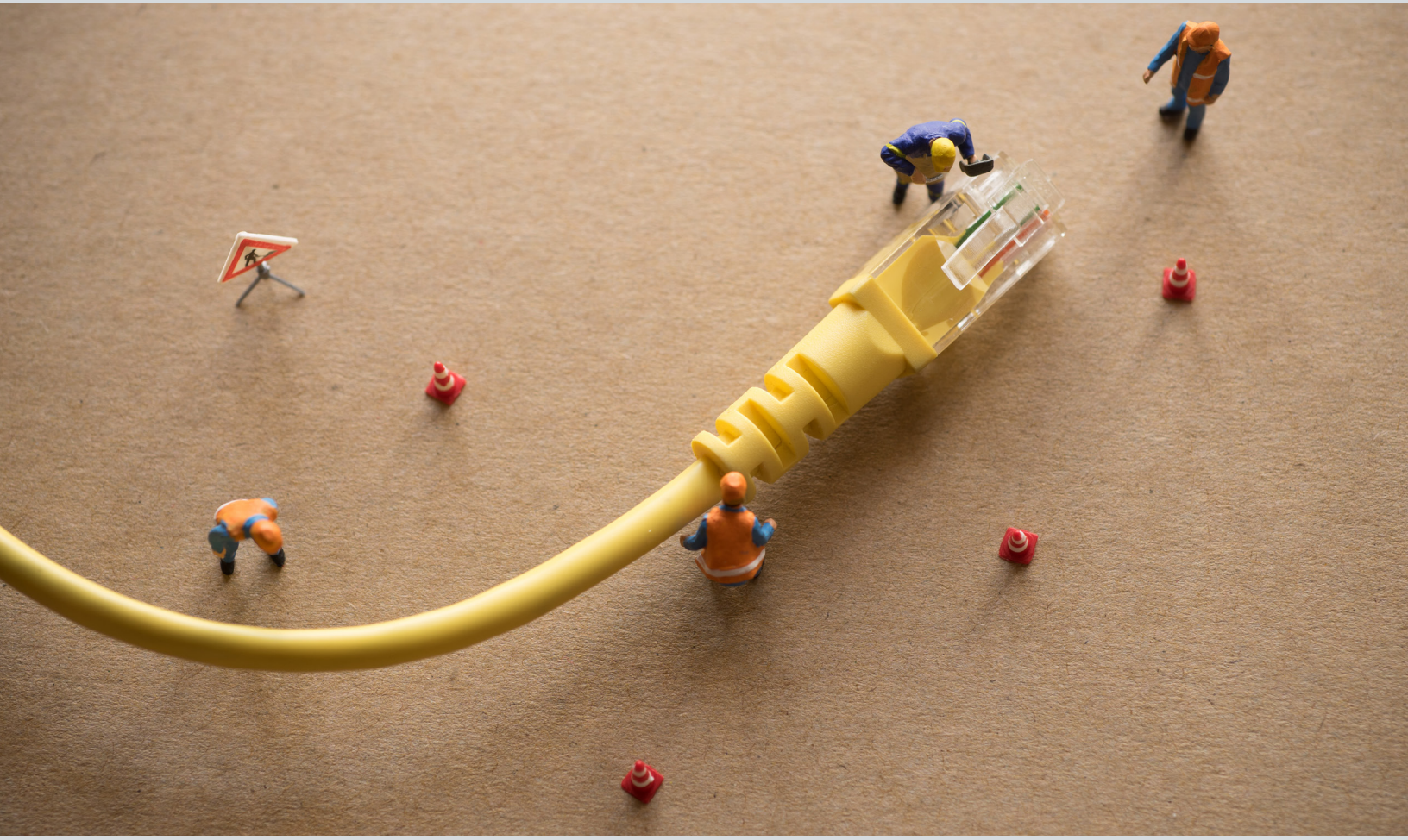
Digital Prosperity:
HOW BROADBAND CAN DELIVER HEALTH AND EQUITY TO ALL COMMUNITIES



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Executive Summary

Two decades into the new millennium, the digitalization of American life is no longer striking—it is ordinary. Every industry relies on computing, cloud storage, or other digital equipment to sell goods and services. Employers increasingly demand more advanced digital skills from the labor force. Meanwhile people's individual lives often orbit around the internet, whether at home, at work, or on the move. Even decades-old infrastructure—from roads and rails to water pipes and the energy grid—now relies on digital equipment for construction, operation, and modernization.

Broadband is so influential on society that we would now consider it essential infrastructure. That means affordable subscription prices, universal access to connected devices, and a population equipped with digital skills are vital characteristics of a healthy neighborhood, city, state, or country. Because broadband's applications are so wide ranging, it can deliver services that at least indirectly touch a wide range of conditions that impact health and life outcomes, known as social determinants of health (SDOH). Yet these benefits can only be maximized if every individual has physical access to networks, can afford a subscription and the equipment, and has the skills to use broadband-related services.

Over the past year, Brookings Metro and the National Digital Inclusion Alliance pursued research to understand the connections between broadband and health and equity, assess the gaps in broadband access and adoption, the market and policy barriers that lead to those gaps, and promising points of intervention for local, state, and federal leaders to deliver shared value to individuals and entire communities.

Why broadband matters

For most Americans, broadband is commonplace in professional, personal, and social interactions. Even with this ubiquity, the extent of broadband's health and equity benefits aren't yet fully understood. From economic stability, to education, to social supports, to civic agency, broadband and the digital services it enables are intrinsically tied to collective health and equity outcomes.

Broadband delivers economic benefits to both individuals and communities. Broadband makes it easier for job seekers to search for jobs, apply for them, and to keep looking for longer. In turn, businesses reap benefits from e-recruiting, which makes it less expensive to access a larger pool of candidates. And having a digitally fluent workforce brings productivity gains to firms, who can then reward employees with higher wages. Taking a macro lens, other researchers have found that higher levels of broadband adoption lead to economic growth, higher incomes, and lower unemployment.

Broadband also plays an important role in improving social outcomes, including health. Broadband democratizes access to education, offering a wide supply of free and open education platforms, courses, and resources. It can also help people foster social supports and stay in contact with a broader social network. For traditionally marginalized groups who are prone to social isolation, access to the internet allows them to connect to others anonymously. Though education and social support both have indirect health benefits, telehealth—the use of telecommunications to deliver health services and education—can directly improve health outcomes, especially for those who otherwise lack access to medical providers.

Broadband gaps are pervasive

Despite its importance, broadband is still far from ubiquitous. According to the 2018 American Community Survey (ACS), 18.1 million—or 15%—of households do not have subscriptions to any

form of "broadband" internet service. Compare that to the 99.6% of households with complete plumbing, or the effective 100% of households with access to electricity.

Broadband works best when households have both an in-home connection—for activities such as telework and entertainment streaming—and a wireless subscription. However, of those households with a broadband subscription, about 14 million only have a cellular data plan, and 12.3 million only have a wireline subscription.

Such broadband gaps infect every kind of community. The majority—13.6 million—of digitally disconnected households across the United States live in urban areas, but the gaps in rural areas are an even larger share of the total rural population. Researchers consistently find those least likely to have broadband in America are communities of color and low-income communities, suggesting that systemic barriers remain in place.

Systemic barriers to universal broadband

Broadband may be essential, but there are systemic reasons some Americans do not subscribe.

Pricing is a structural barrier to adoption, but a lack of federal reporting standards requirements leaves information gaps around what consumers experience. Targeted reporting does offer some evidence of the pricing challenges for disadvantaged American households. This includes global comparisons that find the United States ranks 18th out of 23 countries for standalone broadband plans with download speeds between 25 Mbps and 100 Mbps.

Beyond just having a broadband subscription, users need to have a range of **digital skills** to be active and engaged participants in digital spaces. However, according to the Pew Research Center's most recent report on Digital Readiness Gaps, the slight majority (52%) of U.S. adults are still "relatively hesitant" when it comes to new technologies and digital skills. This means that they have low levels of digital skills, limited trust in the internet, or don't often turn to it as a source.

Gaps in **physical access to broadband** persist, especially in rural areas. Setting up rural broadband networks demands significant capital investment to reach a limited number of potential customers. Consequently, private ISPs often ignore predominantly rural markets. Some urban and suburban neighborhoods face similar challenges due to ISPs skipping over or underserving specific areas. Current federal regulations do not require ISPs to service every resident or business within their service geography or to bring faster speed tiers to every neighborhood equally.

Systemwide interventions to address broadband gaps

Broadband availability gaps are a natural offshoot of the privately owned and privately financed industry model prevalent across the country. **Improving broadband's physical reach** will require interventions that either incentivize private capital to invest in riskier geographies, allocate public funding to construct public networks, or some mix of the two. Likewise, all levels of government can play a role in supporting publicly owned broadband networks, or what are commonly called "muni networks."

Making broadband more affordable is another important intervention. Direct subsidy programs can be run from any level of government, such as the FCC's Lifeline program. Likewise, the public sector can operate equipment purchase or leasing programs. The federal government could also do more to promote pricing transparency, set national affordability standards, and partner with private companies who are already leading affordability efforts.

Boosting digital skills relies on a network of public, private, and civic actors. Primary

schools, public libraries, and various nonprofit organizations can host digital literacy interventions. Workforce development agencies can survey employer needs and develop contemporary training modules. And both ISPs and governments at all levels can offer direct funding and expertise to support these efforts.

Strategies to educate decisionmakers, community members, and influencers

In addition to direct interventions related to availability, affordability, and skills development, communication techniques are essential to maximize effectiveness. But just as importantly, reaching universal adoption requires decisionmakers and community members understanding the systemic barriers and committing to overcome them, Strategies can include:

1. **Build coalitions.** The most successful interventions from the local to national level consistently include a diverse set of interested parties—workforce organizations, libraries, elected offices, schools, and religious institutions are just some examples—whose members can coordinate their advocacy. Creating a unified voice creates a wider base to demonstrate the importance of broadband to a given community.

2. **Target impacted institutions.** Many well-endowed civic institutions and public agencies rely on broadband adoption among their focus populations to maximize their effectiveness. The banking industry can reach far more individuals if their customers use online banking. The health care industry's push to digitize records, scheduling, and communications assumes patients have broadband and are able to use it. The same logic extends to schools for the digital classroom, consumer affairs agencies to streamline resident engagement, and so on.

3. **Speak their language.** There is a need to speak in concepts policymakers understand. In particular, "quality of life" and "workforce development" were prominent issues that impact every level of government. Placing broadband needs within the context of these goals can ease the learning curve.

4. **Communicate measurable impact.** Using statistical reference points is one method of reinforcing broadband's relationship to health and equity goals. For many communities, this includes direct reporting on the neighborhoods without network service, the number of total households without in-home or mobile subscriptions, and other measures that can rely on public data inputs.

Broadband is the connective tissue of this young digital millennium, a physical service that can benefit every person across social, economic, and physical health dimensions. Building more equitable broadband infrastructure will make good on that promise.

Introduction

Two decades into the new millennium, digitalization is a dominant theme in everyday American life. Every industry relies on computing, cloud storage, or other digital equipment to sell goods and services. Employers increasingly demand more advanced digital skills from the labor force. People's individual lives often orbit around the internet, whether at home, at work, or almost anywhere else. Even decades-old infrastructure—from roads and rails to water pipes and the energy grid—now relies on digital equipment for construction, operation, and modernization.

Broadband is the connective tissue behind such sweeping digitalization. Using a mix of wireline and wireless technology, broadband infrastructure allows people and businesses to rapidly exchange data between digital devices of all kinds. Broadband has also given rise to innovations that were previously thought of as science fiction: doctors consulting on surgeries over remote video, people taking phone calls on their watches, computer simulations running on multiple computers, countries apart. Broadband is the newest essential public infrastructure, joining the ranks of water, energy, and transportation.

But despite its importance to almost every person and business, broadband is still far from universally available. The Federal Communications Commission (FCC) repeatedly reports millions of people living in communities without access to wireline broadband, with gaps especially pronounced in rural America and many low-income, central-city neighborhoods.[1] In-home broadband subscription rates consistently range from 70% to 85% of households, depending on the statistical source.[2] Smartphone adoption continues to climb, reaching 81% in 2019, but too many of those same households do not have an in-home subscription to conduct professional work and other activities dependent on a nonmobile device.[3]

These gaps matter because broadband has an impact on nearly every social determinant of health. Broadband affects the economic and social opportunities for single households and entire neighborhoods, including direct access to health care or 24-hour access to educational opportunities. In the 21st century, communities without ubiquitous broadband adoption simply cannot achieve universal prosperity.

The purpose of this paper is to establish the role broadband plays in impacting health and equity, explore the systemic barriers that limit its adoption and use, and introduce market and policy reforms to overcome those barriers. It begins by outlining how current governance structures and private marketplaces influence the current state of broadband access and adoption. The paper then uses interviews and desk research to demonstrate how broadband impacts health and equity in U.S. communities. The paper concludes with promising points of intervention for addressing inequities in the current broadband sector, using case studies to offer locally specific evidence. Appendixes include further background research, broadband impacts by geography and demographics, and areas for further investigation.

How the broadband sector works

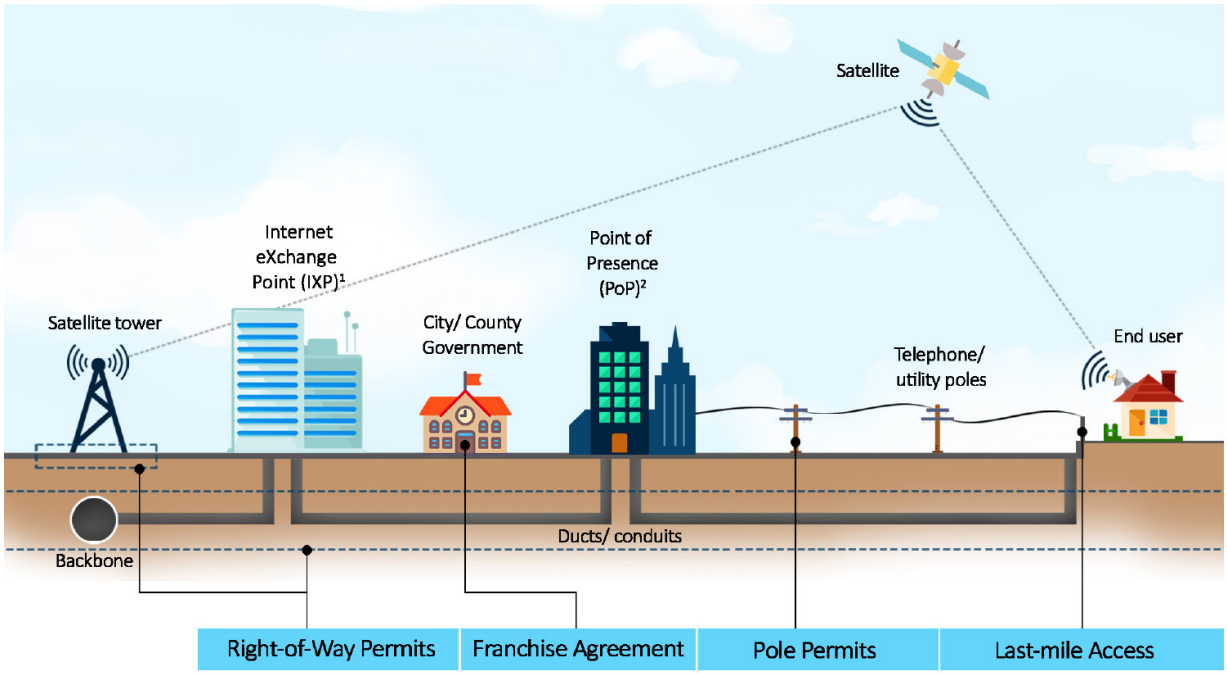
"Broadband" refers to a set of networked data transmission technologies which permit internet-protocol communication, access to digital information at high speeds, and participation in the information society. These transmission technologies commonly include optical fiber, copper telephone lines, cable television lines (fiber plus coaxial cable), and wireless systems using a variety of radio frequencies transmitted via cellular, microwave, satellite, and other infrastructures. These technologies are deployed and interconnected to create networks operating at three broad levels: internet backbone networks, middle-mile networks, and last-mile networks (Figure 1).

While all three levels impact broadband performance, this paper focuses primarily on last-mile networks, since these are the networks households directly engage with (often via a personal subscription service). It is the quality of these networks—including whether a last-mile network is available—that are most visible to household users. But last-mile networks are also the most expensive to build and operate on a per-user basis, making the economics challenging. Last-mile networks are often the focus of media and policy discussions regarding broadband availability, speeds, and household adoption.

Speed is a central component of any broadband network's performance. However, what speeds qualify as "broadband" is an inherently flexible concept. The FCC formally defines wireline broadband service as access to internet services at both 25 megabits per second (Mbps) downstream and 3 Mbps upstream, or what's commonly listed as "25/3" service.[4] The FCC

FIGURE 1

Broadband's physical function and general governance



Source: The Brookings Institution

currently uses the same speed thresholds to qualify wireless service as broadband, but there is debate among current FCC commissioners over whether this threshold is too high, as well as which technologies should be included.[5] In practical, day-to-day use, however, the term "broadband" is used interchangeably with "fast internet," which can mean any download speed from 3 Mbps to 1,000 Mbps or more—and any delivery technology, from all-copper DSL or 4G smartphone access up to home fiber service. Effectively, speed definitions depend on the user's perception and demands.[6]

Beyond the technology, there are two additional characteristics of "broadband infrastructure" that are critical for appraising its equity and potential impact on individual and community well-being: its **physical availability** to individuals and communities, and the **systemic barriers to adoption and effective use** by those individuals and communities.

This section frames how the broadband sector works in greater detail, exploring concepts related to policies, actors, capital operations, and usage among households. Central to this framing is the absence of a clear, formal principle adopted across all government levels designating broadband as a "basic human right." The absence of such a principle, combined with the private sector's investment leadership and current governance approaches, gives rise to a set of disparate broadband outcomes.

Governing environment

Rooted in congressional authority, the FCC serves as the country's central regulator of broadband networks.[7] The Telecommunications Act of 1996 generally empowers the FCC to regulate internet service providers (ISPs), similar to its historic oversight of telephone providers as public utilities. This regulatory role stretches to both wireline and wireless services, where FCC management and allocation of national radio frequencies (or spectrum) is essential. The FCC's primary broadband mission is to encourage the private sector to deliver networks that reach all Americans, and focus their policies on places where the business investment case is not clear.

Absent major updates to congressional law, FCC rulemaking often represents the most impactful swings in national broadband policy. For example, the FCC can establish regulations that will either preempt state or local government authorities or allow those other jurisdictions to establish their own laws, as it did in the late 2010s, limiting local governments' right to regulate wireless deployments and local cable franchise agreements.[8]

State and local governments can regulate other components within their local broadband networks, although these authorities can change depending on federal law. For example, states have the authority to determine whether municipally owned broadband networks can operate in their state—but federal law could circumvent that if Congress or the FCC so decided. Current law permits state and local governments to negotiate certain benefits in exchange for a cable company's franchise agreement, including service provisions into specific neighborhoods. However, federal law precludes franchise agreements from including pricing.

While physical network regulation is clear—even when regulation is used to preempt more local authority—broadband adoption is one area where federal, state, and local policies are underdeveloped. There is no consistent federal guidance around how and where to deliver digital skills training or to provide access to computing equipment. Likewise, each state and local government is left to their own preferences around establishing similar policies, whether independently or as part of formal relationships with private ISPs through vehicles such as cable franchise agreements. For example, some municipalities apportion funding to dedicated digital inclusion offices, while most do not.

The absence of such policies gives rise to a clear gap: How should the public sector define equitable broadband outcomes? Should every

household live in a residence where there is physical access to a broadband wireline connection, or is it enough to have access to high-speed wireless data service? Should every household also maintain a subscription, irrespective of their income levels, geographic location, or other demographic considerations? Should every household have both wireline and wireless subscriptions? Current federal policy does not clearly answer these questions.

Network ownership structure

Across the country, private cable and telecommunications corporations—often acting as monopolies or duopolies—provide the vast majority of end-user internet service to households and businesses. For residents, this means that there is little competition and limited involvement with the public sector as it relates to broadband service delivery. Like any industrial sector, traditional market analysis suggests limited competition can lead to higher consumer prices and reduced output, including geographic service gaps.

Wireline service offers high-speed, in-home connections to consumers. The private sector provides the vast majority of service, with almost 90% of U.S. residential, in-home broadband customers served by just 14 firms.[9] There are hundreds of municipalities and other not-for-profit entities—including rural electric cooperatives—which service an extremely small share of total residential subscribers. These initiatives often have significant competitive effects where they exist, but their combined footprint in the national home broadband landscape is still relatively minimal.[10] Likewise, despite its physical reach, satellite internet has minor market shares where wireline alternatives exist, and is not considered a true broadband technology by many analysts due to high latency (transmission delay) and other reliability issues.[11] Overall, it is difficult to discern the exact amount of wireline network choice found across all neighborhoods and larger communities due to mapping irregularities and the FCC's statistical methodology.[12]

While private networks provide the vast majority of wireline service to residences and businesses, there is an emerging debate around the concept of publicly owned broadband networks and whether federal or state law should preempt their existence. When successful, publicly owned broadband networks can create affordable services for neighborhoods or entire municipalities. However, given the constraints and demands placed on state and local budgets, as well as potential corporate or political resistance to public networks, states and municipalities rarely launch public networks. This situation continues to evolve, with more states creating rural broadband funds and more local communities launching community-owned networks.

The national **wireless** data industry operates within a more consolidated market structure, although competition is more visible. The current fastest wireless service is considered fourth-generation technology, commonly referenced as 4G or LTE service, of which an even smaller set of network providers serve the general public. The advent of various higher-speed cellular technologies collectively called "5G"—which range from enhanced versions of current LTE service to gigabit millimeter-wave connections—could mean wireless technology can begin to compete with home wireline service. To do so, 5G will need to reach many of the neighborhoods where wireline service is currently available. That will require significant build-out of fiber networks that connect to 5G small cells, of which many are required within small areas to offer such high-speed, low-latency services.

As it stands, wireline and wireless services are not direct substitutes, due to physical differences and services. Wireline services offer faster speeds, and tend not to have monthly data caps—while many wireless services do, especially the most affordable ones.[13] The services trend more as complementary goods, as evident by the 85% of households that have a cellular data plan as well as another broadband subscription.[14]

Key actors, influencers, and decisionmakers

The broadband sector relies on a wide set of actors who impact the current and future state of broadband performance.

Stakeholders working at public agencies and network companies carry significant influence on the availability and quality of broadband services in every neighborhood across the country. Their decisions—ranging from federal rulemaking within the FCC to capital investments, spectrum purchases, and community interactions within ISPs—inherently make them major decisionmakers.

Complementing these groups are professional "influencers"—legal, technical, policy, and legislative—who work in and around the related corporations, trade organizations, policy shops, congressional staffs, lobbying businesses, and the FCC. This circle also includes civic organizations, whose mission is to represent the public interests of internet consumers and other grassroots constituencies. Depending on each group's mission statement or their collaborators' interests, these groups will argue for specific regulatory, policy, and market reforms to influence broadband performance. Research entities—including academic institutions, philanthropic foundations, and nonprofit research organizations—also aim to influence the marketplace, typically using data analysis and commentary.

Institutions that do not have direct responsibilities for broadband provision or regulation but could benefit from improved broadband adoption are plentiful.[15] Community anchor institutions such as hospitals and religious organizations or civic groups such as chambers of commerce and social organizations could all benefit from more equitable broadband availability and adoption. However, since many of their leading stakeholders don't focus on broadband or have deep expertise in the area, it's challenging to understand the gaps, advocate for specific reforms, or even see digital inclusion as their responsibility.

Broadband financing, funding, and maintenance

Private companies are the primary owners and operators of the broadband infrastructure serving residential end users. Working within the confines of their spectrum licenses, state or local cable franchise agreements, and other regulatory controls, these companies have wide latitude to decide where they will invest in capital assets, the dollar amount of their investment, and the financing mechanism for those investments. Maintenance of their infrastructure assets is a business expense, undertaken by its owners as they see fit, in accordance with their private business plans. Critically, these companies can choose the locations where they would like to invest and eventually offer service—again, working within the confines of any franchise or other state and local service agreements.

Because private networks constitute nearly all the country's broadband infrastructure and invest on variable long-term schedules, it's difficult to determine the exact value and annual investment levels made by these companies. Similarly, it's nearly impossible to find verified geographic statistics regarding broadband spending. This creates challenges when trying to compare broadband spending to other major infrastructure sectors. It also complicates public officials' ability to estimate what investments would be required to build publicly owned networks at any geographic scale.

However, since many broadband companies are publicly traded, their annual reports offer a way to uncover rough spending data. According to data compiled by USTelecom, the industry's trade association, the combined capital expenditures of the largest broadband providers was $66.3 billion in 2018.[16] According to USTelecom, these six companies tend to represent 80% to 85% of total capital expenditures across the industry, meaning total national spending could have reached roughly $80 billion that same year. While private companies drive most broadband capital investments, the **public sector** still plays a sizable role.

Federally, the FCC's Universal Service program uses legal structures adopted from legislation passed in 1934 and 1996 to collect fees directly from telecommunications providers for investment in infrastructure. Since 2010, the FCC has significantly reformed and modernized these policies, and now utilizes the Connect America Fund to expand broadband in rural communities, the E-rate program to bring broadband to schools and libraries, the Lifeline program to make broadband more affordable for low income households, and three rural health care programs—the Healthcare Connect Fund, the Rural Health Care Program, and the Rural Health Care Pilot Program—to make broadband build-out and service costs more affordable for health care providers. While the Universal Service program bundles telephone service support, the FCC's total disbursement in 2018 was $8.9 billion across all programs.[17]

Congress also has the authority to devote targeted funding resources via enacted legislation and annual appropriations. The major recent example is 2009's American Recovery and Reinvestment Act, which provided roughly $4.7 billion to the NTIA to administer the Broadband Technology Opportunities Program, or BTOP. While not subsequently funded, BTOP aimed to reduce the digital divide by making direct grants for new infrastructure, improved public computer centers, and policies to encourage broadband adoption, including digital skills development.[18] However, appropriated programs are less consistent over time than programs like the Connect America Fund, which have dedicated annual revenue streams.

State and local efforts complement these programs. States directly invest in broadband infrastructure, from Kentucky's statewide fiber network to rural efforts in Washington state. Many rural cooperatives— typically established to provide electricity or telephone service starting in the 1930s—now provide broadband service to their local populations. Communities such as Fort Collins, Colo. and Chattanooga, Tenn. operate municipally owned broadband networks. The limitations to these investments are the public's willingness to spend and the federal and state laws that may preempt state and local infrastructure ownership.

Considering the heavy role of private investment in building and maintaining broadband networks, there is a clear opportunity for **capital investments to overlook specific geographic or demographic communities**. In particular, if private business calculations and risk assessments suggest their investments will not lead to a return for their public or private shareholders, then it's the business' fiduciary duty to not invest in those places. This creates a natural incentive to neglect lower-density locations (due to higher investment needs per capita) and lower-income neighborhoods (where the ability to pay may be less likely than higher-income neighborhoods).

Similarly, there is a lack of a clear federal regulatory position on what would qualify as discriminatory private investments based on race. As the following section will show, broadband adoption rates are lower among people of color versus white households. Based on prior research, especially by Free Press, these lower adoption levels could be directly associated with structural racism across the economy, from credit discrimination to a rental unit owner's approach to in-building wiring investments.[19] In essence, the lack of mature anti-discriminatory regulation leaves an opening for lower broadband adoption based on the investment preferences of the private sector.

Other public infrastructure sectors do not share the same structural issues. Due to the pooling of public revenue and pursuit of public good, public infrastructure owners frequently develop management structures and investment programs to ensure spending delivers equitable infrastructure service. For example, public water authorities collect revenues from all customers, some of whom pay discounted rates, and can use bond revenues to serve all neighborhoods—not necessarily just neighborhoods with higher or lower water usage. The same applies to state transportation departments, which often use gas

taxes to invest anywhere in their state, not just where tax collections are the greatest. However, due to the low levels of public broadband ownership, these equitable ownership benefits are not yet seen at scale in the broadband sector.

The current state of broadband adoption

An examination of the current state of American broadband reveals divergent outcomes. Focusing on the number of subscribers—a top-line assessment of broadband adoption and digital skill level—there are clear disparities across the country. If the goal is to ensure every household has a high-speed connection, the current state of broadband infrastructure is inequitable.

According to the 2018 American Community Survey (ACS), there are 121.5 million households in the United States. All but 18.1 million of them now have subscriptions to some form of home "broadband" internet service.[20] The ACS first began collecting data on broadband adoption in 2013, when the connection rate was 73%. In 2018, the number of connected households was at its highest rate yet, at 85.1%.

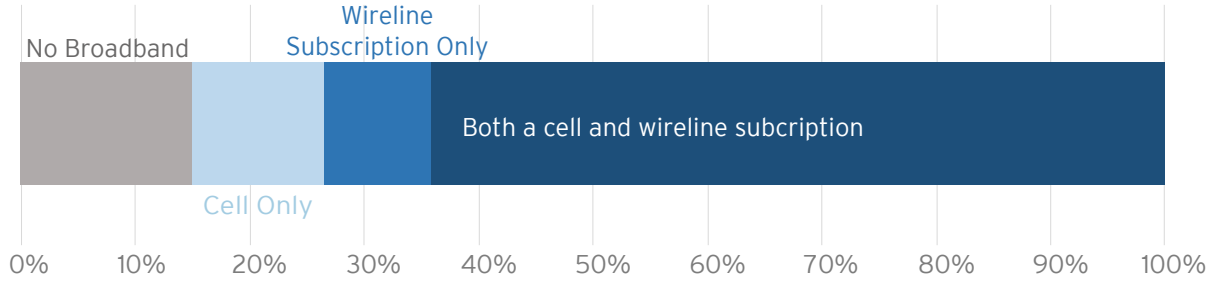
However, there's more to the story than the top-line numbers (Figure 2). Of those households with a broadband subscription, about 14 million only have a cellular data plan, and 12.3 million only have a wireline subscription.

In terms of those households without broadband subscriptions, 4.9 million are in rural areas (as defined by the census), while 14.9 million are in urbanized areas (metropolitan or micropolitan).[21] Although the majority of households without a broadband subscription live in urbanized areas, the overall rural broadband adoption rate of 79% is still more than five percentage points lower than that of urbanized areas (84%).

The differences in broadband adoption rates between states underscore this geographic divide (Figure 3). In 2018, the average state had a broadband adoption rate of 84%, but there was still a nearly 15-percentage point difference between the states with the highest rate of adoption (Washington and Utah, at 90%) and the lowest (Mississippi, at 76.3%). These differences can largely be explained by social, economic, and geographic contexts. The states with the lowest broadband adoption rates also had the lowest median incomes, highest shares of rural communities, and the highest shares of communities of color.

FIGURE 2

Household broadband adoption by subscription type
United States, 2018



Source: Brookings analysis of 1-year American Community Survey data.

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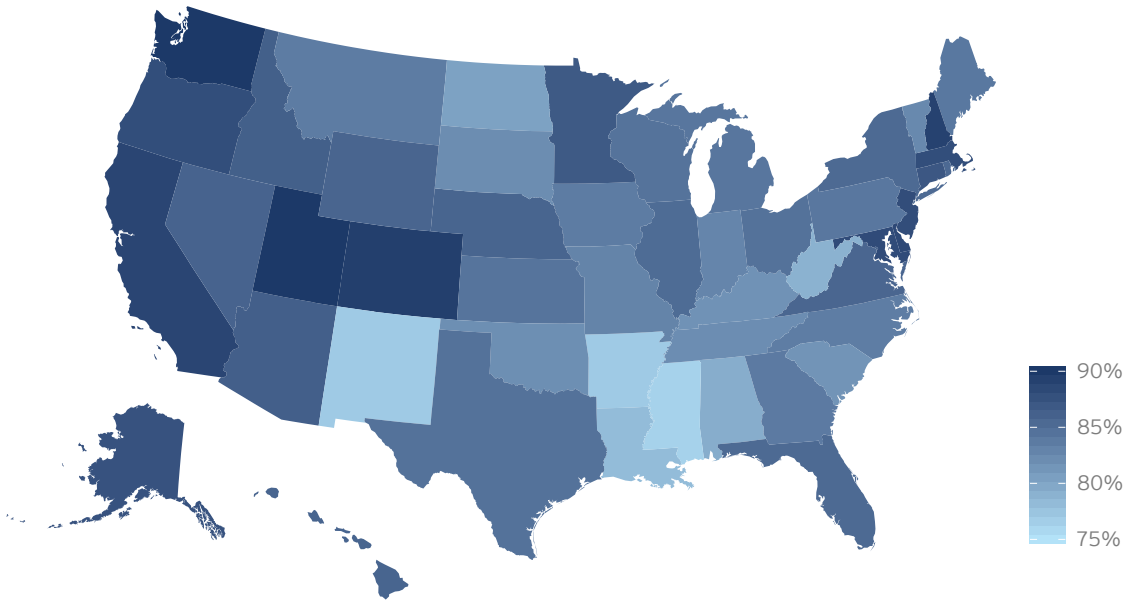
There are even greater deviations when comparing broadband adoption by county-level population density. Using neighborhood-level data via the 2014-2018 5-year ACS,[22] the median rural neighborhood has a lower broadband adoption rate (69.2%) than mature suburbs (84.4%) or urban cores (84.5%).[23] However, there are fewer disparities across rural neighborhoods—a larger percentage of them all have lower adoption rates.[24] More urban neighborhoods demonstrate wider disparities, suggesting a higher adoption ceiling and floor. This means that higher average or median rates may mask suburban or urban neighborhoods struggling with broadband adoption. Figure 4 visualizes this phenomenon.

Bundling data by large metropolitan areas—or those where population exceeds 500,000—confirms the disparities found even in regions with the highest subscription rates. In general, the metropolitan areas with the highest overall broadband adoption rates do tend to have the lowest standard deviations (Figure 2). Metro areas such as San Jose, Calif., Seattle, and Colorado Springs, Colo. all have well-connected neighborhoods and fewer outliers. On the other hand, Memphis, Tenn., El Paso, Texas, and New Orleans have lower overall adoption rates, signifying large gaps between neighborhood subscription levels. Again, this data confirms how statistical deviation serves as evidence of local digital divides.

Regression analysis of these variables at both the state and neighborhood levels confirmed the literature base: that states and neighborhoods with higher incomes, lower poverty rates, higher levels of education, fewer residents of color, and fewer residents over 65 had statistically significant higher broadband adoption rates.[25] Looking further at how broadband adoption intersects with communities of color at the national level, white, Asian American, and Latino or Hispanic households all have broadband

FIGURE 3

Household broadband adoption rate across the United States
2018, 1-year estimates



Source: Brookings analysis of American Community Survey data

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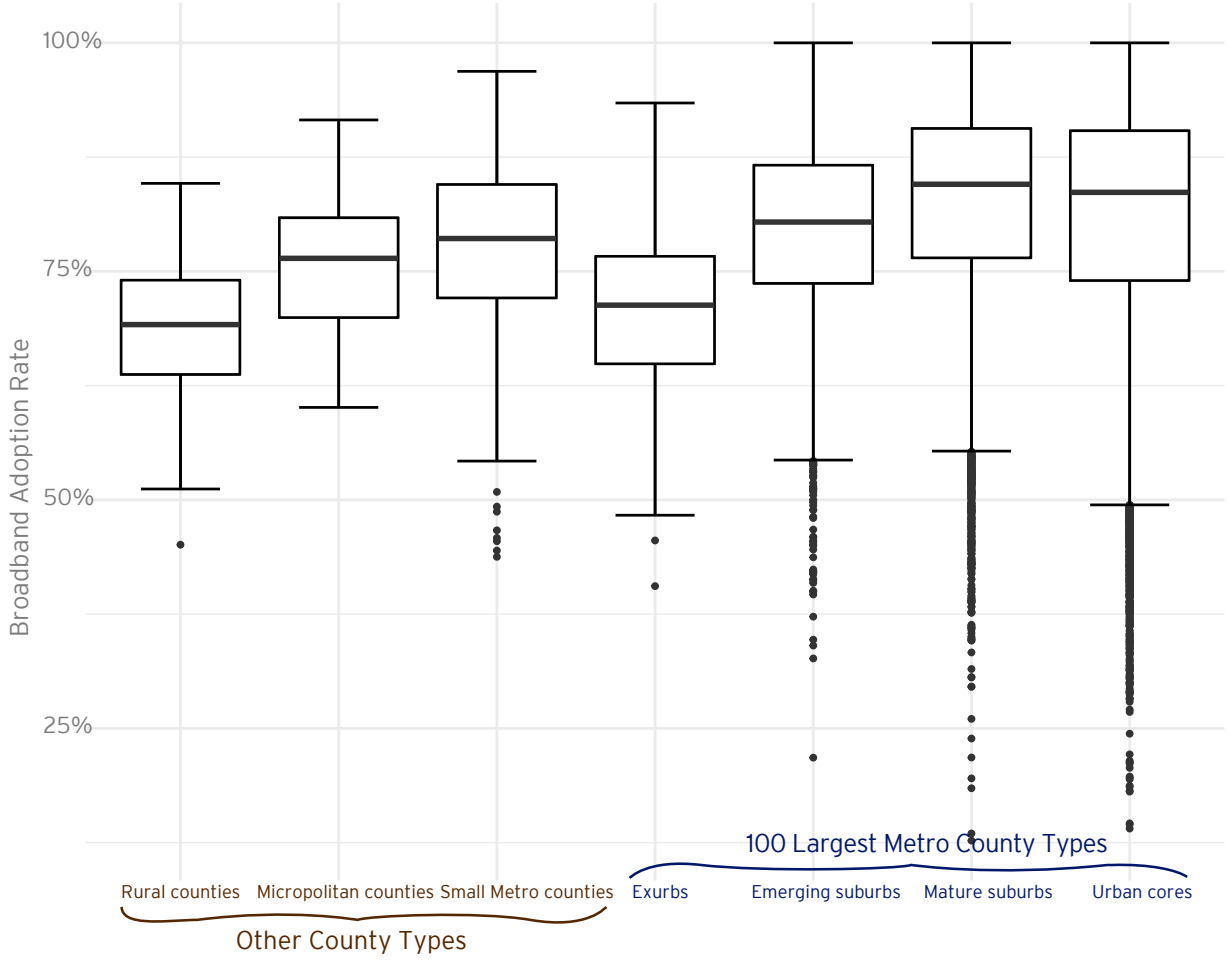
FIGURE 4

Neighborhood broadband adoption by county population density
2018, 1-year estimates



Source: Brookings analysis of American Community Survey data.

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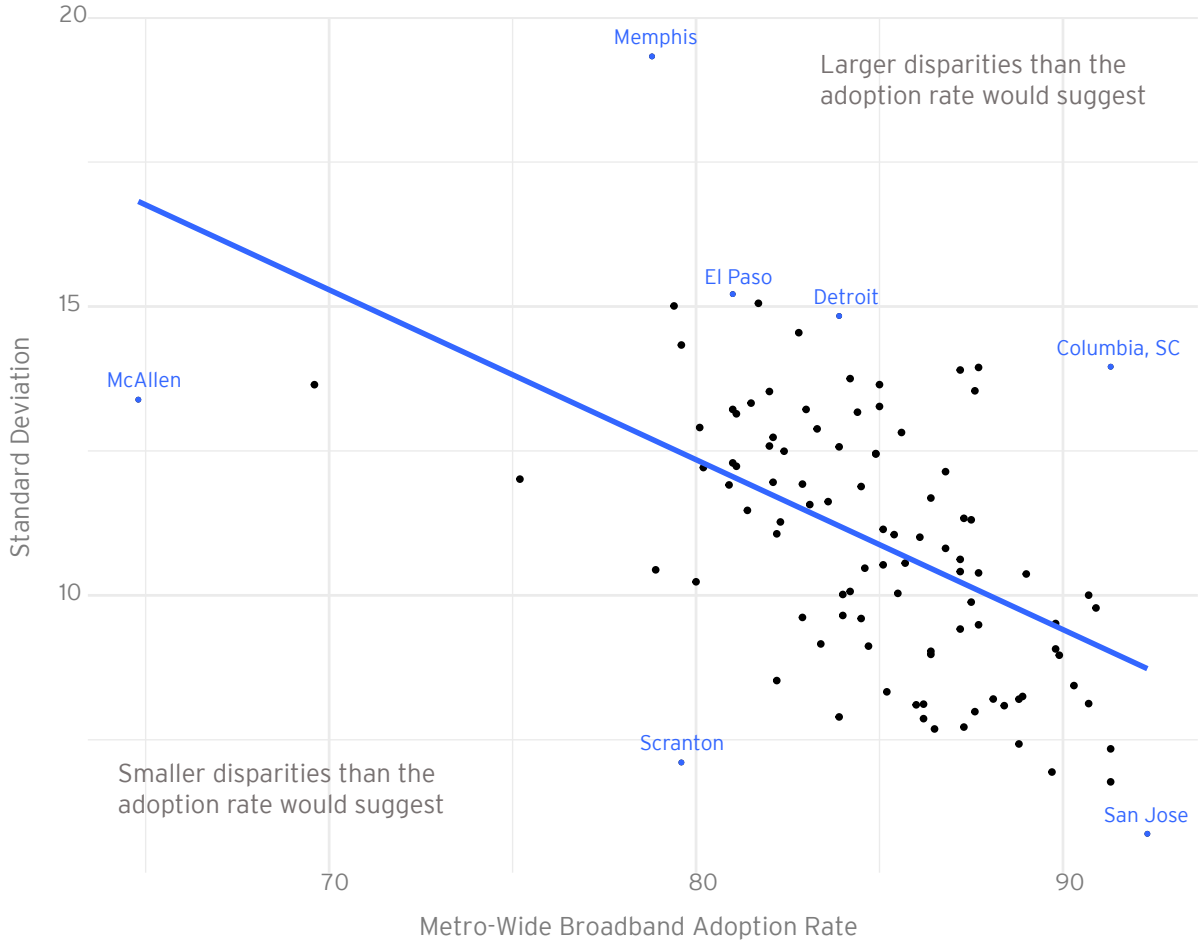
adoption rates above the national average (at 90%, 94%, and 86%, respectively), but Black households have a lower adoption rate, at 82%. A neighborhood-level analysis revealed even starker differences. While the average majority-white tract had an average broadband adoption rate of 83.7%, the average majority-Black tract (more than 50% Black residents) had a broadband adoption rate of just 67.4%. The neighborhood-level regression analysis found that the poverty rate of a tract is a highly significant indicator of low broadband adoption rates. In fact, the average tract with a poverty rate lower than 20% had an 81.8% broadband adoption rate, while the average tract with a poverty rate over 20%—or what qualifies as concentrated poverty—had an average broadband adoption of 64.9%.

From rural communities to the largest metro areas, communities of color and low-income communities were likelier to see larger differences in broadband uptake, suggesting that systematic barriers remain to deliver equitable national broadband outcomes.

FIGURE 5

Metro areas with the highest broadband adoption rate also have less inequality in uptake
2018, 5-year estimates



Source: Brookings analysis of American Community Survey data.

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While it's challenging to statistically control for any one of them, research and public data illuminates many of the barriers to equitable broadband access and adoption. Likewise, many of these barriers are rooted in public policies and private business activities.

Pricing: One of the clearest structural barriers to adoption

Unfortunately, due to a lack of federal reporting requirements and the practice of bundling broadband with television and telephone services, there is a lack of clear data on consumer broadband pricing. However, targeted reporting does offer evidence of pricing challenges for disadvantaged American households. First, American pricing exceeds global developed-economy averages when compared on consistent data usage.[26] There is also wide pricing

inconsistencies between metro areas, impacting broadband adoption in higher-price markets.[27] These price differences, especially relatively high prices, can negatively impact adoption levels, especially by making households believe broadband is not relevant enough for their limited budgets.

Several major cable and telecom ISPs created special low-cost rate programs for populations of low-income customers between 2009 and 2014, in response to FCC deal-making during merger approvals. Comcast's program has demonstrated the need for a low-cost alternative by attracting several million low-income households; other programs have been less well-marketed and less successful.[28] As of April 2020, all the remaining low-cost programs will be voluntary, and some could disappear depending on the company's interests.

The only federal subsidy for qualifying low-income households is the FCC's Lifeline program. Originally launched as a reduced-cost phone service program in 1985, since 2017 the Lifeline program has required participating wireless phone providers to offer smartphones, a capped amount of data usage per month, and a $9.25 monthly rate for each household that has internet access through the program. However, there is uncertainty around the future of the program—Lifeline's inclusion of internet access continues to be debated in federal courts due to changing FCC positions between presidential administrations.[29]

Finally, outside the immediate circle of industry and government players, there is inconsistent financial support for community "digital inclusion" programs providing assistance for lower-income and other digitally disadvantaged households. Digital inclusion can vary based on each community's needs and the provider's expertise, but activities tend to focus on developing basic computer skills, offering information on affordable internet services and devices, and delivering technical and social support for other digital inclusion efforts. The federal government offered direct funding support to digital inclusion policies through the Broadband Technology Opportunities Program (BTOP), which was funded through 2009's American Recovery and Reinvestment Act until 2012. Since expiration of BTOP, National Telecommunications Information Administration staff continue to offer technical support through their publications and direct relationships, but the cessation of direct funding support to local providers resulted in many shutting or reducing services.

Geography: A broadband barrier for both rural and urban areas

Rural broadband development is particularly challenging due to the higher investment needs per capita. As a result, rural households—plus their business peers—face a challenging private broadband marketplace. Increased broadband infrastructure deployment in unserved and underserved rural areas is an active public policy issue associated with the broadband sector, as evidenced by multiple congressional hearings and public FCC statements since 2016. Last year, the FCC chairman identified "fixing the rural digital divide" as his highest priority.[30] (By "divide," he meant the absence of high-speed Internet infrastructure in many rural areas.[31]) Multiple members of Congress and 2020 Democratic presidential candidates are currently calling for big investments in broadband infrastructure.[32] At the state level, governors and legislators introduced similar proposals, and multiple state agencies publicly promote rural broadband expansion.[33] But even with consistent political support, there is still disagreement on what technologies would be supported, the range of eligible providers, and the role of competition. Across federal and state debates, there are still open-ended questions on whether fixing the rural digital divide will lead to public network ownership, construction and operational subsidies to private providers, or some mix.

Geography is also challenging for urban and suburban neighborhoods due to the potential for broadband network owners to skip over

or underserve specific areas—a practice that's come to be called "digital redlining." Current federal regulations do not require ISPs to service every resident or business within their service geography. Federal law also doesn't require ISPs to bring faster speed tiers to every neighborhood equally. As seen in Cleveland and Dallas, this regulatory architecture permits market failures even within otherwise well-served metropolitan geographies.[34]

Combined, the lack of regulatory controls requiring service to specific neighborhoods and the higher cost to deliver broadband infrastructure to lower-density areas creates structural barriers to equitable broadband outcomes. This is especially threatening for rural communities, isolated smaller cities, and any lower-income neighborhood.

Broadband access as a health and equity issue

How broadband influences health, equity, and opportunity

Broadband is our newest infrastructure system, and the public is still learning how digital telecommunications impact health and equity outcomes. What differentiates broadband from more traditional infrastructure sectors, though, is that it is a cross-serving platform by which a range of different applications operate and eventually impact individuals. For example, once connected, an individual can use broadband to access remote health care providers, services, and information, all of which can improve physical and mental health. Broadband is the means; digital services deliver the ends.

The broadband platform is so widespread, though, that it can deliver services that touch every social determinant of health (SDOH)—or the wide range of conditions that impact health and life outcomes. From economic stability to education to social supports to civic agency, broadband and the digital services it enables are intrinsically tied to collective health and equity outcomes. Since the academic community uses different categorizations for the connections between broadband and collective health and equity outcomes, this section chooses to bundle them under three groups: access to health care, economic opportunity, and social cohesion. *(For an expanded discussion of these factors, additional categories, and more academic resources, see Appendix I.)*

Access to health care: Telehealth—defined broadly as the use of telecommunications technologies to deliver health services and education—is a clear example of how broadband can directly improve health outcomes, especially for those without access to traditional health facilities.[35] These groups include rural communities far from providers, low-income residents who cannot afford transportation to providers, and mobility-limited adults who cannot leave their homes. With the expanding range of telehealth technologies and a broadband connection, providers can increasingly fill these service gaps, and patients can connect with doctors, manage chronic conditions, and even get prescriptions from home.[36]

Patients can either schedule a remote consultation or message their doctors through secure messaging platforms to ask quick questions without needing to travel to a facility. If a patient is able to travel to a facility but there are no specialists available, medical imaging applications enable images to be transmitted to radiology, pathology, and cardiology specialists, who can then interpret the results.[37] For patients with chronic conditions that need to be managed, they can use remote monitoring services which transmit data to doctors in real time. This live monitoring allows doctors to detect irregularities that can be addressed through early interventions, before hospitalization is needed.[38]

The adoption of digital equipment and services—or the "digitalization" of the health care sector—also helps medical teams provide better service to patients, reduce errors, and make better, more informed, and accurate decisions. Online prescriptions reduce the likelihood that pharmacists will miss prescription details.[39] Electronic medical record-keeping assures that doctors have a comprehensive view of a patient's medical history, so that nothing is missed in providing diagnoses.[40] Further, electronic records can decrease overhead administrative costs and costs associated with potential errors. Recent research suggests that use of providers' online patient portals can increase engagement in outpatient visits—potentially addressing unmet clinical needs—and reduce downstream health events that lead to emergency and hospital care, particularly among patients with multiple complex conditions.[41]

Economic opportunity: New digital infrastructure enables job seekers to find more employment

opportunities online, equips workers with the skills to qualify for digital jobs, and decreases job strain.[42] [43] Further, early evidence suggests that high-speed internet availability may lead to job creation in some markets, opening up more opportunities for job seekers.[44] On the other hand, the digital age comes with increased inequities, as more than 80% of Fortune 500 companies now only accept job applications online.[45] Job seekers without a broadband connection are therefore left at a disadvantage compared to their digitally equipped peers.

Broadband also democratizes access to education, offering a wide supply of free and open education platforms, courses, and resources. Beyond the exponential growth of "massive open online courses" (MOOCs), there are less formal educational opportunities as well, such as YouTube tutorials, GitHub, and communication forums.[46] But there are also equity drawbacks to online education. With an increasing number of class assignments and activities occurring online, those students who lack internet access at home are at risk of falling behind their peers.[47]

Social cohesion: Broadband can promote the development and maintenance of people's social support systems. There is empirical evidence that the internet can offer a platform to form new friendships.[48] For traditionally marginalized groups who are prone to social isolation, access to the internet allows them to connect to other members anonymously.[49] Further, because the internet decreases the cognitive burden involved with maintaining long-distance relationships, it also allows people to maintain more loose social ties.[50] Although there is ample evidence showing the negative relationship between social isolation and health outcomes,[51] there's also emerging evidence in the internet era showing that even weak social ties can have positive health effects.[52] Broadband can even promote community safety by offering a new platform to share information, whether through neighborhood community forums or the First Responder Network Authority (FirstNet), which connects police, fire, and medical services.[53]

Broadband also has the potential to increase civic engagement.[54] First, internet access can expose users to a number of viewpoints on any given issue, as well as keeping citizens generally informed—although recent evidence also suggests issues around confirmation bias. Second, citizens equipped with more information are more likely to become involved with community activities and organizations. Third, broadband allows governments to develop new platforms through which citizens can engage directly with public officials and other stakeholders. Broadband has also been shown to increase people's likelihood of voting, donating to campaigns, and participating in civic organizations.[55] Moreover, on the administrative side, broadband helps governments run more efficiently and save costs in engagement and service distribution efforts.[56] However, this potential is limited by the fact that the transition to an online-only system is costly and impossible until broadband adoption is universal. In the meantime, governments need to undertake the expensive endeavor of maintaining both an online and physical presence.

Equity and health goals in the broadband sector

The public sector—from the federal to local level—tends to prioritize broadband equity through the lens of physical access. Often termed "equitable service delivery," governments focus on where wireline or wireless networks operate and at what speed thresholds. However, this approach does not reflect the full range of equity- and health-related outcomes that broadband can impact. To do so, the public sector would also need to address adoption and skills gaps that limit broadband's full equity and health impacts.

A clear example of the strict focus on physicality is high-level FCC strategy. The FCC recently released its strategic plan for fiscal years 2018 to 2022, which emphasizes four major priorities, only one of which addresses the question of digital equity. The plan's vision for closing the digital divide includes creating a regulatory environment that incentivizes the

private sector to deploy and maintain broadband infrastructure.[57] However, physical access is often not the reason households do not subscribe to a broadband service; according to a recent survey by the Pew Research Center, only 22% of Americans cite lack of access to service as a reason for not adopting.[58] The most commonly cited factors are cost and a lack of relevance, which the FCC's strategic plan does not address.

In some instances, the focus on physical gaps also includes a focus on adoption, especially among anchor institutions. The FCC Universal Service program's three rural health care programs—the Healthcare Connect Fund, the Rural Health Care Program, and the Rural Health Care Pilot Program—all prioritize both broadband build-out and reduced subscription costs for health care providers. The same applies to the FCC's E-Rate program, which reduces costs to qualifying schools.

Recently the FCC formally adopted a rule to bolster support for its Rural Health Care Program, or what the FCC calls a "Report and Order".[59] The Report and Order followed an increase on the annual cap of funding the program receives.[60] Further, the FCC is looking to create a program to support the delivery of telehealth services to low-income individuals,[61] as well as launching additional research efforts to better understand the connection between broadband and health outcomes in America.[62]

Beyond federal efforts, some local governments and state legislatures have established broadband goals related to equity, and in some cases use formal regulations to enforce goals. Minnesota and West Virginia have both launched efforts to address the digital divide in their states by publicly investing in network expansions in disinvested areas.[63] The same applies to municipal networks built across Colorado, all of which required a ballot measure to overcome a statewide limit on municipal network ownership.[64] Cities such as Louisville, Ky. and Chattanooga, Tenn. use established digital equity offices to pursue a broad suite of policies. It's up to individual leadership in municipalities to initiate an office; we explore many promising examples later in the paper.

Finally, certain ISPs have formally adopted their own digital equity goals and then used philanthropic efforts and discounted services to pursue those thresholds. Regardless the physical footprint, efforts by companies such as Comcast and Cox Communications can provide a digital gateway to communities in need. However, much like public policies that may lose budgetary resources, there is always the possibility that private companies can discontinue their equity programming.

At times, federal law can also preclude states and localities from advancing certain equity or health goals. Cable franchise agreements serve to demonstrate this broader point: While cable franchise agreements can require providers to serve every residential address within the given service area, there are no national standards around speed thresholds, monitoring service levels is expensive, and federal law precludes certain levers such as pricing within agreements. In addition, municipal franchise negotiations have been preempted or eliminated by legislatures in over 20 states since 2000. The FCC recently issued new rules which limit the remaining local cable franchise authorities from seeking money or in-kind support for community initiatives via franchise negotiation.[65]

Obstacles to improving health, opportunity, and equity outcomes

Between the spring and fall of 2019, the authors conducted interviews with private, public, and civic stakeholders across the country, including a lengthy workshop held in Washington, DC. Those broadband stakeholders revealed three categories of obstacles to improving health and equity outcomes: impacts are indirect; disconnect between decision-makers and their constituents; and information gaps around digital skill levels.

First, broadband's impacts on health and equity outcomes are often indirect. Even though there's

a clear case to be made for the connection between broadband and health or equity outcomes, the fact that those connections occurs through a range of mechanisms—employment stability, educational attainment, social inclusion—might make elected officials, civil servants, civic executives, community advocates, and other relevant stakeholders are less likely to view broadband investment as a lever to affect near-term health and equity outcomes. For example, experts cited the challenge of having economic development officials recognize the digital divide as a focus area within their economic inclusion programs. Research indicates that broadband may influence social determinants of health such as employment, educational attainment, and social connections over an extended period of time. Indeed, many studies on the link between broadband and employment examine effects on a 15-year timescale. So while broadband may be an important platform for enabling health equity, the long-term nature of its impacts may obscure that importance.

Second, the prevailing disconnect between community members and decisionmakers is that almost all public officials in positions of power have always had personal access to the internet, and thus do not understand life without it.[66]

This disconnect can lead to misperceptions that stand in the way of health and equity. From one interview, we learned that local public officials sometimes dismiss the importance of the internet because they see its value primarily in terms of leisure applications (such as streaming services or social media). If they see the primary value as a nonessential one, then decisionmakers will fail to see the health and equity benefits, which can lead to limited investment or interest. Others often suggest that people use public Wi-Fi without understanding its inconvenience, as well as its lack of data security and privacy.

Third, some decisionmakers do not understand how many local residents lack basic digital skills. If decisionmakers do not understand the extent to which digital literacy is an adoption barrier, then they might focus too much effort on the wrong forms of intervention. For example, if a hospital is interested in promoting its online health portal but does not understand that the main reason for nonadoption is a lack of digital skills, they may spend money and resources on awareness campaigns and still not increase usage of the portal.[67] Interviewees also mentioned challenges library staff face, since they often serve as digital skill hubs but struggle to attract other public sector leaders to support their programming.

Improving broadband's health and equity outcomes

This section, based on demonstrated practices and interviews with stakeholders and across the country, details the systemic levers that can ensure broadband delivers on health- and equity-driven goals. Each of these interventions relies on a basic premise: improving social determinants of health starts with every household having personal broadband subscriptions that they can take full advantage of. These system-wide efforts will create pathways to health and equity.

System-wide interventions

Broadband's ability to reach and positively impact any household depends on three critical inputs: physical availability, affordability of services and equipment, and digital skill levels. These serve as a "three-legged stool," where deficits in any one can restrict the larger goal to drive health or equity outcomes. Any system-level approach to improving broadband will include interventions that address all three inputs.

Closing the availability gap

Broadband availability gaps are a natural offshoot of the privately owned and financed industry model prevalent across the country. Improving broadband's physical reach will require interventions that either incentivize private capital to invest in riskier geographies, allocate public funding to construct public networks, or some mix of the two. All levels of government can contribute to these kinds of interventions.

Federal, state, and local governments each have capabilities to **incentivize build-out's of private networks** to connect difficult-to-reach places. Where possible, state and local governments can negotiate franchise agreements with cable providers to reach every neighborhood within a franchise area. These are especially valuable for small- and medium-sized cities in regions with cable networks, as well as in low-income neighborhoods or communities of color where digital redlining may be occurring. The federal government also has the ability to enact policies—whether through new legislation or via current FCC funding—that offer direct financial incentives to adjust the risk profile for any network owner and operator. Here, the strengths and weaknesses of the FCC's Connect America Fund experience can inform future strategies.[68] As one interviewee mentioned, this is an area ripe for further public-private partnership experimentation.

Likewise, all governments can **support publicly owned networks**—oftentimes in interrelated ways. Generally, the federal government and individual state governments maintain enormous sway over whether individual communities can launch publicly owned broadband networks, or what are commonly called "muni networks." As it stands, there are numerous states that use preemption to make publicly owned networks and even public-private partnerships either illegal or extremely difficult to establish.[69] If legal, then each city, county, or regional government must be willing to build and operate a muni network.[70] Similarly, federal and state policies can make it easier for communities operating electrical or telephone co-ops to launch a co-op broadband network. No matter the legal structure, any publicly owned broadband network will require significant workforce capacity to ensure successful operation. Overall, launching such networks is an important option for communities of any size—rural communities in particular—where broadband is not currently available within a reasonable distance.

There is also an opportunity for state and local governments to use their current capital assets to fill network gaps via **targeted wireless services**. This includes: the use of libraries, schools, and other public buildings to broadcast accessible, 24-hour wireless networks; using vehicles such as school buses to create mobile hotspots, including during nonoperating hours; and installing wireless access points in parks, light poles, and other

public spaces. These interventions are especially important within neighborhoods where network service is unavailable, slow, or simply unreliable. Public access points can be impactful in low-income neighborhoods and communities of color where residents may not have in-home or wireless subscriptions.

Making broadband more affordable

Broadband service can consume a significant portion of a monthly household budget, especially when considering the need for both a household wireline subscription and a wireless subscription for each member of the household. Likewise, using broadband also requires up-front or monthly payments for desktops, laptops, and mobile devices.

Here, too, the public sector has an opportunity to influence affordability. **Direct subsidy programs** can be run from any level of government, and already take place via the FCC's Lifeline program. Federal law could also permit cable franchise agreements to begin including pricing components within their broader legal frameworks. Likewise, the public sector can operate equipment purchase or leasing programs. Any federal, state, or local capital grants could either require private companies to offer affordability policies as a condition of receiving a grant. Finally, there's an especially important role at the federal level to promote pricing transparency—the lack of which currently limits consumer knowledge and research opportunities—and set national affordability standards, like those used in the energy sector. Continued calls to improve federal broadband mapping efforts presents one such opportunity to include price data.[71]

The private sector is already a national leader around affordability, and this is another area with the potential for deeper **public-private-civic collaboration**. Private ISPs, most notably Comcast, offer more total discounted internet subscriptions than the number of subscribers within public discount programs. Critically, these programs already tie into public efforts by using federal qualifications such as Electronic Benefits Transfer (EBT) status to enroll households. Similarly, many equipment manufacturers offer discounts to certain populations, including students, their families, and often entire school districts. For rural areas, the U.S. Department of Agriculture is well-positioned to use public-private partnerships to promote affordability via its e-Connectivity pilot program.[72]

Improving digital skills and literacy

Third, developing a population's digital skills can improve broadband's impact on health and equity within a given community. Individuals need a baseline level of digital literacy to even use computer equipment, software, and the internet. Basic digital literacy is also a building block for other digital skills, from skills development in the modern workplace to navigating health care and other essential services. The flip side is also evident in the data, where a lack of digital skills often correlates with survey respondents who cite "lack of relevance" for why they choose not to subscribe to broadband services.[73] Developing basic digital literacy among the entire population—no different than traditional literacy—is an essential target to ensure every person can enjoy the benefits broadband can deliver.

Boosting digital skills already relies on a network of public, private, and civic actors. Primary schools, public libraries, and various nonprofit organizations can **host digital literacy interventions**. Workforce development agencies can survey employer needs and develop contemporary training modules. And ISPs can offer direct funding and expertise to support these efforts. Interviews and case studies also confirmed a growing recognition of the need for trusted actors—such as social workers, community health workers, and religious leaders—to track community deficits and design skills-focused interventions for targeted communities. The Cleveland, Ohio and Brownsville, Texas case studies confirmed the importance of such trusted advocates in communities of color and foreign-born populations.

There are also multiple efforts underway at the federal level to **repurpose current policies** to advance digital skills development. One example is to ensure banks can use Community Reinvestment Act credit to financially support community digital inclusion programs serving Low and Moderate Income (LMI) households in their lending areas.[74] Another is to allow the Department of Housing and Urban Development (HUD) to ensure that Community Development Block Grant (CDBG) funding applies to a broader set of broadband access and digital literacy training for LMI households.[75] The Department of Health and Human Services and the Department of Veterans Affairs can deploy multiple policy reforms to support digital health care inclusion efforts.[76]

Raising consumer and stakeholder awareness

In addition to direct interventions related to availability, affordability, and skills development, **communication techniques** are essential to maximize effectiveness. Boosting broadband adoption requires awareness among disconnected populations, whether it is policies to address service gaps, improving service affordability, or new digital training opportunities. There is also a need to adopt more precise language around any communication strategy. Interviewees and workshop participants consistently referenced the need to convince many public officials and general residents that "broadband is no longer a luxury" and that using libraries and Wi-Fi in coffee shops are inadequate substitutes for a household connection. Techniques to successfully deliver this message can galvanize support for the kind of systemic interventions listed in this section.

Strategies to educate decisionmakers, community members, and influencers

There are a series of strategies that can improve the educational efforts to reach key actors. These strategies rely on input from past research, interviews, workshop notes, and five case studies.

All of our project activities readily made reference to the importance of **coalitions**. The most successful interventions—from the local to national level—consistently include a diverse set of interested parties such as workforce organizations, libraries, elected offices, schools, and religious institutions whose members are able to come together and coordinate their advocacy. A unified voice creates a wider base to demonstrate the importance of broadband to a given community. This was the case around the award-winning Tech Goes Home program, which includes a coalition of local schools, community organizations, and public funding support around Greater Boston to offer free digital skills training, discounted new computers, and assistance with low-cost, high-quality internet.[77]

Another strategy regularly mentioned was education campaigns targeted at **impacted institutions**. Many civic institutions and public agencies rely on broadband adoption among their focus populations to maximize their effectiveness. The banking industry can reach far more individuals if their customers use online banking. The health care industry's push to digitize records, scheduling, and communications assumes patients have digital skills, computing equipment, and broadband access. The same logic extends to schools for the digital classroom, consumer affairs agencies to streamline resident engagement, and on.

However, our research made clear that many of the employees at these institutions and agencies do not have clear knowledge about the extent of the digital divide, how it impacts health and equity overall, and how their employers could become involved in efforts to address broadband inequities. Targeted education campaigns—conducted in concert with diverse coalitions—can raise awareness of needs and opportunities.

Policymakers play a significant role in broadband's health and equity impacts, meaning it's important that the **language** used to discuss the topic reflects their knowledge base and

broader priorities. Across nearly every interview and case study we conducted, our colleagues mentioned the need to speak in concepts policymakers understand. In particular, "quality of life" and "workforce development" were prominent issues that impact every level of government. Placing broadband needs within the context of these goals can ease the learning curve. The extensive connections between broadband and most social determinants of health (SDH) present one opportunity to adjust language. SDHs such as living wages, community safety, and traffic conditions reflect more traditional public policy goals; adjusting broadband language is about making explicit connections between digital telecommunications and SDHs.

Complementing these education efforts is the ability to communicate broadband's benefits as **measurable**. Because broadband evolves quickly and its impacts are diffuse, it's important to benchmark and measure progress with respect to different health and equity goals. For many communities, this includes direct reporting on the neighborhoods without network service, the number of total households without in-home or mobile subscriptions, and other measures that can rely on public data inputs. Our research also indicated the importance of including measures related to other governance concerns. For example, reporting the change in programmatic adoption rates for concepts such as digital health records after digital skills training. These measurable outcomes can help make the case for broadband's overall utility and interconnection with other governance objectives.

Our research consistently pointed to a set of conditions that can positively impact the potential for effective communication:

- **A high degree of trust between interested parties.** Groups who do not know one another and who have not worked together in prior instances will face additional challenges in communicating their respective needs and engendering compromise. Broadband issues touch a diverse set of actors, but many who may not regularly interact. Building trust becomes that much more important.

- **A direct connection to the people most affected.** Public broadband campaigns struggle when they do not include local parties. Whether it's residents, local employees of the relevant network owner, or government officials with direct relationships to the given community or issue area, educational activities benefit when parties have direct knowledge of a given broadband experience.

- **Public and private communication channels each have a role.** An effective strategy will rely on the "educators" choosing their channels with a sense of purpose and in connection to broader cultural climates, public attitudes, and timing around legislative efforts, regulatory and policy reforms, or other governance activities.

Key opportunities and pressure points for community involvement and advocacy

There are numerous opportunities for community involvement to address broadband-related inequities in disinvested neighborhoods. One of those is when a private or public network owner is considering physical build-out. Whether governed under a cable franchise agreement or any other regulatory structure, major construction is an ideal time to publicly discuss physical service and digital equity policies targeted to disinvested places. Another opportunity is around political elections and the initiation of a new administration. Whether at the municipal, county, regional, or state level, new or continuous leadership will be open to ideas and planning for future years. This is an opportunity to build support for digital equity policies. A third opportunity is when communities, state peers, or

even federal leaders aim to initiate major capital campaigns. Whether joined with "dig once" policies, deciding what activities will be included in a municipal bond package, or considering new tax policies, public capital campaigns are an open moment to make the case for broadband's importance.

Finally, our workshop revealed another key opportunity in this regard: prioritizing new voices within public sector leadership. Improving service to disinvested places can benefit from including individuals who have encountered the challenges of living in such places firsthand.

Case studies

Over the course of this project, our team traveled to five places to understand their distinct broadband environments and how attempts to deliver more equitable outcomes could provide transferable lessons to other communities. The following case studies document those experiences.

Brownsville, Texas

The Brownsville-Harlingen metro area—with a total population of 445,309 in 2017—is part of the Texas border region and consists of a mix of urban and rural geographies. The population is predominantly Latino or Hispanic, with nearly 90% of residents identifying as such. Around a quarter of the population is foreign-born, and of that population, around 70% are not U.S. citizens. The Brownsville metro area also has a relatively high poverty rate of 28% overall and 39% for those under 18. The socioeconomic characteristics are significant because they create systemic barriers to broadband adoption and need to be taken into account when developing solutions.

The Brownsville metro area has a significantly lower broadband adoption rate than the rest of the country. Just half of all households have any type of broadband connection, and 11% only have a cellular connection. To understand the challenges around digital disconnection, we spoke with representatives from health care, economic development, housing, workforce development, and general purpose government

One of the most pressing challenges for the region is addressing concerns around health and access to quality health care. Compared to the national average, there is a high prevalence of diabetes and other related conditions.[78] Though the causes of these outcomes are complex, providers know over half of all cases in certain counties in the border region go untreated. For example, the Area Health Education Center (AHEC) at the Bob Clark Social Service Center has found that the most common reason people do not use the facility's free service is a lack of transportation or awareness around appointments. Expanded broadband access would allow patients to manage appointments online and make preliminary contact with doctors from home.[79] AHEC is already taking advantage of the broadband available in the clinic by connecting patients to specialists via equipment that transmits images and vitals to remote locations.

Also at the top of Brownsville's challenges is the relationship between economic growth and broadband, wherein each is needed to spur the other. Because the region lacks adequate levels of connectivity and adoption, interviewees noted that companies have left the region due to constraints on their business growth. Likewise, the ability to spark entrepreneurial growth is limited if both small business owners and clients do not have broadband access. With no promise of attracting new economic activity, many of the most promising young entrepreneurs leave. The inability for students to connect to digital education services at home, including in publicly supported housing, limits future workforce development in the region.

With this as the case, the region continues to explore interventions tailored to the specific challenges of the border region. A promising method of intervention is to train promotoras—community health workers from local Latino or Hispanic communities—to develop digital skills with their communities. Promotoras are supported by county health departments, and due to the nature of their work, they are already integrated and trusted in their communities. They can leverage their trust and relationships to educate residents on how to navigate online health portals and other services. Though it isn't already a component of their work, it is in both the social and financial interests of health departments to have digitally literate patients. Reorienting health systems toward digital

inclusion can have lasting impacts throughout the region. Similarly, the city and an economic development authority are financing a downtown innovation hub to support digital opportunities for entrepreneurs, to develop scale for attracting private capital, and to incentivize development of faster and more reliable broadband infrastructure.

Brownsville presents a special opportunity to see how the digital divide uniquely impacts communities with rural populations and higher shares of foreign-born individuals. By building a system of trust and a platform for growth, Brownsville is actively working toward bridging their digital divides.

Cleveland, Ohio

The Cleveland-Elyria metropolitan statistical area is home to a population of just over 2 million residents. Between 2007 and 2017, the region has achieved consistent productivity and prosperity gains, keeping pace with the national average.[80] At the same time, the region's overall economic growth has fallen behind most metropolitan peers.[81] Further, the city of Cleveland—with a total population of 385,525 in 2017—remains a racially segregated city, with most of the black population clustered in the eastern side. While Black residents account for 20% of the metro area's population, they account for 50% of the city. Compared with the 100 largest metro areas, Cleveland ranks 98th in terms of racial inclusion, with massive gaps in earnings, poverty, and employment.[82]

Household broadband adoption represents one of the leading indicators for the economic challenges facing Cleveland's Black residents. While the broadband adoption rate for white households in the Cleveland metro area is above the national average, at 89.1%, the adoption rate for Black households lags at just 77%. In this sense, Cleveland's race-based broadband divides exemplify academic research that finds broadband adoption is positively associated with economic prosperity, including higher employment rates and higher incomes.[83]

The challenges in closing Cleveland's broadband adoption gap are systemic and multitiered. A 2017 study by Connect Your Community and the National Digital Inclusion Alliance found that AT&T has systematically discriminated against low-income Cleveland neighborhoods in its deployment of home internet services.[84] And even those lower-income neighborhoods that do have physical access to more than one broadband provider still face affordability challenges. These service challenges are exacerbated by a general literacy challenge, where many adults in Cleveland struggle to read and write.[85] Combined, these challenges make the digital economy more difficult to navigate.

However, Cleveland's civic community is developing creative responses to begin closing the digital divide. DigitalC—a nonprofit which benefits from the federal Broadband Technology Opportunities Program (BTOP) program—serves as a direct ISP to offer discounted, high-speed services to underserved neighborhoods. DigitalC's partnership with the Cuyahoga Metropolitan Housing Authority—which delivers wholesale broadband support to 140 households—is an example of one intervention to combat access and affordability issues. Another, the Ashbury Senior Computer Community Center (ASC3), has offered free courses for the past 15 years to build residents' digital skills, with a particular focus on older individuals. While ASC3 lost significant funding when the federal government eliminated direct support to local digital skills programs, ASC3 still trained 2,000 people in just the last four years, with capacity available if public funding increases.

As these programs continue to innovate, Cleveland offers an important test bed for health-related innovation. MetroHealth, one of Cleveland's three regional medical systems, and researchers at Case Western Reserve University have begun to explore how broadband adoption rates may impact health outcomes. This taps into a clear gap in medical research: quantifying how digital record-keeping and other management systems impact health outcomes. Early results, including work conducted with ASC3, suggest

sustained digital skills development can improve health outcomes by leading to stronger engagement between health providers and patients.[86] Still, regional healthcare providers do not pair their digital records systems with broadband interventions to ensure patients have digital skills or in-home broadband services.

As local stakeholders voiced in interviews, the Cleveland experience directed us to two problems that extend across the country. First, some institutions and their staff are not aware of broadband opportunities because their institution's measures of success don't account for it. For example, MetroHealth could more effectively serve its community if more residents were connected to the internet, including the opportunity for healthcare providers to operate digital skills programs at a regional scale. Second, hospital executives, banking presidents, philanthropic funders, and other leaders with the power to affect broadband adoption uptake may not understand the digital landscape or specific challenges. As our interviewees noted, achieving digital equity will require systemic change beyond digital equity advocates.

Finger Lakes region, N.Y.

The Finger Lakes region is the expansive, mostly rural, area in New York's northwestern edge. Though the median income and education levels are just below the national averages, these statistics don't entirely reflect the disparities within that community. One stakeholder explained the region as a mix of wealthy families clustered around the lake towns, working class families, and mobile homes. Another revealed that one in eight adults in some counties fall short of a third-grade education. And to fully convey how disparate all the communities are, stakeholders regularly mentioned that students often travel 40 minutes to an hour on bus to get to school.

All of this is important context for understanding that, even though the broadband adoption rate (at 77%) only slightly trails the national average, serving the last quarter of households proves to be a difficult endeavor. To better understand the challenges around digital disconnection, we attended a meeting of the Finger Lakes Digital Inclusion Coalition, a group launched in 2018 by a variety of organizations in rural counties to the south and west of Rochester. There, we met with representatives from Wood Library, St. John Fisher Library, the Central New York Digital Inclusion Coalition, Newark Public Library, Pioneer Library System, and Phelps Library's STEAM Lab Makerspace.

The challenges identified across these groups spoke to systemic issues concerning access and adoption. Numerous stakeholders suggested that there was a lack of clarity around how and where ISPs decide to build infrastructure. While the most obvious overlooked pockets are in the most rural areas, there were also cases of streets where houses on one side of the block had access to wired services while houses on the opposite side had none.

On the adoption side, the challenges are just as pervasive. Because the region is relatively low density, many households are only served by one provider—in some areas, only a satellite provider. Consequently, residents face high costs and have no leverage to resist price hikes. Another issue is that many in the region lack digital literacy skills. One stakeholder estimated that at least a third of the population doesn't have the skills necessary to engage in a digital environment. At the same time, across the library network, stakeholders reported a drop in digital literacy class attendance, citing challenges around transportation, embarrassment, and the lack of awareness on the importance of bolstering their digital skills. These challenges suggest that those in the region who remain untrained are also those who are the hardest to reach.

Stakeholders in the Finger Lakes region spoke to how broadband access and use interacts with existing inequalities. In terms of access, people who have the means are better positioned to seek housing that already is connected to the internet, putting them less at the whim of ISP service gaps. However, this means that higher-income families will cluster in connected tracts, separating

them from other members of the community. And on the adoption front, a concern we heard repeatedly is that students without devices to access the internet at home are falling behind in school. Getting around that challenge is difficult: Parents have to drive their kids to the library to complete their homework or take the financial risk of borrowing a hotspot or computer from the library that they will not be able to pay back if the device breaks.

At the local level, though, there are many creative solutions afoot. Some school districts in the region provide internet access on long bus rides that take kids to and from school. Students can use the time to either do homework or play games, which community members emphasized is a privilege that students with internet at home have all the time. And the libraries lend a limited number of 4G Wi-Fi hotspots, granting at least temporary in-home internet access. However, these interventions are patchwork solutions.

In the Finger Lakes region—much like in the rest of the country—ISPs still have the power to operate with free reign. Though libraries, schools, and businesses are independently working on solutions, alone, they don't have the power to advocate for system change. If they're able to build a cross-organization coalition, then they would have more power to educate state legislators or advocate for expanded service. Though the state of New York has committed to expanding rural connections, many stakeholders worried that they wouldn't follow through.[87] As individual actors, many felt limited. However, as a coalition, they would have more ability to advocate for rural broadband needs.

Louisville, Ky.

The city of Louisville has a population of 620,149, which represents the combined population of the historic city boundaries and its formal merger with Jefferson County as a unified government. The city/county represents almost half of the larger metro area population of nearly 1.3 million.[88] Though the city's median household income ($52,303) is below the national average and the poverty rate (17.3%) is above it, the metro area has seen economic growth and prosperity outpacing the national average.[89]

Both the historic city of Louisville and the Louisville-Jefferson metropolitan area have close to universal broadband access, with Spectrum offering high-speed cable broadband to more than 95% of residents, according to the FCC's June 2018 Form 477 deployment data.[90] The percentage of residents living in blocks with 25/3 Mbps speeds offered by two or more providers (Spectrum and AT&T) in 2018 was about 91% for historic Louisville and 85% for the entire county. The FCC data says home fiber service was available in to 45% of both core city and county residents.

Yet even with expansive service, not all households are connected to broadband. The latest American Community Survey data (2018 ACS 1-Year Estimates) indicates that 15% of households in historic Louisville lacked home broadband subscriptions of any kind, including 33% of households who lacked wireline broadband (cable, DSL, or fiber) at any speed. The disconnect is closely tied to income: About 35% of Louisville city households with annual incomes below $20,000 had no home broadband of any kind; they accounted for 20% of all households but 45% of those without broadband. In contrast, all but 4% of households with incomes above $75,000 had some type of broadband subscription.

FCC Form 477 data also confirmed the areas that did not enjoy AT&T broadband at 25/3 Mbps speeds or greater were concentrated in lower-income neighborhoods surrounding downtown, and to the west and southwest. Louisville released a Digital Inclusion Plan in 2017 referring to "fiber deserts" in neighborhoods in west and southwest Louisville, which also have their highest unemployment rates.[91] The plan states, "These previously unrelated issues of employment and broadband access are now intertwined and are most likely, based on research, affecting outcomes for our citizens."

The Louisville story is one of identifying existing resources, building relationships, and continually planning for the next step.

Louisville's Office of Civic Innovation and Technology identified lack of technology access and use as an issue that must be addressed. With no project budget and no dedicated staff, they focused efforts on promoting discounted AT&T and Spectrum internet offers. Their first step was to attend community events such as back-to-school events and job fairs with individuals who were likely to be eligible (families with children receiving free/reduced lunches, seniors receiving supplemental security income, and households receiving SNAP benefits), inform them of their potential eligibility, and help them sign up. They then recruited volunteers for this task to expand their reach.

They also developed relationships with organizations providing services to low-income community members. Louisville worked with Goodwill Industries of Kentucky and the Louisville Metro Housing Authority to set up digital literacy training courses and computer labs. Louisville acquired donated computers which they and partners then refurbished. Goodwill and the Housing Authority donated space and staff time.

To identify new digital inclusion strategies for Louisville, in 2019, the metro government established a research partnership with the local chapter of the Interaction Design Association (IxDA). The partnership's goals were to understand how people without access to high-speed internet at home are accessing the internet now, how they use it, and what changes after they gain access. They also wanted to discover how to improve the signup process for low-cost internet services and where to increase awareness of low-cost internet and other digital inclusion services.

The results were illuminating. Following interviews, the partnership identified four systemic barriers: a lack of awareness of home internet options, a lack of basic technology skills and stigma around asking for help, a challenging sign-up process for low-cost internet, and associated challenges involving financial assets, bureaucratic trust, and transportation limitations among qualifying populations. Those findings are now informing a set of strategies to directly address the needs of disadvantaged and disconnected households.

This commitment helped increase formal adoption of digital equity strategies. In 2019, Louisville's Office of Civic Innovation and Technology hired a permanent program manager focused entirely on digital inclusion. Past research results plus Louisville's relationships with Goodwill Industries of Kentucky, the Louisville Metro Housing Authority and other local partners are all informing development of the metro area's next steps.

Portland/Multnomah County, Ore.

Multnomah County has a population of 811,880 residents and is in the bistate Portland-Vancouver-Hillsboro metro area. It contains both Portland, the largest city in the region, and the smaller municipalities of Gresham and Troutdale, among others. The county's median income is $71,186—with most of the wealth concentrated in and around Portland—and 63.7% of the population has at least some college-level education. Though these conditions, partnered with strong regional growth numbers, lay the groundwork for high broadband access and adoption numbers, there remain concerns around inclusive growth, especially for less affluent parts of the county.[92] [93]

Still, the city of Portland and Multnomah County have close to universal broadband access, with Comcast cable broadband service in census blocks covering more than 98% of county residents, according to the FCC's June 2018 Form 477 deployment data. The percentage of residents living in blocks with 25/3 Mbps service from two or more providers (Comcast plus CenturyLink or Frontier) in 2018 was 91% for Portland and 90% for the entire county. The FCC data reports home fiber service was available in census blocks holding about 80% of both Portland and Multnomah residents.

Despite the widespread availability of home broadband from multiple providers, 2018 ACS 1-Year Estimates show 9% of Portland households lacking home broadband subscriptions of any kind—including cellular data plans—and 22% of households without wireline broadband (cable, DSL, or fiber) at any speed. This disconnect primarily come from lower-income households. About 29% of Portland households with annual incomes below $20,000 had no home broadband of any kind, accounting for 42% of county households without broadband. In contrast, only 3% of households with incomes above $75,000 had no broadband subscription.

As a result, Portland serves as an important case study of what's needed to bring ubiquitous broadband adoption to some of the country's most digitally fluent markets. The community's digital inclusion ecosystem began to be defined in 2010, when members of the community gathered together to apply for federal Recovery Act funding. While that proposal was not successful, those same organizations continue to work toward digital equity by investing in their programs, building partnerships, and increasing local awareness.

In 2014, Multnomah County Library, Multnomah County, and the city of Portland came together with Portland State University to create the Digital Inclusion Network (DIN), a "coalition of community organizations interested in raising awareness about digital equity barriers and developing solutions to bridging the digital divide."[94] DIN meets monthly to discuss local challenges and successes in addition to state and federal policies that will or could impact their work. Portland's Office for Community Technology, Multnomah County, and the Multnomah County Library coordinate the efforts.

DIN now has over 45 members, including local governments, community media centers, a nonprofit computer refurbisher, universities, and community-based nonprofits. One example of this coalition-building is the lasting partnership between Multnomah County Library, Free Geek, and MetroEast Community Media to provide a computer literacy course to low-income residents that gives participants a refurbished laptop computer and one year of tech support upon completion.

The buy-in and diversity of this coalition helped the DIN to create a forward-looking Digital Equity Action Plan for systemic change. The plan presents a vision that all residents of Portland and Multnomah County will have barrier-free access to high-speed broadband internet at home and school, an affordable computing device, and the training to use it effectively. In 2016, the Portland City Council and the Multnomah County Board of County Commissioners adopted the plan.[95] In 2016, the DEAP was named Community Broadband Strategic Plan of the Year by the National Association of Telecommunications Officers and Advisors, solidifying Portland's approach as a national best practice.

The coalition continues to deliver benefits to the region. In May 2018, the Digital Inclusion Network—led by Multnomah County Library and Portland's Office for Community Technology—hosted the 2018 Digital Inclusion Summit. The theme for the full-day event was "economic opportunity," and included a series of featured speakers, panel discussions, and networking breaks to help advance efforts to build a digitally connected, prosperous community. Attendees included policymakers, community leaders, digital inclusion practitioners, and leaders in education, technology, business, philanthropy, and health care. By presenting their vision to the country and learning from peers, Portland's approach proves that delivering full broadband adoption requires constant effort and a true collaborative spirit.

Conclusion

Decades into the digitalization of the American economy, broadband now directly or indirectly touches every individual, every day. Workers and employers rely on digital communications. Consumers shop, socialize, and entertain themselves online. Governments communicate with residents through online portals. And the growing ubiquity of digital computing equipment puts enormous amounts of data no more than a swipe or click away.

This makes broadband the newest form of essential infrastructure. Much like how it's impossible to imagine daily life without electricity, society is quickly integrating broadband service into a seemingly endless array of activities that drive economic prosperity and health outcomes. It's not hard to imagine a future where people rely on broadband to have a quick checkup with their doctor, find an available bench at their neighborhood park, reserve a combined taxi-train-bicycle trip, or remotely monitor every room in their house while on vacation. In fact, every one of those capabilities is already here today.

Yet if broadband is essential infrastructure, the country's digital divide confirms the challenges to bringing its benefits to every person, regardless of demographics or geography. Tens of millions of people do not have an in-home broadband subscription, a mobile data subscription, or both. These gaps are especially wide among rural, low-income, and nonwhite households. These gaps represent a potent mix of limited service areas, expensive subscriptions and equipment, and a lack of digital skills.

Overcoming these barriers requires awareness of persistent digital divides based on community conditions and improved collaboration across the private, public, and civic sectors. Fortunately, lessons from across the country confirm the potential success of interventions related to access, affordability, and digital skills. This work extends beyond larger financial investments, too. Building coalitions, adjusting communication techniques, and developing new statistical evidence can all accelerate trust between key actors, educate on the social impact broadband can deliver, and create opportunities to design new solutions.

Broadband is the connective tissue of this young digital millennium, a physical service that can benefit every person across social, economic, and physical health dimensions. Building more equitable broadband infrastructure will make good on that promise.

Appendix I: Literature review

Broadband is essential infrastructure in the 21st century, but the lack of ubiquitous availability, adoption, and use differentiates it from other essential infrastructure such as clean drinking water, safe wastewater, and reliable electricity service. As a result, clearly outlining the dimensions by which broadband infrastructure impacts communities becomes an essential ingredient in making the case for affordable broadband service.

The following section conducts a literature review to establish the categories through which broadband affects health equity either negatively or positively, and then assesses whether current research can prove those impactful connections. The section begins by defining the concept of equitable public infrastructure, which includes—but is not limited to—the concepts of health, equity, and opportunity.

What is equitable public infrastructure?

According to the Robert Wood Johnson Foundation (RWJF), "equitable public infrastructure" refers to a range of approaches for creating communities and regions where residents of all demographics can participate in and benefit from decisions that shape the places where they live. The goal is to create a built environment that enables all residents access to economic opportunity, health and social services, as well as the information and tools necessary for civic participation. To this end, equitable public infrastructure approaches recognize community preferences and priorities in addition to the role of place in designing the built environment.

To understand what equitable public infrastructure means in the broadband context, the Organisation for Economic Co-operation and Development (OECD) developed an 11-dimension framework highlighting the risks and opportunities introduced by the digital era: income and wealth, jobs and earnings, housing, health status, education and skills, work-life balance, civic engagement and governance, social connections, environmental quality, personal security, and subjective well-being.[96] Since these dimensions reflect key components of RWFJ's health and equity definitions, we largely relied on these variables for measuring broadband's influence.

We ultimately decided on three high-level categories: economy, society, and governance. These categories are broad enough to reflect the ways in which individual circumstance and opportunity interact with community factors to build access and opportunity for all.

Economic opportunity

The variables we explored in terms of their contributions to economic opportunity were jobs and earnings, wealth and income inequality, and industry health.

Jobs and earnings

Research is clear that broadband should improve outcomes in the labor market. The new digital infrastructure should enable job seekers to find more employment opportunities online, equip workers with the skills to qualify for digital jobs, and decrease job strain. At the same time, it's also clear that broadband could create a new layer of inequity between job seekers based on digital skills and employers based on their overall digitalization.

In 2000, Alan Krueger predicted in *The New York Times* that the age of the internet would lower search friction between job seekers and employers, decreasing unemployment and increasing productivity—and that the transparency enabled by the internet would increase fair pay.[97] More recently, the Pew Research Center surveyed households to find where the lack of a broadband subscription

limited job market success. They found that households without broadband had more difficulty contacting employers via email, filling out online applications, searching local job openings, and even creating a professional resume.[98]

Moreover, the academic literature base confirms that broadband is reshaping the labor market. In 2009, Nakamura et al. wrote about how, beginning in 2001, employer recruiting predominantly moved online.[99] Further, research from T.R. Beard et al. indicates that since the internet and available online platforms decrease the costs of searching for a job, unemployed persons are less likely to experience discouragement and less likely to cease their job searches.[100] These findings also work in reverse, confirming that lacking access to a broadband connection limits the number of opportunities that job seekers come into contact with.

Though this literature review will get into the specific education effects later, research confirms that digital skills increase both employability and earnings potential.[101] Research has even found that broadband adoption can result in increased job satisfaction across education levels.[102]

Income inequality and wealth

Ideally, broadband will become an equitable platform for shared prosperity. However, we found it difficult to identify studies that show how broadband impacts wealth and inequality. Instead, the majority of the literature confirms a more discouraging truth: that current income inequality exacerbates broadband inequities, leading to a negative economic cycle that impacts both current income inequality and longer-term wealth generation. We would speculate that most literature exists in this direction because: 1) according to research by the Pew Research Center, the plurality of broadband nonadopters point to cost as the main reason they do not have high-speed internet in their homes,[103] and 2) broadband has only been around for a few decades and wealth generation only occurs over many decades.

However, there is some promising literature that explores these connections. Given the research that indicates broadband adoption and digital skills increase employability and earnings potential, it seems likely that those households with high-speed internet will have higher earnings. And, given that price is the main limiting factor in adopting broadband, it would make sense that the digital skills payoff would accrue to those with enough money to afford it. Consequently, there might be growing inequality between those with and without access to broadband.

Conversely, research by Houngbonon and Liang indicates that broadband adoption within certain towns in France actually decreases those towns' Gini indices (a measure of inequality).[104] They found that over a four-year period, broadband adoption lead to a 34% rise in average income and an 80% fall in the Gini index.[105] However, the authors cede that: 1) the effects are stronger when the level of education is high and there are few educational inequalities, and 2) that the risk of endogeneity threatens the validity of these findings. The authors also confirm our findings that much of the literature in this area does not discuss income inequality.

In terms of broadband's effects on wealth generation and poverty reduction, we also found some evidence of a connection, but a tenuous one. Reporting in the *Wall Street Journal*, for example, found that high-speed internet may increase home prices, which in turn helps build wealth.[106] And the International Development Research Centre provided a theoretical framework for understanding how internet access could alleviate poverty, while also pointing out that the current research base is equivocal.[107] We would argue that more work certainly needs to be done here.

Industry health

Broadband's effects on industry health, as measured by output growth and productivity, is well-covered by the literature base. Roller and Waverman, for example, use evidence from

21 OECD countries over a 20-year period, and estimate that 92% of the GDP growth that these countries saw over the time period can be attributed to telecommunications.[108] Whitacre et al. confirmed that these results hold in nonmetropolitan counties. As broadband became available and adopted in rural counties across the U.S. between 2001 and 2010, these counties saw corresponding economic growth. Taken together, their results reflect the consensus of the research base: that broadband enables economic growth across geographies.

In attempts to understand the underlying mechanisms behind the growth, many studies point to increases in employment, wages, and potentially innovation, while finding mixed results in terms of productivity increases. Kolko, for example, shows that broadband expansion most likely leads to country-level growth, but mostly through employment and wage growth.[109] Bertschek, Cerquera, and Klein studied DSL expansion in Germany, finding that while increased adoption did not necessarily increase productivity, it did significantly and positively increase innovation activity.[110]

Even though the empirical connection between broadband adoption and productivity is tenuous, Colombo et al. lay out a theoretical argument for why broadband should bring productivity gains to small and medium enterprises (SMEs). According to them, broadband is a platform on which a number of complementary and efficiency-enabling applications may run. These applications should produce efficiency gains in terms of communications, consumer-relationship management, human resource administration, and employee recruiting. Since broadband increases productivity through these applications rather than through itself, Colombo et al. show how SMEs of different sizes and industries reap the benefits differently.[111]

Social outcomes

The variables we explored in terms of their contributions to social outcomes were education and skills, health, leisure, social connections, and work-life balance.

Education and skills

As explored above, education in digital skills increases an individual's job prospects and earning potential. However, education itself also enables individuals to be more resilient in response to social challenges as well as equipping them with life skills and experiences.[112] Further, lifelong learning helps older adults continue to participate in their communities, increasing personal satisfaction and community well-being.[113]

Broadband has led to the creation of a seemingly endless supply of free and open education platforms, courses, and resources. Beyond the exponential growth of massive open online courses (MOOCs),[114] there are a number of less formal educational opportunities as well, such as YouTube tutorials, GitHub, and communication forums. Since online learning can take place anywhere with internet access, the benefits it brings are particularly acute for the geographically isolated—such as residents of rural communities—and for the accessibility-limited, such as the elderly and disabled.[115]

In addition to providing supplemental learning opportunities, broadband also enables augmented instruction. Several online applications—ranging from educational portals to chat forums to web documents and collaborative editing—have changed how in-person instructors are able to engage with students. These applications have brought educational benefits to students across subject areas and fields.[116] [117]

However, with the benefits enabled by online education, there are also drawbacks. With an increasing number of class assignments and activities occurring online, those students who lack internet access at home are at risk of falling behind their peers.[118] Likewise, many school districts in geographically isolated communities do not yet have enough bandwidth running to their schools, creating a long-run economic disadvantage for their students and entire community.[119]

Health

In May 2017, the American Medical Informatics Association (AMIA) wrote a letter to the chairman of the FCC, Ajit Pai, urging him to consider broadband a social determinant of health.[120] In arguing that broadband should be considered critical in achieving positive health outcomes, AMIA pointed to three notable studies. The first, by Perzynski et al., shows how patient portals have the potential to increase health care quality and efficiency.[121] However, patient portals largely are not used by racial and ethnic minorities, resulting in possible discrepancies in outcomes between these groups.[122]

AMIA also references a study which showed similar findings, but with reference to online health records and secure message exchanges.[123] These platforms increase patient engagement and improve outcomes, but there are similar discrepancies in uptake across races.

The third study AMIA appealed to surveyed all existing literature on broadband-based consumer health informatics (CHI) tools.[124] The authors found that these tools helped improve health care process outcomes (such as receiving appropriate treatment), intermediate health outcomes (including improvements in diet and exercise), and even clinical outcomes (such as improving mental health or managing diabetes or asthma). The authors, though, speculate that there might be differences in outcomes between users of different sociocultural backgrounds, and those differences had not yet been well-studied by the literature.

Further research by the President's Cancer Panel sought to demonstrate why connected health care is so integral to improving outcomes for cancer patients.[125] As the research outlines, cancer is a long-lasting disease that requires coordination between a network of caregivers. Online platforms allow patients to reach out to their doctors at any moment as their circumstances change, and also allow the network of caregivers to communicate updates, information, and tests more easily among themselves.

A 2011 study by Brian Whitacre sought specifically to understand how telemedicine has the potential to benefit rural communities.[126] In his examination of 24 hospitals from predominantly rural states, he found four distinct areas of cost savings introduced by the technology: hospital cost savings, transportation savings, missed-work income savings to patients, and savings from locally performed lab work.

These benefits may not be realized, however, if patients lack e-health literacy.[127] Patients who lack e-health literacy will be more hesitant to consult the internet-based services or sources that the above studies explored. Hence, e-health literacy is now of critical importance in achieving healthier outcomes.

Leisure

Broadband gives users access to a whole universe of content and entertainment options. According to Deloitte's digital media trends survey, consumers with internet access use it for a variety of online entertainment. Sixty-five percent of consumers use it for pay TV, 69% use it for streaming video services, 41% for streaming music services, and 30% for gaming.[128] The internet also provides a platform for an increasing number of free entertainment options, effectively democratizing access to enjoyable leisure.[129] Anyone with access to the internet has access to a large suite of entertainment options, which they can customize to meet their needs.

However, immediate access to instantly gratifying content creates the potential danger of internet addiction.[130] It has been hypothesized that the time we now spend consuming content on the internet has displaced deeper social connections and perhaps more meaningful hobbies.[131] Even if there is increased choice, the addictive properties of the internet might mean that people are not

making choices that result in long-term life satisfaction.

Social Connections

Broadband access has the potential to both increase and strengthen social connections as well as weaken them through online harassment and fewer face-to-face engagements.

A literature survey conducted by Boase and Wellman revealed the importance of the internet in fostering and maintaining relationships.[132] The authors found that although very few people use the internet to foster new friendships, the internet does provide a tenable platform for it. They indicate that people who are physically isolated from others or dissatisfied with themselves are more likely to use online forums to make friends. This suggests that the internet could lead to a decrease in social isolation. Further research has discussed how the internet enables traditionally marginalized groups to connect with one another, since online platforms are relatively anonymous.[133]

The same study by Boase and Wellman also found that widespread internet adoption enables people to maintain both local and long-distance relationships via the internet.[134] Effectively, it allows people to keep more loose social ties because of the low cognitive lift involved in maintaining relationships. Additionally, a study of a newly built suburban neighborhood of standalone homes found that a broadband-enabled local network increased social capital and feelings of connectivity.[135] Neighbors who were part of the wired homes showed an increased recognition of their neighbors and an increased number of social interactions per day.[136]

Though we had expected to find more literature suggesting that internet use increases loneliness or feelings of social isolation, those hypotheses were hard to corroborate via the literature. Social isolation rose toward the end of the 20th century, but hasn't increased since 1985.[137] These findings suggest that broadband augments rather than displaces social connections. However, some studies suggest that— although social ties aren't weakened—online communicating can lead to increased levels of anxiety, particularly in teens.[138]

Further, with 85% of teens on some form of social media, and 45% reporting that they are online on a near-constant basis, it's important to acknowledge some of risks introduced by the platforms.[139] Though most teen users report having neutral to positive experiences with social media, 24% have negative experiences, largely citing online bullying as the reason.[140] Cyberbullying is especially pernicious since it occurs in relatively unregulated spaces, and malicious messages can spread quickly.[141] Victims of cyberbullying have lower rates of self-esteem, higher rates of depression, and lower academic performance.[142]

Work-life balance

Broadband access creates the opportunity for employees to work from home if their position allows for it. Since telework allows for more flexibility in work hours and less time lost commuting, we would expect health and equity gains both from increases in productivity and increases in emotional well-being.

A 2014 study of workers from a U.S. government agency found that employees experienced more job-related positive affective well-being on days when they worked from home compared to days they were in the office.[143] In terms of increasing productivity, a meta-review of 32 studies on the topic found a small but significant relationship between telework and organizational outcomes as defined by the employer.[144]

Governance outcomes

The variables we explored in terms of their contributions to governance outcomes were built environment issues as well as governance and civic engagement.

Built environment

In terms of other built environment outcomes, broadband opens options for increased modal choice and information about built environment decisions. For example, online tools such as Google Maps for directions and traffic information as well as city websites for transit updates help people make better, more informed transportation choices.

However, despite the strong theoretical case for a connection here, it's hard to find much literature on the subject. We were able to identify one 2012 study which discusses the transportation challenges faced by those in rural areas without access to broadband and related technologies.[145]

Instead, there are clear examples from the marketplace of increased usage of internet-enabled applications to change household infrastructure use. The share of Americans who have used ride-hailing services has more than doubled between 2015 and 2018, with 36% of people now using services such as Uber and Lyft for their transportation needs.[146] Estimates of the "smart thermostat" marketplace now exceed $500 million in annual sales.[147]

However, these same adoption statistics underscore the inequity and questionable nature of the well-being benefits. First off, these benefits are only afforded to those households with broadband subscriptions. Second, the services themselves are not cheap, whether it's a new product for the home or a standard service cost. Third, the societal returns are not yet clear. Early research suggests the rise in ride-hailing apps—while positive for the consumer—may lead to greater roadway congestion in the country's biggest metro areas.[148] Likewise, there is no clear data on net energy consumption reductions due to smart thermostat adoption.

Early research also confirms that internet-connected sensors can improve shared spatial outcomes, although the results are still based on isolated data and may exhibit bias by ignoring failed projects. So-called "smart city" interventions involve the use of sensors and accompanying management software to deliver improvements to the built and natural environment, including reduced pollution, more efficient resource use, safer streets, or improved public safety. When successful, the results are promising: data analytics have been used to optimize medical emergency responses in Cincinnati,[149] video sensors optimize traffic and parking in Kansas City,[150] and sound sensors quickly detect incidences of gunfire in New York City.[151] Questions remain, however, on the openness of the data powering such systems, whether the benefits will flow to all communities, and how well solutions can scale to different cities and metro areas.

Governance and civic engagement

The internet has become critical for governments performing even their most basic functions. According to a recent study on Cuyahoga County, broadband enables government agencies to distribute benefits to recipients at a lower cost. It also improves government processes, as staff are able to transition from spending time on rote activities to higher-value tasks.

Beyond improving how the government operates, broadband has the potential to increase civic engagement. The authors of a recent study on the topic studied how broadband influenced engagement through several means: 1) internet access exposes users to a number of viewpoints on any given issue, as well as keeping citizens generally informed; 2) equipped with more information, citizens are more likely to become involved with community activities and organization; and 3) opening up more platforms through which citizens can engage with their governments.[152] The study found that access to broadband increased citizens' likelihood to vote, donate to campaigns, and attend church. However, the results that were less clear were whether broadband access increased more time-consuming activities such as volunteering or attending political speeches. Other studies have confirmed increases in contacting representatives, voting, and donating

to campaigns.[153] [154] [155]

In terms of understanding how these benefits can be reaped in rural areas, Whitacre and Manlove sought specifically to understand which aspects of broadband are most important in delivering these engagement benefits to rural communities.[156] The authors found that broadband adoption—rather than access—is what matters most for increasing community participation in rural areas. Adoption increased individuals' likelihood of expressing opinions as well as joining organizations.

Appendix II. Broadband impacts by geography and demographics

Broadband infrastructure can promote greater health and equity across society. However, due to the investment decisions of private ISPs and the regulatory and statutory approach to broadband governance, broadband service levels and residential skillsets vary in communities of all sizes. Assessing broadband across different geographic and demographic groups shows how these impacts vary, both in terms of the opportunities broadband can create and the costs when there are broadband inequities.

Due to their smaller size, **rural communities** must manage fewer opportunities per capita. Whether it's the number of regional jobs or the size of public services like libraries and hospitals, rural communities must deal with fewer local opportunities. Further, because resources aren't proximate in rural areas, residents face limited transportation options. When driving is the primary if not only mode of transportation, low-income, undocumented, and disabled communities may lose access to physical opportunities not within walking distance.[157] Broadband makes it possible for the physically disconnected to overcome distance barriers. This is an enormous quality-of-life improvement for rural areas.

Rural populations face particularly acute challenges in terms of accessing health services. There are fewer physicians and specialists per capita[158] and, recently, there has been an uptick in hospital closures.[159] All of this means that rural populations now need to travel longer distances to access quality health care, putting even more strain on the already-limited transportation system. Broadband has the potential to close this gap through the health opportunities previously discussed, but rural populations also have lower rates of broadband adoption than their urban counterparts and often lack adequate digital skills. Central to these lower adoption levels are fewer network investments by the private sector and, when broadband is present, rural subscribers often face slower speeds.[160] There is some evidence that slower speeds limit economic growth potential,[161] which limits economic stability, which in turn can affect health outcomes.

Small and midsized cities may face similar positive and negative impacts as rural communities if they, too, are geographically isolated. However, American jurisdictional geography means many of the country's small- and mid-sized cities are part of a larger metropolitan area. That leaves many of these cities as part of much larger labor pools and general population centers. As such, proximity is not likely their concern, and they are far more likely to have broadband networks present across their metropolitan area. Instead, small and midsized cities' broadband environment will be dictated more by demographics around income and race.

Low-income communities sometimes face similar barriers to access as rural communities. Namely, though, because the cost of transportation (rather than the lack of infrastructure) limits their access to goods and services. This means that broadband has the similar potential to connect low-income communities to different services and opportunities.

However, there are many barriers to low-income families having consistent and reliable internet connections. For one, cost is often a major barrier to adoption putting lower income families at a disadvantage in terms of accessing service. Though there are low-cost internet plans open to low-income families,[162] from our site visits, we've learned that many low-income residents don't know these plans exist, and they also don't exist everywhere. Further, broadband and mobile services may not be available in the areas that

are covered by the discount programs. Another issue is that some low-income families experience housing instability, which makes a consistent wireline connection more difficult to maintain. Each installation can require hefty one-time fees that many low-income customers won't be able to pay.

There is also some evidence that lower-income households are less likely to have digital literacy skills.[163] A lack of digital literacy skills, at the least, makes navigating the internet more difficult, and may discourage some households from subscribing to the internet. Moreover, there is some evidence that developing and using digital skills begins a self-reinforcing cycle wherein having more skills allows people to build more skills. Conversely, lacking digital skills makes it more difficult to build even a basic skillset.[164] Traditional digital skills interventions also might not be as successful with these populations if they lack the transportation and time to attend skills training classes.

Communities of color can overlap with either rural or lower-income communities. However, our research finds that communities of color independent of income or geography adopt broadband at a lower rate than white peers. In addition to demand-side barriers to adoption, there is also evidence of a small but significant difference in broadband availability in underserved racial and ethnic communities.[165] And when there is broadband available, there is also evidence to suggest that people of color have fewer choices in terms of providers, often forcing them to bear higher costs.[166] Such institutional biases serve as a significant obstacle to advance national digital equity.

The same report also shows that Black and Latino or Hispanic communities are more likely to have mobile-only subscriptions.[167] In terms of addressing equity issues, this last point is especially problematic as Black and Hispanic children already lag in educational outcomes. With an increasing number of homework assignments requiring internet use, there is a concern that students of color will further lag behind their white peers.[168] More broadly, there is evidence that mobile-only connections are useful for social networking and reading news but may be limiting in terms of applying for jobs, working from home, or researching health-related issues.[169]

Appendix III. Opportunities to advance the work

As the economy and society continue to digitalize, broadband's connection to health and equity will continue to grow and transform. But there is no guarantee that that process will lead to health and equity improvements. Public officials, private network owners, and civic organizations have a collective responsibility to maximize shared benefits and minimize shared costs related to broadband infrastructure. Making good on that responsibility requires those leaders to continuously scrutinize their approaches to broadband infrastructure and collaboratively develop new interventions.

The following section presents areas for continued work. It includes categories of thought leaders who can advance the connection between infrastructure, wellness, and equity. It also lists research needs to advance the broadband discussion, most of which build on findings from the literature review (see Appendix I). While neither list is exhaustive, their extent demonstrates how many people are involved in the broadband space and how much we still do not know about its impacts.

Thought leaders:
PUBLIC
Elected Officials (Executive and Legislative) and Their Teams
Digital Agency Representative, including IT and Telecom Services
Budget Experts
Construction and Contracting Experts
Civil Servants from Related Agencies (ex: Transportation, Parks and Recreation, Health and Human Services)
CIVIC
Medical Industry Officials
Educators
Religious Leaders and Volunteers
Social Workers and Legal Advocates
Arts and Culture Advocates
Workforce Development Officials
Neighborhood Advocates
National, State, and Regional Issue Leaders
Academic and Nonprofit Researchers
PRIVATE
ISP Employees
National and Local Financiers
Construction Companies
Companies Involved with Digital Workforce Development
Agriculture and Manufacturing Industries

Research needs:
RESEARCH GAPS
Service conditions:
By acquiring consistent data from variable geographies, investigate pricing's effects on adoption and related issues
As the FCC continuously tweaks the formal threshold to qualify broadband services, investigate how speed levels impact use and secondary effects, including personal economic performance and social habits
Economic benefits:
How broadband helps people build long-term wealth, not just annual income or employment benefits
The impact of broadband network quality on any local government's ability to execute smart city programs and the equitable nature of those policies
Measurement gaps:
Improve geographic data around service availability, speed, pricing, and other availability conditions
Usage habits of in-home, wireless, and nonsubscribing households—and how those habits relate to health and equity considerations
The relationship between different demographic groups and benefits experienced from broadband adoption
Determine the most effective forms of intervention so that local governments pressed for resources know where to invest their money
The return on investment from skills training programs and subsidies to access and equipment
POLICY QUESTIONS
Federal funding:
Should the country be technology-agnostic? Does it make sense to have federal funding support specific technologies over others?
What are the best funding interventions for passing price benefits onto consumers? If the federal government subsidizes capital expenditures, how do private network owners respond? Do consumers see price decreases?
Advocacy questions:
Do targeted communities understand the level of disconnect their physical community faces?
How do advocates create a sense of urgency around the concept of broadband and its impact on health and equity?
For anchor institutions directly impacted by lack of broadband access or affordability, what are the outcomes when they increase involvement in local broadband issues?
Stakeholders questions:
What is the appropriate role for civic institutions?
Civic trust and media's role: What's the intersection between broadband deserts and news deserts?

Endnotes

1 . Federal Communications Commission, 2019 Broadband Deployment Report. Broadband definition equates to 25 megabits download and 3 megabits upload (or 25/3).

2. The Pew Research Center reported a 73 percent in-home adoption rate in 2019, while the National Telecommunications Information Administration reported a 86 percent wireline adoption rate in November 2017.

3. Pew Research Center, "Mobile Technology and Home Broadband 2019."

4. Federal Communications Commission, 2019 Broadband Deployment Report.

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23. Based on Brookings classifications.

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25. Brookings analysis of ACS 1-Year (2017) and 5-Year (2013-2017) data.

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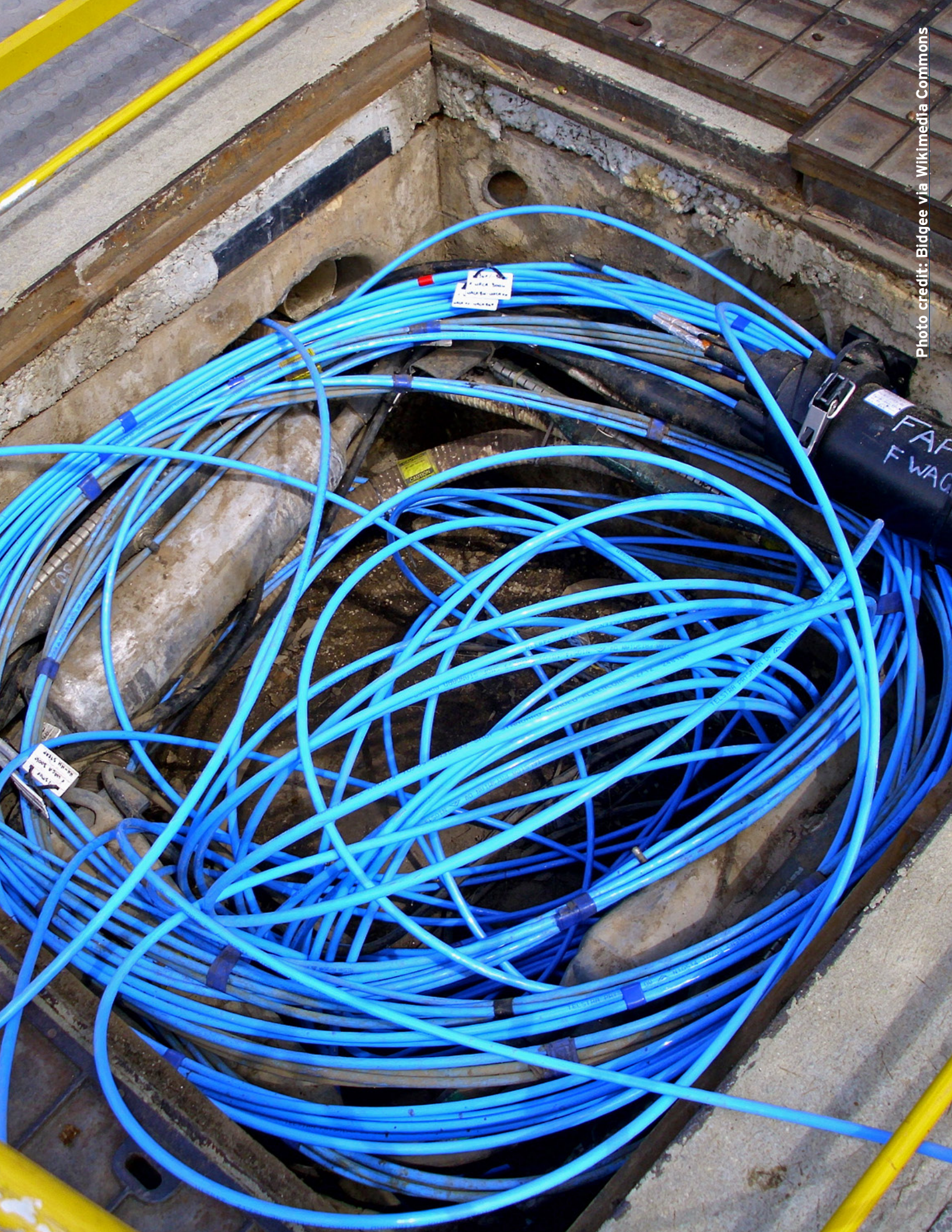

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