the same price point.⁷³ The Illinois Century Network (ICN), which spans both urban and rural markets, similarly charges the same price across the state.⁷⁴ These approaches are critical to the notion of open access.

Relatedly, contract terms must be realistic about the needs of broadband providers. ICN listened to broadband providers who told the network what they would need to make the partnership feasible, and, when possible, the network adapted its service offerings to meet those needs.⁷⁵

ConnectArlington offers a cautionary tale of what can happen when a proposed agreement attempts to shift too much risk onto the broadband provider. Arlington’s network offered a temporary license, not a longer-term commitment, which made it difficult or impossible for broadband providers to contract with their own consumers. For instance, broadband providers would not be able to offer a three- or five-year contract with their customers, because Arlington wanted to be able to cancel the contract at any time with 12 months’ notice.⁷⁶ Arlington’s county manager created a Broadband Advisory Committee to assess why ConnectArlington’s business model was failing.⁷⁷ After a review, the Advisory Committee characterized the proposed terms as “one-sided” and “not reciprocal” and recommended that the county “create a culture that facilitates technological innovation.”⁷⁸ No broadband providers have been willing to take the risks inherent in ConnectArlington’s inflexible terms.⁷⁹

C. Building Community Support

As the networks described herein show, community support has played a central role in the success of open-access, middle-mile projects across the country. Demonstrating demand, bringing the community together over shared goals, and joining state and local resources can all help build community support for a network.

Demonstrate Consumer Demand

Community surveys are one useful way to assess demand before construction. NoaNet has a statewide system in place for community surveys and demand aggregation to determine the need in a given community.⁸⁰ The network will supply a community with a project manager to help understand the results from the survey.⁸¹ NoaNet will then even write a white paper that includes a market analysis of the community, survey results, and data on the economic impact of broadband, all to help local leaders make data-driven decisions when considering an open-access network.⁸² In Illinois, the Wabash Communications Co-Op, which connects to the Illinois Century Network, sent a nonbinding pre-subscription form to local farms and businesses asking about their current internet-

access technologies (including their cost and level of service) and their interest in new broadband at various performance tiers.⁸³

Even the act of searching for broadband solutions signals to broadband providers that there is unmet demand in a community, as was the case for Grayson County, Virginia. When Appalachian Power looked for a locality with which it could partner on a pilot project, the utility sought a local government that had taken steps to find a broadband solution.⁸⁴ Grayson County had already hired a broadband consultant and determined that up to 60 percent of the county lacked broadband access, far above the estimate given by the Federal Communications Commission.⁸⁵ Grayson County gave Appalachian Power powerful information to make the case that there are additional residences to be served.

Broadband providers themselves may also demonstrate their demand for middle-mile networks, as occurred in Maine. Before the Three Ring Binder was built, the ConnectME Authority heard again and again from broadband providers who wanted to provide service to rural areas but needed middle-mile connectivity to make it work.⁸⁶ Those broadband providers were some of the first to use the network once Three Ring Binder completed the build.⁸⁷

Bring Communities Together with Shared Goals

Community support helps to demonstrate that middle-mile projects serve the public interest. For Project THOR in Colorado, shared goals brought together a large and diverse group of stakeholders. The 400-mile network is the result of years of collaboration between a constellation of local partners, including three counties, four municipalities, one local consortium of anchor institutions, one rural electric co-op, and a health district.⁸⁸ The strong partnership helped ensure that the network met local needs at an affordable price. For instance, Tim Miles, technology director for the Steamboat Springs School District, says that his district is now paying \$500 less per month than it did before for 10 times the amount of bandwidth.⁸⁹ Further, the network helps the region's communities avoid a common problem: hours-long service interruptions because of a lack of redundancy in the old networks. This benefits providers, too: Allo Communications is rolling out service in Breckenridge because Project THOR provides the redundancy the firm needs.⁹⁰

Partnerships work best when all partners are deeply invested in bringing success to the region. In the case of the Appalachian Power pilot project in Grayson County, the electric utility, the broadband provider, and the locality all expressed a common interest in the economic success of the region. The local government wants to afford residents a higher quality of life and attract new businesses, the broadband provider wants to add new customers, and the utility wants to combat population and industry decline.

Attempts to use public funding to deploy open-access, middle-mile networks may not win immediate support with all members of the community. The Roanoke Valley Broadband Authority (RVBA) dealt with early challenges from both the telecommunications lobby and some local elected officials.⁹¹ Incumbent lobbyists compared RVBA to another municipal broadband network in Bristol, Virginia, which failed after several executives were found guilty of corruption and other federal felonies.⁹² When RVBA was founded in 2013, some members of the Roanoke County Board of Supervisors were reluctant or opposed to joining the network because they saw it as government intervention in the private market.⁹³ RVBA responded by keeping operations

transparent and communications ongoing⁹⁴—and in time, much of the initial opposition faded; now the network enjoys bipartisan support.⁹⁵

Criticism can also be constructive, allowing a network to learn how to improve its service. Arlington's Broadband Advisory Committee pointed out shortcomings in the county's approach. These suggestions may help ConnectArlington fulfill its initial promise of economic development and improved telecommunications capacity for the community.

Join Together the Resources of Both Local and State Governments

Integrating the network into the economic-development strategy of the region can garner political support, which increases the odds that a successful middle-mile network may be built. Of course, state programs that fund middle-mile deployment, as in Colorado and Minnesota, are designed to do just that. But there are other methods as well.

Mid-Atlantic Broadband was able to negotiate a resource-sharing agreement with the Virginia Department of Transportation (VDOT) because of support from Democratic then-governor (and now senator) Mark Warner. The network would eventually pass through 32 counties in southern and southeastern Virginia, rural areas with little private investment in broadband.⁹⁶ When MBC initially laid out its plans for a public-private partnership with VDOT, the agency was unsure about partnering with a new, unknown entity like MBC.⁹⁷ Governor Warner encouraged VDOT to reconsider its decision, recognizing the economic boon that middle-mile could bring to the region, and helped negotiate an eventual agreement.⁹⁸ Through the agreement, MBC received rights-of-way for no cost and VDOT received two strands of fiber at no cost wherever MBC built.⁹⁹ Not only did this simplify the building process for MBC, but the partnership also allowed VDOT to deploy smart-traffic technologies, such as roadway cameras and traffic sensors.¹⁰⁰ Now 85 percent of Mid-Atlantic Broadband's 1,900 miles of fiber is carried underground along VDOT rights of way.¹⁰¹

Political support for Three Ring Binder's BTOP grant in Maine was crucial to the success of this unique application. The main applicant for the project, a broadband provider called Great Works Internet (GWI), promised to turn funding over to an independent nonprofit if the project were selected.¹⁰² The Maine legislature created a Broadband Strategy Council (BSC) to evaluate BTOP grant applications from within the state.¹⁰³ The BSC formally endorsed GWI's application, as did a host of other political figures and entities in Maine such as the governor, Maine's congressional delegation, and both houses of the state legislature. That political support lent legitimacy to the application; Fletcher Kittredge, CEO of GWI during that period, commented that "without such support, the project may never have come to fruition."¹⁰⁴

Appalachian Power's pilot project required changing Virginia law to allow the electric utility to include the cost of the project as part of its regulated cost structure, because the new fiber facilities would be used both to upgrade the electric utility network and to offer access to broadband providers.¹⁰⁵ A local state representative championed the law change, and Virginia's General Assembly enacted legislation authorizing pilot projects with two of the state's investor-owned electric utilities.¹⁰⁶

||| The Need for More Broadband and More Competition

As we noted at the beginning of this report, open-access, middle-mile networks can help solve America's broadband competition problem. They can play a vital role in the goal of ensuring that everyone in America can use High-Performance Broadband.

Too many Americans do not have access to high-speed broadband service at home. Even the current Federal Communications Commission analysis that systematically overstates the presence of broadband networks demonstrates how limited broadband competition is.¹⁰⁷ At the typical cable-broadband speeds of 100 Mbps downstream and 10 Mbps upstream,¹⁰⁸ about 9 percent of Americans have no broadband available to them—and that includes both rural and urban areas.¹⁰⁹

Simultaneously, America has a broadband monopoly problem. At the same typical cable-broadband speeds, almost half of rural America is served by only one provider. A smaller percentage of Indian Country is served by a monopoly—but only because almost 40 percent of residents have no broadband at cable-broadband speeds. Low-income urban areas also suffer a lack of broadband choice.¹¹⁰

- **Nationally**, as noted, at typical cable-broadband speeds about 9 percent of Americans have no broadband available to them, about 37 percent have only one provider (a monopoly), about 41 percent have only two providers from which to choose (a duopoly), and just under 13 percent have three or more providers from which to choose.¹¹¹ Of course, as the Department of Justice emphasized in the remedies it pursued in the T-Mobile/Sprint merger, even three broadband providers doesn't necessarily do the trick.¹¹²
- **In rural America**, the circumstances are notably worse. At the typical cable-broadband speeds, about 36 percent of rural Americans have no broadband, about 47 percent have only one provider, about 14 percent have only two providers from which to choose, and just under 2 percent have three or more providers from which to choose.
- **In Indian Country**, about 39 percent of residents have no broadband at the typical cable broadband speeds, about 43 percent have only one provider, about 17 percent have only two providers from which to choose, and under 1.5 percent have three or more providers from which to choose.
- **Urban areas, especially low-income neighborhoods**, also suffer from limited competition. According to FCC data, about 34 percent of urban residents face a monopoly and about 48 percent face a duopoly. Why is this so? National Digital Inclusion Alliance studies suggest that telecommunications firms have chosen not to deploy or have delayed deployment in low-income urban neighborhoods.¹¹³ For example, in a 2019 report, Dr. Brian Whitacre, professor at Oklahoma State University, concludes that the incumbent telecommunications provider “withheld fiber-enhanced broadband improvements from most Dallas neighborhoods with high poverty rates, relegating them to Internet access services which are vastly inferior to the services enjoyed by their counterparts nearby in the higher-income Dallas suburbs.”¹¹⁴

A new study sheds light on the impact of limited competition on prices. In July 2020, the Open Technology Institute at New America issued its annual report on the cost of connectivity, which found substantial evidence of an affordability crisis in the United States and concluded that municipal networks “appear to offer some of the best value in the United States.”¹¹⁵ New America calculates that “[a]ssuming that one pays for 25 Mbps download speed monthly service, for example, a resident in Lafayette, Louisiana, would on average pay \$73.10 annually on the municipal network, versus \$690.87 annually on a private network.”¹¹⁶ To the same effect, the aforementioned Dr. Whitacre and Roberto Gallardo, assistant director of the Center for Regional Development at Purdue University, find that “the existence of municipal broadband restrictions tends to lower availability and broadband competition.”¹¹⁷ Of course, many private broadband providers use open-access, middle-mile networks, for reasons including to bring additional competition, as in the case of Wabash Telecommunications discussed previously.

Forthcoming research from the Benton Institute and CTC Technology & Energy focuses on the opacity of the information provided by incumbent broadband providers about their stand-alone broadband offerings, which hinder the ability of consumers to make informed decisions, and the importance of new value propositions when a third (or even fourth) broadband provider enters a local market, including such features as lower pricing (in absolute terms or by Mbps); higher speeds, especially upstream; increased monthly capacity; and/or simplified pricing plans.

Where there is no broadband, the problem is obvious. But limited competition is typically associated with harm to consumers in the form of higher prices, lower quality, slower innovation, reduced customer service, or some combination thereof. And, because fixed broadband is a widely subscribed service that, especially in light of the COVID-19 crisis, is now an essential pathway to participation in our democracy, society, and economy, any artificially higher prices will tend to disproportionately harm those subscribers who have lower incomes.

Conclusion: The Importance of Federal Policy That Supports State and Local Leadership

Experience has shown that state and local governments can experiment with and facilitate pragmatic solutions, such as the implementation of open-access, middle-mile networks that help ensure that everyone can use High-Performance Broadband—from building networks that offer affordable broadband service to ensuring that people, such as the newly unemployed, have the resources and skills to use broadband. Perhaps most importantly, state and local governments are nearby, not thousands of miles away, and they hear the voices of local communities.

Tony Neal-Graves, chief operating officer of Colorado’s Office of Information Technology, directly answers the question posed by the title of this policy brief, saying, “I am reminded of the adage ‘If you build it, they will come.’ We have demonstrated the downstream effect of increased broadband availability in our rural communities as a result of the state’s investment in open-access, regional middle-mile networks.”¹¹⁸

That work, combined with other efforts across the nation, demonstrates how funding open-access, middle-mile networks can help the nation meet its deployment and competition challenges.

Endnotes

- 1 Arnold and Sallet are affiliated with the Benton Institute for Broadband & Society, alumni of the University of Virginia and members of the Raven Society. This work intersects with, and reflects, their parallel work in support of broadband efforts in the Commonwealth of Virginia. Thank you especially to Joanne Hovis for her insights, counsel and inspiration for the network graphic included herein.
- 2 “High-Performance Broadband means that fixed broadband networks are fit for the future; they provide fast, symmetrical upload and download speeds, low latency (moving data without noticeable delay), ample monthly usage capacity, and security from cyberattacks. Networks that, once installed, can be easily upgraded as the demand for greater broadband performance continues to increase.” Jonathan Sallet, “Broadband for America’s Future: A Vision for the 2020s,” *Benton Institute for Broadband & Society*, October 2019, 12, <https://www.benton.org/publications/broadband-policy2020s>.
- 3 Here, we use the term “broadband provider” to denote a network that sells internet access of at least 25/3 Mbps on a retail basis to mass market customers. Although we refer to residential customers, small businesses typically buy the same service, as opposed to the enterprise connections used by large businesses. Of course, a broadband provider may also operate its own middle-mile or backbone facilities, or it may simply be operating the connection between a middle-mile access point and mass market customers.
- 4 By “the network,” we mean a network that is fully operational, like a fiber facility. That is distinct from merely providing access to conduit.
- 5 BroadbandMatters.com, “What is Broadband?,” <https://broadbandmatters.com/what-broadband>, accessed October 9, 2020.
- 6 Joanne Hovis (President, CTC Technology & Energy), in email to Jonathan Sallet on September 22, 2020.
- 7 Hannah Lott-Schwartz, “This Is the Loneliest Road in America,” *National Geographic*, February 21, 2019, <https://www.nationalgeographic.com/travel/destinations/north-america/united-states/nevada/pictures-loneliest-road-america-route-50/>.
- 8 By “incumbent” we mean the resident cable or telecommunications company. Examples of large “incumbents” here include AT&T, CenturyLink, Comcast, Charter Communications, Frontier Communications, and Verizon; smaller cable or telephone companies would typically also be incumbents.
- 9 U.S. Department of Agriculture, “USDA Invests \$11 Million in Broadband for Rural Minnesota and Iowa Communities,” January 17, 2020, <https://www.usda.gov/media/press-releases/2020/01/17/usda-invests-11-million-broadband-rural-minnesota-and-iowa>.
- 10 Sallet, “Broadband for America’s Future: A Vision for the 2020s.”
- 11 Anne Stauffer, Kathryn de Wit, Anna Read, and Dan Kitson, “How States Are Expanding Broadband Access,” *Pew*, 23, February 2020, https://www.pewtrusts.org/-/media/assets/2020/03/broadband_report0320_final.pdf
- 12 Stauffer et al, “How States Are Expanding Broadband Access,” 18.
- 13 Stauffer et al, “How States Are Expanding Broadband Access.”
- 14 Arizona Department of Administration, “Arizona Statewide Strategic Broadband Plan,” February 2018, https://azlibrary.gov/sites/default/files/erate_2018_az_broadbandstrategicplan_final.PDF; “Program Evaluation: Funding, Oversight, and Coordination of Broadband Programs,” New Mexico Legislative Finance Committee, Report #19-05, November 1, 2019, https://www.nmlegis.gov/Entity/LFC/Documents/Program_Evaluation_Reports/Program%20Evaluation%20-%20Funding,%20Oversight,%20and%20Coordination%20of%20Broadband%20Programs.pdf.
- 15 Stauffer et al, “How States Are Expanding Broadband Access.”
- 16 Evan Feinman (Governor’s Chief Broadband Advisor, Virginia) in email to Jonathan Sallet, August 7, 2020.
- 17 The Quilt, “Home,” <https://www.thequilt.net>, accessed October 13, 2020.
- 18 The Quilt, “Research and Education Networks: Enabling Breakthrough Innovations that Power the Greater Good,” May 20, 2016, <https://www.thequilt.net/wp-content/uploads/Quilt-REN-Value-PageF.pdf>.
- 19 Department of Innovation and Technology, “Illinois Century Network” <https://www2.illinois.gov/icn/about/network/Pages/default.aspx>, accessed October 13, 2020.
- 20 Lori Sorenson (Chief Technology Officer, Illinois) in video interview with Jonathan Sallet and Jordan Arnold on April 23, 2020.
- 21 Ibid.
- 22 Department of Innovation and Technology, “Illinois Century Network.”
- 23 Lori Sorenson (Chief Technology Officer, Illinois) in video interview with Jonathan Sallet and Jordan Arnold on April 23, 2020.
- 24 Sean Middleton (former Manager of Engineering and IT, Illinois Elective Cooperative) in a phone interview with Jonathan Sallet and Jordan Arnold on August 26, 2020.
- 25 Dave Spenser, “Community Broadband Bits Episode 159,” July 16, 2015, Community Networks, Institute of Local Self Reliance, <https://muninetworks.org/content/transcript-community-broadband-bits-episode-159>.

- 26 NoaNet, “Our Story,” <https://noanet.net/about/our-story/>, accessed October 17, 2020.
- 27 Hannah Trostle, “Fifteen Fun Facts about NoaNet - Fifteen Years of Accomplishments,” January 13, 2016, Community Networks, Institute of Local Self Reliance, <https://muninetworks.org/content/fifteen-fun-facts-about-noanet-fifteen-years-accomplishments>.
- 28 Ibid.
- 29 Mid-Atlantic Broadband, “History,” <https://mbc-va.com/history/>, accessed October 15, 2020.
- 30 Tad Deriso (CEO, Mid-Atlantic Broadband) in a phone interview with Jonathan Sallet and Jordan Arnold on March 12, 2020.
- 31 Ibid.
- 32 Mid-Atlantic Broadband, “History.”
- 33 Northwest Colorado Council of Governments (“NCCOG”), “Project THOR Broadband Access Project Achieves Full Availability,” April 2020, <https://nwcog.org/programs/broadband/project-thor/>.
- 34 Judith Kohler, “Major High-Speed Broadband Network Goes Online Across Northwest Colorado,” *The Denver Post*, April 8, 2020, <https://www.denverpost.com/2020/04/08/northwest-colorado-communities-launch-broadband-network/>.
- 35 “UTOPIA Fiber Announces that Clearfield, Utah Will Become America’s Newest Fiber City,” August 6, 2020, <https://www.utopiafiber.com/2020/08/06/utopia-fiber-announces-that-clearfield-utah-will-become-americas-newest-fiber-city/>.
- 36 “Transcript: Community Broadband Bits Episode 220,” September 27, 2020, Community Networks, Institute for Local Self Reliance, <https://muninetworks.org/content/transcript-community-broadband-bits-episode-220>.
- 37 Masha Zager, “Is Fiber the Tipping Point?” Broadband Communities, May/June 2019, <https://www.bbcmag.com/community-broadband/is-fiber-at-the-tipping-point>.
- 38 Amy Friedenberger, “Grayson County Poised for a Broadband Expansion Via New State Law,” *The Roanoke Times*, May 15, 2019, https://roanoke.com/news/local/grayson-county-poised-for-a-broadband-expansion-via-new-state-law/article_270bed18-55a6-5dc4-a02c-5e3260414e3d.html.
- 39 AEP Appalachian Power, “Appalachian Power to Build “Middle Mile” For Broadband Access in Proposed Virginia Pilot Program,” May 21, 2019, <https://electricenergyonline.com/article/energy/category/automation-it/53/768896/appalachian-power-to-build-middle-mile-for-broadband-access-in-proposed-virginia-pilot-program.html>.
- 40 Appalachian Power, “Virginia SCC Approves Appalachian Power’s Broadband Pilot Program,” May 14, 2020, <https://www.appalachianpower.com/info/news/viewRelease.aspx?releaseID=5556>.
- 41 Brad Hall (VP of External Affairs, Appalachian Power) in a phone interview with Jonathan Sallet and Jordan Arnold on March 9, 2020.
- 42 National Telecommunications and Information Administration, “Fact Sheet: Broadband Technology Opportunities Program Nondiscrimination and Interconnection Obligations,” November 11, 2010, https://www2.ntia.doc.gov/files/Interconnection_Nondiscrimination_11_10_10_FINAL.pdf.
- 43 Moving Forward Act, H.R. 2, 116th Congress (2020), § 31321, <https://www.congress.gov/116/bills/hr2/BILLS-116hr2eh.pdf>, incorporating Accessible, Affordable Internet for All Act, H.R. 7302, 116th Congress (2020), §3101, <https://www.congress.gov/116/bills/hr7302/BILLS-116hr7302ih.pdf>.
- 44 Larry Strickling (Administrator, NTIA) in an email to Jonathan Sallet on September 13, 2020.
- 45 Rural Utilities Service - Department of Agriculture, Broadband Technology Opportunities Program, Federal Register, Vol. 74, No. 130, July 9, 2009, https://www.ntia.doc.gov/files/ntia/publications/fr_bbnofa_090709.pdf.
- 46 Stauffer et al, “How States Are Expanding Broadband Access,” 22.
- 47 Minnesota Office of Broadband Development, “Broadband Grant Program,” <https://mn.gov/deed/programs-services/broadband/grant-program/>.
- 48 Ibid.
- 49 Tamara Chuang, “Internet Service in Western Colorado Was So Terrible That Towns and Counties Built Their Own Telecom,” *The Colorado Sun*, April 16, 2020, <https://coloradosun.com/2020/04/16/internet-service-western-colorado-rural-broadband-nwcog-sb152/>.
- 50 Evan Biagi, “Transcript: Community Broadband Bits Episode 406,” April 30, 2020, Community Networks, Institute for Local Self Reliance, <https://muninetworks.org/content/transcript-community-broadband-bits-episode-406/>.
- 51 Illinois Century Network, “Illinois Broadband Opportunity Partnership-East Central (IBOP-EC),” <https://www2.illinois.gov/icn/projects/ibop-ec/Pages/default.aspx>.
- 52 NoaNet, “Community Support,” <https://noanet.net/community-support/>, accessed October 18, 2020.
- 53 NCCOG, “Project THOR Broadband Access Project Achieves Full Availability.”
- 54 Tony Semerad and Vince Horiuchi, “UTOPIA: Fiber-optic Nirvana or a Nightmare with No Way Out?,” *The Salt Lake Tribune*, December 3, 2012, <https://archive.slttrib.com/article.php?id=55284692&ctype=CMSID>.
- 55 Drew Clark, “UTOPIA Fiber: A Model Open-Access Network,” Broadband Communities Magazine, November/December 2019, <https://www.bbcmag.com/community-broadband/utopia-fiber-a-model-open-access-network>.
- 56 Mono County, “Digital 395,” <https://www.monocountyeconomicdevelopment.com/digital-395/>, accessed October 25, 2020.
- 57 Steve Blum, “Eastern Sierra Consortium Presents Plans for Building Broadband out from Digital 395,” Tellus Venture Associates, March 8, 2014, <https://>

- www.tellusventure.com/blog/eastern-sierra-consortium-presents-plans-for-building-broadband-out-from-digital-395/.
- 58 Steve Blum, "CPUC Approves \$10 Million and Maybe a Bit More for Digital 395," Tellus Venture Associates, September 5, 2013, <https://www.tellusventure.com/blog/cpuc-approves-10-million-and-maybe-a-bit-more-for-digital-395/>.
 - 59 Steve Blum, "A Decade Late and Megabucks Short, Kern County Fiber Project Gets Environmental Approval," Tellus Venture Associates, August 7, 2019, <https://www.tellusventure.com/blog/tag/digital-395/>.
 - 60 California Broadband Cooperative, Inc., "Annual Performance Progress Report For Broadband Infrastructure Projects," October 29, 2014, https://www2.ntia.doc.gov/files/grantees/nt10bix5570098_apr2014_0.pdf
 - 61 "Sho-Me MO Fact Sheet," BroadbandUSA, National Telecommunications and Information Administration, September 2010, <https://www2.ntia.doc.gov/files/grantees/factsheetmosho-me.pdf>.
 - 62 "Sho-Me Pays \$24M To End Land Dispute Before 3rd Trial," Law360, July 26, 2018, <https://www.law360.com/articles/1066856/sho-me-pays-24m-to-end-land-dispute-before-3rd-trial>.
 - 63 National Telecommunications and Information Administration, "Fact Sheet: Broadband Technology Opportunities Program Nondiscrimination and Interconnection Obligations," November 11, 2010, https://www2.ntia.doc.gov/files/Interconnection_Nondiscrimination_11_10_10_FINAL.pdf.
 - 64 Lori Valigra, "New York firm Buys a Major Maine Broadband Provider," *The County*, May 18, 2019, <https://thecounty.me/2019/05/18/news/business-news/new-york-firm-buys-a-major-maine-broadband-provider/>.
 - 65 Leichtman Research Group, "About 1,245,000 Added Broadband in 2Q 2020," August 13, 2020, <https://www.leichtmanresearch.com/about-1245000-added-broadband-in-2q-2020/>.
 - 66 *See, e.g.*, Ry Marcattilio-McCracken, "Electric Cooperatives Partner with Dominion Energy to Bring Broadband to Rural Virginia," Community Networks, Institute of Local Self Reliance, August 6, 2020, <https://muninetworks.org/content/electric-cooperatives-partner-dominion-energy-bring-broadband-rural-virginia>.
 - 67 Shirley Bloomfield (CEO, NTCA – The Rural Broadband Association) in an email to Jonathan Sallet on August 7, 2020.
 - 68 Tom McLaughlin, "Fiber-to-the-Home Gains Toehold in the County," November 14, 2019, *South Boston News & Record*, SovaNow.com, http://www.sovanow.com/index.php?news/article/fiber-to-the-home_gains_toehold_in_county/.
 - 69 *Ibid.*
 - 70 Peggy Schaffer (Executive Director, ConnectME) in an email to Jonathan Sallet on August 27, 2020.
 - 71 Lindsay Cayne, "One Bent Mountain Resident Brings Broadband to His Community," *WDBJ7*, January 24, 2019, <https://www.wdbj7.com/content/news/Bent-Mountain-residents-get-broadband-504823932.html>.
 - 72 Brian Snider (CEO, Lit Communities) in an email to Jonathan Sallet on March 29, 2020.
 - 73 Tad Deriso (CEO, Mid-Atlantic Broadband) in a phone interview with Jonathan Sallet and Jordan Arnold on March 12, 2020.
 - 74 Lori Sorenson (Chief Technology Officer, Illinois) in video interview with Jonathan Sallet and Jordan Arnold on April 23, 2020.
 - 75 *Ibid.*
 - 76 Broadband Advisory Committee, "Recommendation Document," January 14, 2019, <https://s26551.pcdn.co/wp-content/uploads/2019/02/BAC-Document-14-JAN-19-FINAL.pdf>.
 - 77 Broadband Advisory Committee, "Recommendation Document," 1.
 - 78 Broadband Advisory Committee, "Recommendation Document," 1, 8.
 - 79 Alex Koma, "Arlington Spent \$4.1 Million on a 10-Mile Dark Fiber Network, But No One's Using It," *ARLnow*, February 7, 2019, <https://www.arlnow.com/2019/02/07/exclusive-arlington-spent-4-1-million-on-a-10-mile-dark-fiber-network-now-no-ones-using-it/>.
 - 80 NoaNet, "The Road to Broadband: A Planning Guide for Your Community Broadband Network," 2020, <https://t1h.d3d.myftpupload.com/wp-content/uploads/2020/10/The-Road-to-Broadband-2020.pdf>.
 - 81 *Ibid.*
 - 82 *Ibid.*
 - 83 Wabash Communications Co-Op, "Illinois Connect Broadband Grant Program: Broadband Pre-subscription Form for Farms and Other Businesses," 2020, <https://awesomefiber.com/wp-content/uploads/2020/03/Farm-and-Business-Forms-WTC.pdf>.
 - 84 Brad Hall (VP of External Affairs, Appalachian Power) in a phone interview with Jonathan Sallet and Jordan Arnold on March 9, 2020.
 - 85 *Ibid.*
 - 86 Fletcher Kittredge, "Maine's Three Ring Binder," *Maine Policy Review*, 22.1, 2013, 30-40, <https://digitalcommons.library.umaine.edu/mpr/vol22/iss1/7>.
 - 87 *Ibid.*
 - 88 NCCOG, "Ten County Broadband Project Operational," April 7, 2020, <http://nwccog.org/wp-content/uploads/2020/04/PR-THOR-Launch-Release-April-2020.pdf>.
 - 89 Tamara Chung, "Locally Built Internet Provider Improves Colorado Service," *The Colorado Sun*, April 19, 2020, <https://www.usnews.com/news/best-states/colorado/articles/2020-04-19/locally-built-internet-provider-improves-colorado-service>.
 - 90 *Ibid.*

- 91 Frank Smith (CEO, Roanoke Valley Broadband Authority) in a phone interview with Jonathan Sallet and Jordan Arnold on March 17, 2020.
- 92 Dan Casey, "Bristol Virginia Utilities Shows Culture of Corruption, Entitlement, and Greed," *The Roanoke Times*, March 26, 2016, https://www.roanoke.com/news/bristol-virginia-utilities-shows-culture-of-corruption-entitlement-and-greed/article_5ef651bc-4629-5554-a45e-8b35a815daa7.html.
- 93 Jacob Demmitt, "Government Subsidized Internet Crosses Political Boundaries in Southwest Virginia," *The Roanoke Times*, November 24, 2018, https://www.roanoke.com/business/news/botetourt-county/government-subsidized-internet-crosses-%20political-boundaries-in-southwest-virginia/article_da10cd45-15a5-5591-94b4-180d937be3df.html.
- 94 Frank Smith (CEO, Roanoke Valley Broadband Authority) in a phone interview with Jonathan Sallet and Jordan Arnold on March 17, 2020.
- 95 Jacob Demmitt, "Government Subsidized Internet Crosses Political Boundaries in Southwest Virginia."
- 96 Tad Deriso (CEO, Mid-Atlantic Broadband) in a phone interview with Jonathan Sallet and Jordan Arnold on March 12, 2020.
- 97 Ibid.
- 98 Mid-Atlantic Broadband, "MBC Hosts Senator Mark Warner on his Southern Virginia Tour," August 16, 2016, <https://mbc-va.com/news/mbc-hosts-senator-mark-warner-on-his-southern-virginia-tour/>.
- 99 Tad Deriso (CEO, Mid-Atlantic Broadband) in a phone interview with Jonathan Sallet and Jordan Arnold on March 12, 2020.
- 100 Michael Sluss, "Broadband Deal Gets Green Light," *The Roanoke Times*, April 13th, 2005, https://roanoke.com/archive/broadband-deal-gets-green-light/article_ddca95f4-3d1b-538f-8b57-de7d7e5d8eab.html.
- 101 Tad Deriso (CEO, Mid-Atlantic Broadband) in a phone interview with Jonathan Sallet and Jordan Arnold on March 2, 2020.
- 102 Kittredge, "Maine's Three Ring Binder."
- 103 National Conference of State Legislatures, "State Broadband Task Forces, Commissions or Authorities and Other Broadband Resources," June 2020, <https://www.ncsl.org/research/telecommunications-and-information-technology/state-broadband-task-forces-commissions.aspx>.
- 104 Kittredge, "Maine's Three Ring Binder," 35.
- 105 Friedenberger, "Grayson County Poised for a Broadband Expansion Via New State Law."
- 106 Ibid.
- 107 Sallet, "Broadband for America's Future: A Vision for the 2020s"; Federal Communications Commission ("FCC"), "Compare Broadband Availability in Different Areas" (information request platform), June 2019, https://broadbandmap.fcc.gov/#/area-comparison?version=jun2019&tech=acfow&speed=100_10&searchtype=state&searched=y&geoid=36, (100/10 Mbps, excluding satellite).
- 108 Jonathan Sallet, "Broadband for America Now," *Benton Institute for Broadband & Society*, October 2020, 25, note 119, <https://www.benton.org/publications/broadband-america-now>.
- 109 FCC, "Compare Broadband Availability in Different Areas," (100/10 Mbps, excluding satellite).
- 110 Sallet, "Broadband for America Now," 25.
- 111 The Form 477 data do not cleanly present the percentage of the population that have just two choices.
- 112 Competitive Impact Statement, United States v. Deutsche Telecom AG, et al., CA No. 1:19-cv-02232-TJK, at 7 (D.D.C. July 30, 2019).
- 113 Communication Workers of America and National Digital Inclusion Alliance, "AT&T's Digital Redlining Leaving Communities Behind for Profit," October 2020, https://www.digitalinclusion.org/wp-content/uploads/dlm_uploads/2020/10/AT&T's-Digital-Redlining-Leaving-Communities-Behind-for-Profit.pdf; Bill Callahan, "NDIA's First AT&T Redlining Report Is a Year Old Today," *Digital Inclusion News*, National Digital Inclusion Alliance, March 10, 2018, <https://www.digitalinclusion.org/blog/2018/03/10/ndias-first-att-redlining-report-is-a-year-old-today-2/>, (Cleveland); Bill Callahan, "AT&T's Digital Redlining of Dallas: New Research by Dr. Brian Whitacre," *Digital Inclusion News*, National Digital Inclusion Alliance, August 6, 2019, <https://www.digitalinclusion.org/blog/2019/08/06/atts-digital-redlining-of-dallas-new-research-by-dr-brian-whitacre/>, (Dallas). Both Cleveland and Dallas are served by cable-broadband providers that were not part of the studies. BroadbandNow, "Internet Providers in Cleveland, Ohio," <https://broadbandnow.com/Ohio/Cleveland>, accessed September 23, 2020; BroadbandNow, "Internet Providers in Dallas, Texas," <https://broadbandnow.com/Texas/Dallas>, accessed September 23, 2020.
- 114 Callahan, "AT&T's Digital Redlining of Dallas."
- 115 Becky Chao and Claire Park, "The Cost of Connectivity 2020," Open Technology Institute, New America, July 2020, 6-7, https://d1y8sb8igg2f8e.cloudfront.net/documents/The_Cost_of_Connectivity_2020_XatkXnf.pdf.
- 116 Chao and Park, "The Cost of Connectivity 2020," 53.
- 117 Brian Whitacre and Roberto Gallardo, "State Broadband Policy: Impacts on Availability," *Telecommunications Policy*, 44, no. 9 (October 2020): 102025.
- 118 Tony Neal-Graves (Chief Operating Officer, Colorado Office of Information Technology and Executive Director, Colorado Broadband Office) in an email to Jonathan Sallet on August 17, 2020.



Broadband Delivers Opportunities
and Strengthens Communities