MECHANISMS FOR LOCAL BROADBAND DELIVERY: A CASE STUDY

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ABSTRACT

The COVID-19 pandemic exposed America's stark inequality in broadband access. Struggling as a result of previous policy and market failures, local municipalities across the country are taking matters into their own hands and exploring various ways to provide crucial broadband infrastructure, particularly to the unserved and underserved population. This project explores case studies in Texas, Minnesota, and California to identify the key factors leading to community efforts to expand broadband access. Overall, this thesis finds that the development and engagement of community resources, the presence of active agents, a project's positive impact, and the opportunities created by the pandemic stimulated local broadband development. Interestingly, these cases show that the initial lack of community resources need not impede local broadband infrastructure expansion if community actors collaborate to promote collective impact. Implications for federal and state policy include enhanced and flexible support for community actors while preferencing the national ISPs less.

BIOGRAPHICAL SKETCH

Born in Beijing, China, Yixiao Edward Guo originally wanted to build houses and become an architect. After finishing 8th grade in China, he began attending high school in the United States, where he met friends that eventually made him realize the importance of people, policy, and politics, and led him to pursue urban planning at Cornell. Also, he sucked at drawing and still does.

He started college hoping to derive a general solution to regional inequalities, but struggled to find the appropriate avenue to explore such a broad topic. Gradually, after having studied and worked Le Corbusier's ideal cities, autonomous vehicles, affordable housing policy, flood mitigation, and complete street designs, and having been guided by trusted friends and mentors, he eventually realized that infrastructure development is his true passion as without infrastructure, modern societies would not be possible. He believes that figuring out how to do a better job delivering equitable and quality infrastructure can have tremendous impact on everyone's lives.

Du Fu, a Chinese poet from the Tang dynasty, once wrote the following words: "*If only I could get a great mansion of a million rooms, broadly covering the poor scholars of all the world, all with joyous expressions, unshaken by storms, as stable as a mountain.* (安得廣廈千萬間，大庇天下寒士俱歡顏，風雨不動安如山。)" Taking them as a reminder on the importance of infrastructure, Guo has written this thesis in the hopes of contributing, even if just slightly, to infrastructure's betterment for all.

To practitioners who improve our lives one small step at a time.

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It has been a long journey up to this point and I want to offer my most sincere gratitude to my parents, without whose support I would not be where I am today. I want to thank my advisor Dr. Mildred Warner, whose positive energy, kindness, dedication, and attention to detail have challenged yet guided me in the most incredible way. I also want to thank my partner Tina Yu for standing by my side this entire time, whose boundless affection I rely on more each day.

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LIST OF ABBREVIATIONS

ACP	Affordable Connectivity Program
ARPA	American Rescue Plan Act
CAF-II	Connect America Fund Phase II
COE	County Office of Education, Santa Cruz County
DSL	Digital Subscriber Line
EASC	Equal Access Santa Cruz
FCC	Federal Communications Commission
IIJA	Infrastructure Investment and Jobs Act
IRRRB	Iron Range Resources and Rehabilitation Board
ISP	Internet Service Provider
NTCA	National Telephone Cooperative Association – The Rural Broadband Association
RDOF	Rural Digital Opportunity Fund
PPP	Public–Private Partnership

1. INTRODUCTION

Over the past two decades, our society has undergone a massive digital transformation — the Internet now appears ubiquitous. Movies, books, and the process of socialization in general have been moved onto or made drastically different by the Internet. The disruption caused by the COVID-19 pandemic has furthered our dependency on the Internet with schooling, work, and even governmental affairs now conducted online.

Our growing dependency on the Internet has made digital equity issues more pressing as the Internet now has important public functions as a forum for discussion, a method to access key services, and a carrier of creative information. Citizens without viable broadband connections, who lack affordable service plans, or who have inadequate knowledge to navigate the increasingly complex Internet are put at a disadvantage to engage with and benefit from the Internet.

While arguments to consider broadband as infrastructure have always existed, the COVID-19 pandemic brought broadband front and center in the infrastructure discussion as it showed how indispensable the Internet is to every aspect of life. Remote work, online learning, e-commerce, and telehealth provided Internet users with great flexibility and convenience. At the same time, however, the pandemic also exposed wide gaps in broadband availability. Many children and adults, especially in rural and low-income areas, struggled to access education, social services, and remote jobs (Chin 2020; Loten 2020; de Zeeuw et al. 2020). An estimated 42 million Americans do not have access to broadband today (including DSL and cable), and those with access often pay higher prices for lower speeds compared to customers in European and Asian countries (Busby, Tanberk, and Cooper 2021; Chao, Park, and Stager 2020). Thus, the question of how to enhance the

delivery of broadband infrastructure, especially for presently underserved and unserved places, is more crucial than ever.

Seeking to address the inequalities that exist in the broadband landscape, communities have taken action. This thesis utilizes a case study approach and examines three communities' actions on broadband in the hopes of determining mechanisms that enhance broadband delivery in underserved and unserved communities. The following section first reviews the existing broadband landscape in the United States. The second section introduces the analytical framework of the thesis based on existing literature on community resilience. The third section details the methodology of this research. The fourth section presents the detailed case studies of the three localities: Brownsville, TX; St. Louis County, MN; and Santa Cruz County, CA. The fifth section analyzes the case studies based on various mechanisms, and is followed by policy recommendations and conclusions.

Overall, this thesis finds that the development and engagement of community resources, the presence of active agents, a project's positive impact, and the opportunities created by the pandemic positively enhanced broadband delivery. The case studies also suggest that the initial lack of community resources need not impede local broadband infrastructure expansion if community actors collaborate and generate collective impact. While equity was a key consideration for all cases, the extent it can be sustained, and the methods used to do so, require further monitoring. This thesis suggest that federal policies place a greater emphasis on initiating and better supporting local actors in broadband.

2. CURRENT STATE OF BROADBAND AND EXISTING ISSUES

2.1 Three Lenses of Broadband Connectivity

Access, affordability, and adoption represent the three separate but interconnected lenses through which broadband infrastructure can be examined. Using the framework from Gonsalves (2021), access refers to whether the Internet and broadband infrastructure are physically available; affordability refers to whether users wishing to access broadband services can afford to pay; and adoption refers to whether people who want to or need to use the Internet have the skills, knowledge, and devices to use it.

2.2 Existing Broadband Landscape and Its Impacts

Scholars over the past decade have argued that America's broadband landscape is one of increasing division.

In terms of access, it appears from data collected by the Federal Communications Commission (FCC), the agency in charge of regulating and overseeing broadband development, that over 97% of the country's population is covered by broadband that supports 25Mbps download and 3Mbps upload from 3 or more providers in 2020 (Federal Communications Commission n.d.). However, more detailed research finds that over 42 million Americans lack reliable broadband access (Busby, Tanberk, and Cooper 2021). The discrepancy between government and scholarly estimates is mostly due to flaws in FCC's data collection standards and process. First, Internet service providers (ISPs) self-report their coverage to the FCC, which does not audit the accuracy of the information provided. Second, the definition of "covered" is extremely relaxed: a census block can be considered served as long as a single building within it can be connected to the Internet within 10 business days. Additionally, the FCC considers outdated, slow, and often unreliable

technologies, such as satellites, as meeting its standard for broadband, leading to inflated statistics on access (Ali 2020).

In terms of Internet and broadband affordability, U.S. consumers pay some of the highest broadband prices in the world compared to their European and Asian counterparts at an average of $68.38 per month (Chao, Park, and Stager 2020). Many of the U.S. plans analyzed stated only their temporary promotional rate, and the true monthly cost of the plans jumps an additional $22.55 on average after the promotion period ends (Chao, Park, and Stager 2020). Comparatively, European consumers pay only $44.71 for broadband per month, and U.S. providers do not offer significantly faster speeds on average to justify the higher prices (Chao, Park, and Stager 2020). While other large-scale reports on broadband affordability are hard to find, affordability issues have been documented in individual instances all over the country across urban and rural areas, as the issue is just starting to gain widespread scholarly attention (Porter 2021; Tibken and Reardon 2021; Stewart 2020).

The broadband adoption landscape is far from encouraging. Not only is Internet service affordability an issue, many Americans also find it expensive to own a device that will enable them to comfortably enjoy the benefits the Internet brings. While smartphone and tablet ownership rates are similar across races, 80% of white adults report owning a computer while only 69% and 67% of Black and Hispanic adults report so. The distinction across income lines is even starker: only 59% of those earning $30,000 or less annually claim to own a computer compared to 84% and 92% of those earning between $30,000 and $100,000 and over $100,000 annually (Atske and Perrin 2021; Vogels 2021). In terms of their knowledge regarding the digital world, a Pew survey found that a majority of U.S. adults can answer fewer than half the questions correctly on a digital knowledge quiz, and

many struggle with questions regarding cybersecurity and privacy. The knowledge gap across age and education lines is also painfully clear: 18- to 29-year-olds can correctly answer a median of 5 out of 10 questions compared with a median of 3 for those over 65 years old (Vogels and Anderson 2019).

While broadband access, affordability, and accessibility are national issues, their impacts are felt differently along several lines. Compared to the early days of the Internet, broadband has evolved into a much larger and more complicated problem than just the haves and have-nots (Grubesic and Mack 2015). Many Americans have nominal access to the Internet, but the quality of services provided differs significantly from a spatial standpoint. Studies have shown extensive broadband coverage gaps between rural and urban America (Busby and Tanberk 2021; Ali 2020). Cities and wealthier suburbs get the most advanced 5G technology and fiber-optic deployment, but rural and remote communities, in which private providers cannot earn sufficient returns for infrastructure upgrades, continue to struggle with slower satellite and DSL connections (Ali 2021). In addition, because of high infrastructure costs, there is little competition in the rural broadband market, further degrading service quality, raising prices, and discouraging new infrastructure investments (Grubesic and Mack 2015). Conservative FCC figures estimate that 22.3% of rural America, or over 11 million people, do not have access to a broadband connection, only 19% of Rural America have a choice in broadband provider, and areas with low population density pay over 30% more than dense urban cores on average for their broadband services (Ali 2021). Beyond the urban-rural divide, there are also spatial divisions along class lines as studies, such as Grubesic and Mack (2015) and Porter (2021), report significant heterogeneity in broadband access and pricing within metropolitan areas as well.

Because of the additional benefits broadband brings to all aspects of life, a spatial divide in broadband access creates and exacerbates economic and social divides. The lack of reliable and fast broadband connection impedes one's ability to access timely healthcare, perform remote work, and complete studies online. In rural and poorer urban areas where life expectancy, income levels, and education levels are already lower compared to the urban core and wealthier suburbs, substandard broadband could be detrimental to local residents' welfare and local businesses ("Educational Attainment in Rural Areas" 2022). Overall, broadband inequality, if left unaddressed, could further the rising inequality in the U.S.

2.3 Existing Issues that Delay Broadband Infrastructure Deployment

The existing broadband landscape, marred with inequalities in access, affordability, and adoption, is the result of a series of market and policy failures.

First, the private market for broadband functions as a natural monopolistic quasi-market as defined by Gómez-Ibáñez (2006) because broadband infrastructure is often expensive, durable, and immobile, making it difficult for new providers to enter the market especially in places with low demand. This leads to market failure. While broadband is not as expensive on a per-mile basis as traditional natural monopolistic infrastructure such as roads and power lines, it is still quite costly to construct. According to data provided by NTIA, the cost of fiber and conduits alone could cost upwards of $35,000 per mile; routers, communication hubs, backup generators, and network node equipment all cost tens if not hundreds of thousands of dollars to invest, and various other fees such as pole attachment fees and right-of-way purchases could drive up costs further (BroadbandUSA 2017). Wireless deployment is also costly. Not counting land and construction costs, a single 75-foot tower could cost anywhere from $7,500 to $20,000 just to maintain and operate. To

ensure network coverage and redundancy, more than one tower is typically required. Relays, transmitters, receivers, and various key equipment can also cost tens of thousands of dollars (BroadbandUSA 2017). Broadband investments are durable – coax or fiber cables, if not physically damaged, could remain in service for decades (Van Vickle 2013). Towers, cabinets, and cables are also difficult to remove and reinstall in a different location, making the entire network infrastructure immobile. According to economic theory, these characteristics of broadband increase the cost of potential providers to enter the market, allowing existing providers to function as monopolies (Gómez-Ibáñez 2006). The market is not entirely monopolistic because competition exists in densely populated areas where enough demand exists to support multiple providers. However, in rural areas where demand is low, there is a clear market failure as many remain unserved, pay high prices, or have no choice of service provider (Stewart 2020).

The market failure is made worse by a series of policy failures, mostly at the federal level. The policy failures, according to Ali (2021), are four-fold: management, meaning, money, and mapping. The management failure is a result of the federal government's inability to settle on a set plan to promote broadband connectivity in rural and underserved areas. In 2009, the FCC and USDA jointly developed a rural broadband plan that would give local authorities more autonomy, enhance collaboration and strengthen monitoring. However, the plan was abandoned when the FCC released the National Broadband Plan in 2010, which paid significantly less attention to rural areas. To date, many of the proposals outlined in the original rural broadband plan remain unrealized, and the national broadband plan has not received updates in the past decade (Ali 2021).

The meaning failure is mostly the failure to set a standard for broadband that matches the users' needs. In 2015, the FCC defined broadband as any network connection that offers 25Mbps download speed and 3Mbps upload speed. While this speed represents a significant increase from the previous 4/1 standard, the new standards align perfectly with average speeds of DSL services, allowing the FCC to continue to claim near-universal broadband coverage while absolving major providers from having to update their network infrastructure to meet higher standards (Grubesic and Mack 2015). In addition, the FCC continues to maintain technology neutrality in its definition of broadband, meaning it does not associate any particular technology with broadband as long as the technology can deliver speeds upward of 25/3. This technologically neutral definition, however, allows legacy technology providers, such as satellite ISPs, to continue to claim their service as broadband and to be eligible for broadband funding even when they struggle to meet the 25/3 standard (Ali 2021; 2020).

The money failure refers to the misallocation of federal funding that failed to produce significant network improvements while strengthening market control for large telecommunication companies. For example, the Connect America Fund Phase 2 (CAF-II) administered by the FCC was designed to provide $10 billion over 6 years to national carriers based on the cost to serve a subscriber at each program location. However, the providers could choose how much money they wanted to receive, and which areas they wanted to serve. Worse, to obtain the funding, the providers merely had to provide service at 10/1 speeds. When CenturyLink and Frontier, which combined received over $4 billion in federal broadband funding under the CAF-II program, reported that they failed to meet their deployment obligations in 23 and 13 states respectively, the FCC did not levy sanctions (Ali

2020). The successor program to CAF-II, the Rural Digital Opportunity Fund (RDOF), is similarly marred by problematic fund administration. Reports from 2021, the first funding cycle for RDOF, claimed that over $78 million of initially awarded funding was withheld from recipients due to the FCC's inability to timely and properly evaluate the eligibility of submitted proposals (Goovaerts 2021).

The final failure identified by Ali was the failure of mapping, or failure to gather detailed information regarding broadband availability, affordability, and adoption in general. The main source of broadband information at the federal level comes from FCC's Form 477, in which ISPs self-report the census blocks they serve. However, information collected via Form 477 has been widely criticized as inaccurate. According to FCC rules, as long as one address within a census block can be served within 10 days, the entire census block can be counted as having broadband available (Ali 2021; Grubesic and Mack 2015). Further, the FCC does not verify the data submitted by ISPs, and the ISPs are not required to report pricing information. The mapping and data inaccuracies have severe consequences for policy and broadband funding. When areas are identified by the FCC as served (using Form 477), they become ineligible for FCC funding. Thus, misrepresentation on the map could lead to stalled broadband development for actually underserved or unserved areas indefinitely. Unsatisfied with the federal data, several states have developed their own maps and datasets on broadband availability in collaboration with ISPs and non-profit organizations. The states of California, Minnesota, and New York, for example, all have published broadband coverage data (New York State Department of Public Service n.d.; California Public Utilities Commission n.d.; Office of Broadband Development Minnesota n.d.). However, reports of inaccuracies persist, and the data is often not standardized to

support further analysis (Jordan 2022; Treacy 2020). State-level data is not incorporated into or cross-referenced with the federal database, leading to large discrepancies between datasets. The Wisconsin Public Service Commission has identified 7,000 locations not shown on FCC maps; similarly, New York found 31,000 missing unserved or underserved locations, and Vermont reports 22% of the locations it knew were missing from FCC counts (Barrett 2022).

At the state level, some have aggressive broadband funding programs and ambitious deployment goals while others have regulatory preemptions that limit local governments' ability to provide broadband services. As of 2022, 17 states have explicit legislation in place against establishing commercial municipal networks, and 4 additional states have other roadblocks that increase the difficulty of operating municipal networks (Cooper 2022). State-level barriers are diverse. They range from the outright and explicit prohibition of municipal networks in Nebraska, to adding phantom costs to ensure a level playing field between public and private providers in Louisiana, to requiring a popular referendum in Minnesota, to prohibiting the use of local tax and funding to cover construction costs in Alabama, to installing a population cap on the size of the city or county that can undertake public broadband efforts, to requiring complicated procedural and accounting methods in Utah (Cooper 2022). Many such barriers were put into place after large private ISPs protested against public efforts, or as the result of private lobbying efforts – both are forms of regulatory capture (Ali 2021; Cooper 2022). While public provision may not be fitting everywhere, eliminating the option entirely from municipalities' toolboxes certainly hampers broadband deployment.

Beyond Ali's four federal-level failures and state preemption, slow progress in American broadband infrastructure is also a function of poor coordination that increases transaction costs for broadband projects at all levels of government. For example, pole attachment fees, the fees ISPs must pay to utility pole owners if they wish to attach cables to poles they do not own, can be a major impediment to broadband deployment (NCTA 2020b). Pole replacement fees, the fees ISPs must pay utility pole owners if the existing pole does not have enough space to accommodate new broadband infrastructure, present similar challenges to broadband deployment (Connect The Future n.d.). These fees may significantly increase the costs of providing broadband, but there is no framework to facilitate greater coordination between utility owners and ISPs and negotiation takes place on an individual basis. Similarly, significant administrative costs are associated with applying for and receiving federal broadband loans and grants in general. A comment by the National Telephone Cooperative Association (NTCA, now branded as the Rural Broadband Association) before the Council on Environmental Quality states that "members…face substantial barriers when…undergoing federally mandated environmental reviews [...as…] these barriers typically far exceed those that arise on the state and local level" and calls the environmental review process "byzantine" (NCTA 2020a, 2). Given that broadband installations do not generally cause any large-scale environmental disturbance, the environmental review process may serve more as a barrier to enhancing community welfare than a process that guards it. However, as with pole attachment and replacement fees, there are currently no proposals to simplify the process for broadband.

The market failure inherent in the broadband space, compounded by federal-level inaction or ineffective action to correct such failures, combined with states actively

restricting development pathways and a lack of overall coordination, has led to the fracturing of the American broadband landscape that continues to generate inequalities.

2.4 Impact of the COVID-19 Pandemic on Broadband

The COVID-19 pandemic was important for broadband deployment in the U.S. for two reasons: the pandemic made painfully clear the importance of broadband to our daily lives, and such realization translated to additional discussion and funding in the broadband space.

The pandemic became a watershed moment for broadband. Seemingly overnight, every aspect of daily life was shifted online. Work from home became the norm: telework accounted for 50% of paid work hours between April and December 2020, significantly higher than the 5% pre-pandemic (Dalton and Groen 2022). Distance learning was ubiquitous with 93% of households with school-age children reporting that they have engaged in some form of distance learning during the pandemic (McElrath 2020). Telehealth usage increased dramatically with the Government Accountability Office finding that in five select states, the number of telehealth services during the pandemic increased to 15 times the pre-pandemic level (from 2.1 million the year prior to 32.5 million in the 12 months from March 2020 to February 2021) (U.S. Government Accountability Office 2022). A study by Tufts University showed that broadband access saved lives during the pandemic – a 1% increase in broadband access across the U.S. reduced COVID mortality by 19 deaths per 100,000 people, or 0.1% after controlling for socioeconomic factors (Adisa 2022).

The realization that broadband is fundamental to our daily lives is simultaneously accompanied by the realization of jarring broadband inequalities. Research conducted during the pandemic found that lower-income households were less likely to report computer and

internet availability for educational purposes compared with higher-income ones; they also have lower levels of internet and computer proficiency, competing priorities, and have children who attend schools that are less equipped to provide online instruction (McElrath 2020). Desperate school districts have resorted to retrofitting school buses with WiFi hotspots to deliver Internet to underserved areas to ensure students can attend school (Al-Arshani 2020).

Overnight, a reliable and fast internet connection transformed from a nice-to-have amenity to something fundamental to everyone's lives, without which one could not interact with the outside world. This epistemic shift propelled by the COVID-19 pandemic has resulted in increased investment. The Infrastructure Investment and Jobs Act of 2021 (IIJA) provides $65 billion in broadband funding, and the American Rescue Plan Act of 2021 (hereafter ARPA) provided billions of dollars to further broadband projects (National Conference of State Legislatures n.d.; "Current Broadband Funding" n.d.). The post-COVID broadband funding from the federal government marks a shift in national broadband policy as new investment is or will be delivered directly to state and local levels as opposed to major telecommunications corporations (Lee et al. 2022). States have also stepped up efforts to enhance broadband connectivity as every U.S. state and territory has formally established or designated an office or agency to lead broadband development in 2022 (Read, Varn, and Gong 2022).

2.5 Why Municipalities and Local Approaches Matter

While a significant amount of broadband funding comes from federal and state levels, local actors at the municipal or county level have a significant role in advancing broadband deployment.

Despite the Internet's ability to connect information from all around the world, broadband is local at the fundamental levels (Ali 2021). Users and providers are local, and the underlying broadband infrastructure depends on technologies that are location-dependent. WiFi, cellular, and other forms of wireless broadband technologies still require fiber or cable backhaul, meaning the quality and capacity of local, physical infrastructure remain important in determining users' connectivity quality (Sylvain 2012; Ali 2021; Grubesic and Mack 2015). Further, as stated in earlier sections, broadband is local by virtue of America's fractured broadband landscape, as one's physical location can have a large impact on one's access to broadband. Grubesic and Mack (2015, 97) identified in their research many "islands of [broadband] availability" and "islands of [broadband] inequality", which are block groups displaying low levels of broadband provision that are surrounded by block groups of high provision, and block groups displaying high levels of broadband provision that are surrounded by neighboring block groups displaying relatively low values, respectively.

The fractured U.S. broadband landscape and broadband network infrastructure mean that broadband infrastructure deployment can only be addressed on a local, case-by-case basis. According to Gillett, Lehr, and Osorio (2004), municipalities can play four roles. Municipal governments can be key broadband users and use their leadership role to "assess, stimulate or aggregate demand." In this role, the government can measure demand by

conducting surveys, stimulate demand by training businesses and citizens, and aggregate demand by using the government itself as an anchor tenant to attract providers. Government can act as a rule-maker and adopt or reform local ordinances to facilitate broadband development. In this role, municipalities can expand access to local facilities such as utility poles or coordinate better planning. Local governments could act as a financier, providing economic support to users or providers. Such support could take the form of grants, loans, or tax incentives for providers, or of devices and services for customers. Additionally, the government itself could act as an infrastructure developer and construct and operate municipal networks.

In reality, different local governments and local institutions have played all the above roles in different circumstances ("Our Big List of American Rescue Plan Community Broadband Projects" n.d.). Because of local actors' active role in actually advancing broadband projects, they best understand the implementation challenges to broadband delivery, and have implemented numerous innovative solutions to address the challenges they encounter. Examining innovative local approaches can help planners more effectively achieve broadband and infrastructure goals and provide local government officials with another set of tools beyond traditional land use planning techniques to improve local quality of life.

3. LITERATURE REVIEW ON MECHANISMS OF BROADBAND DELIVERY

The analysis in this thesis broadly follows the community resilience framework. Developed from studies of ecological systems' capacity to rebound and recover after shocks and disturbances, resilience as a concept has been adopted to examine how social systems adapt to change as well (Roberts et al. 2017). Many definitions of community resilience exist. For example, Brennan (2008) defines it as the ability to respond or perform positively in the face of adversity, to achieve despite the presence of disadvantages, or to significantly exceed expectations under given negative circumstances. Norris et al. (2008) define it as a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance, and Heeks and Ospina (2015) define it as the ability to withstand and recover from short-term shocks and to adapt to long-term trends. However, the most complete definition of community resilience comes from Magis (2010) and its extension by other scholars (Ashmore, Farrington, and Skerratt 2017; Roberts et al. 2017). According to Magis (2010), community resilience is the existence, development, and engagement of community resources to thrive in a dynamic environment characterized by change, uncertainty, unpredictability, and surprise. Further, resilient communities intentionally develop a personal and collective capacity to respond to and influence change, sustain and renew the community, and develop new trajectories for the community's future (Magis 2010).

The community resilience framework is appropriate for examining the mechanisms that underlie broadband infrastructure development for several reasons. Broadly speaking, the framework is fitting because enhancing broadband can be viewed as a critical method to enhance community resilience. High-quality broadband connection has long been argued to

be able to enhance healthcare provision, improve education, facilitate economic development, further civic engagement, and improve quality of life in general — all aspects that can lead to greater resilience (Ali 2021; Roberts et al. 2017). There are five more specific reasons that justify the application of the community resilience framework to broadband delivery. First, the framework incorporates stressors and disruptions (Magis 2010). This incorporation is important as the COVID-19 pandemic and its disruption of normal societal order upended broadband development as explained previously. Second, the framework stresses that the development of resilience is a dynamic process (Magis 2010; Roberts et al. 2017). In broadband, as explained earlier, the situation is constantly changing. New technologies, redefined standards, redrawn maps, and additional government funding can all have an outsized impact on how projects are developed. Third, the community resilience frameworks understand that communities do not control all the factors that affect them, and that the success of resilience-building strategies may depend on factors originating at scales beyond the community (Magis 2010; Roberts et al. 2017). As previously argued, broadband failure in the U.S. is a result of market failure of large, national ISPs failing to provide services to unprofitable areas, and administrative challenges from federal and state-level governments to properly develop policies. Such market and administrative failures are outside the scope of individual communities' range of action and can only be incorporated as a given into communities' broadband projects. Fourth, the resilience framework emphasizes both community capacity and action as both are important determinants of ultimate success (Magis 2010; Fawcett et al. 1995). Last but not least, the framework is fitting because it reflects the growing community action in the broadband space as a response to policy and market failure at higher levels of government, and the

growing recognition that such actions are important (Ashmore, Farrington, and Skerratt 2017; Roberts et al. 2017; Ali 2021). As of 2021, over 900 communities, as tallied by the Institute for Local Self-Reliance, are investing or planning to invest in broadband ("Community Network Map" 2021).

In particular, Magis (2010) presents eight dimensions to evaluate community resilience: existing community resources, development of community resources, engagement of community resources, active agents, collective action, strategic action, equity, and impact. Community resources encompass a wide range including but not limited to natural, human, social, financial/built, and political capital. The development and engagement of these resources refers to the process of building up, and actively utilizing, the community's resources and are mutually reinforcing. Active agents refer to those with the ability to influence decisions and take a leadership position in doing so. Collective action is defined as the community developing partnerships and taking action, whereas strategic action refers to the development of the process of deliberation, planning, implementation, and learning within the community. Equity refers to the equal access and distribution of society's cost and benefits for all groups within it, while impact refers to objective and subjective measures of how successfully a given plan or project is implemented. Ashmore et al. (2017) broadly agree with Magis' framework but add an additional dimension of "sense of place," which refers to shared values and experiences particular to a location that enhance a sense of belonging and thereby facilitate community resilience. However, "sense of place" can be folded within Magis' framework as it could be considered as a community's existing "resource" that allows for more effective organization and collaboration. In addition to

Magis' framework, this thesis also offers a brief discussion on the COVID-19 pandemic as a mechanism for broadband delivery given its importance.

While Magis (2010) mentions the importance of active community agents in enhancing community resilience, the precise process of how they affect change is not specified. Here, the analysis by Doussard and Schrock (2022) of urban policy entrepreneurs provides the appropriate detailed framework of analysis. They argue that urban policy entrepreneurs, or broadly speaking active agents seeking change at local levels of government, can effect change via a combination of: 1) building power through outside organization and protests as well as through the utilization of data and building expertise to direct attention to a particular issue, 2) utilizing the fact that most local governments have unicameral legislatures and a relatively small number of representatives with enough power to affect the agenda, and 3) examine case studies and advocate for solutions successfully implemented elsewhere that can be executed locally (Doussard and Schrock 2022).

The process of collective and strategic action is also not well defined by Magis (2010). Two frameworks of parsing collective action are introduced here as substitutes. In the framework posited by Ostrom (2010), the core relationships that affect collective action include reputation, trust, and reciprocity, which combine to increase the levels of cooperation and thus increase the net benefits to all parties involved. If actors can acquire a reputation for using reciprocity and being trustworthy, additional participants can learn to trust those with such a reputation and cooperate accordingly. In the framework of collective impact outlined by Kania and Kramer (2011), there are five conditions of collective success, namely: common agenda – a shared vision for change, shared measurement systems standardizing how success is measured and reported, mutually reinforcing activities,

continuous communication, and backbone support organizations. Combining the two frameworks, a total of six conditions can be argued to affect the success of collective action. The five conditions from Kania and Kramer (2011), along with a precondition of good reputation and trust. Reciprocity and increased cooperation mentioned by Ostrom (2010) can be subsumed under the mutually reinforcing activities condition under Kania and Kramer (2011).

While the many mechanisms of building community resilience appear separate and are analyzed in the thesis as separate, Roberts et al. (2017) provide the important reminder that in reality, resilience, and the act of building it, is multi-scalar and requires some or all mechanisms to act together to bring success. In addition, Ashmore et al. (2017) and Ashton and Kelly (2019) warn that power issues and relationships must be considered in the resilience analysis to ensure that the resilience of the entire community is enhanced, not just the resilience of particular members of the group.

4. METHODOLOGY

This thesis takes a case study approach and is researched in four steps. First, possible case studies were identified via a database search. Second, key stakeholders in the respective cases were identified and contacted for interviews. Third, interviews were conducted with the relevant stakeholders. Lastly, key mechanisms that propelled action in broadband were identified and analyzed. In addition to the interviews, case studies are supplemented by journalistic reporting from various local, regional, and national news organizations.

The research presented in this thesis began with broad searches through databases containing ARPA-related community broadband projects. While federal and state funding for broadband existed prior to ARPA, ARPA represented a paradigm shift as it provided money directly to local governments without competitive bidding or prior project selection. With a deadline of 4 years to spend the money, ARPA provided communities with not only the resources but also the urgency to address long-ignored problems. Warner, Kelly, and Zhang (2022) show that 70% of local governments acted on existing improvement plans, and that most local governments used the money to focus on infrastructure investment. The ARPA funding, combined with the general realization of broadband's importance during the pandemic, spurred unprecedented local-level action to address substandard broadband. Examining the ARPA project database, therefore, provides a recent, comprehensive lens into the wide array of local actions in the broadband space.

Three separate databases maintained by Community Networks (a subsidiary of the Institute for Local Self-Reliance), Results for America, and the National League of Cities were consulted between the spring and fall of 2022 in search of revealing case studies with a geographic preference for rural or underserved/unserved communities and a general

preference for localities that acted quickly ("Our Big List of American Rescue Plan Community Broadband Projects" n.d.; "ARP Data and Evidence Dashboard" n.d.; "Local Government ARPA Investment Tracker" 2022). After the broad search resulted in a diverse list of localities, additional background research was carried out to identify the state of the respective projects. News reports from local outlets, government meetings and budget documents, social media pages from public utilities, and a variety of other information sources were consulted to verify the true status of the proposed project. This process ruled out projects that remained in the blueprint stage or were scrapped before implementation.

Next, key stakeholders in respective broadband projects were identified. Related news reports or government documents typically identified the main proponent(s) of a given project, or at a minimum the government agencies or private institutions responsible for the proposed broadband projects. Email addresses or phone numbers of relevant individuals or personnel in charge at various institutions were collected via Internet search for available public information.

Contacts were made to all identified individuals via emails that included the purpose of research and a request for a video or telephone interview. For individuals or organizations that did not reply to the initial email, additional emails were sent, and in some cases, telephone calls were made in attempts to establish contact. A number of potential case studies were ruled out due to a lack of stakeholder response.

Remote interviews were then conducted with relevant stakeholders via the Internet or phone. While a uniform list of interview questions was not used due to major differences between local broadband approaches, tailored questions generally proceed along similar themes. Interviews generally began by asking why and how stakeholders chose to engage in

broadband activities. Interviewees were then asked about how different partnerships were established; the current status of the project; how projects are funded, financed, managed, and operated; how challenges encountered were resolved; and how projects are ensuring long-term program sustainability. Additionally, interviewees were asked about additional contacts whom they believe played major roles in broadband program development. The snowball sampling method resulted in additional successful interviews. The complete list of interviewees for the following case studies, along with a sample of questions asked in each interview, is featured in Table 1 at the end of this section.

Each interview was recorded and transcribed using an online transcription engine. It became apparent in the initial interviews that some projects have not proceeded as initially advertised or reported, or the project featured no innovative approaches to address U.S. broadband deficiencies. In the case of Lincoln County, TN, the county simply decided to set aside $1 million from their ARPA funding and use it to incentivize existing private providers in the area to build out to unserved households. This direct subsidy approach to existing providers is common in the broadband space and its advantages and disadvantages are well analyzed (Ali 2021; Dawson 2019; Gillan 2019). As the case study from Lincoln County, and other cases, cannot add value to existing discussions, these case studies were not included in future analysis.

Case studies are constructed from the interviews and are supplemented by news and media reports. These news reports provided a way to access key stakeholders who are unavailable to be interviewed for this thesis, including officials at national ISPs and high-level city officials who have declined, or are at a high likelihood to decline, being interviewed.

Overall, three case studies stand out as they provide unique stories and approaches to addressing broadband issues. The following section describes the cases in the City of Brownsville, TX; St. Louis County, MN; and Santa Cruz County, CA.

Table 1. List of all interviewees for the included case studies and a sample of the questions asked in each interview

Person Interviewed	**Title/Position**	**Sample Interview Questions**
Brownsville, TX		
Elizabeth Walker	Assistant City Manager, City of Brownsville	Note: The two interviews were conducted jointly. ● What led to the city of Brownsville starting this broadband project? ● Why did the city of Brownsville decide to do a public private partnership and why did the city choose Lit Communities as the service provider? ● What are some of the difficulties/challenges the city has encountered, and how has the city dealt with them?
Marina Zolezzi	Chief of Staff, City of Brownsville	
Rene Gonzalez	Chief Policy & Compliance Officer at Lit Communities	● How did Lit Communities end up getting started with the Brownsville project? ● What was Brownsville's connectivity condition before the project started, and why did the city feel there was a need to do the project? ● How's the project going now?
Jordana Barton-Garcia	Former Community Development Banker and Senior Advisor for the Federal Reserve Bank of Dallas	● What led you to start working on broadband issues? ● How did your involvement with Brownsville begin, and what kind of role did you play in the early phases of guiding the development of Brownsville's network? ● Were there any difficulties in the process

		in terms of getting the broadband projects to start?
St. Louis County, MN		
Kip Borbiconi	Resident of Cherry Township and Local Broadband Advocate	● How did you get started and how did Cherry township get connected? ● What are some difficulties that you encountered in this project? ● How did Cherry Township end up partnering with CTC?
Brad Gustafson	Community Development Manager at St. Louis County	● What are some of the most pressing concerns about connectivity and broadband in your community? ● When you are identifying projects, is it really just a truly community led effort, or does the county try to push and say we think this area does not have sufficient broadband, and we are going to try to see if we can get a project going in that direction? ● Why has the county dedicated a broadband planning grant?
Whitney Ridlon	Community Development Representative at Iron Range Resources and Rehabilitation Board	● How do you organize these community-driven efforts, and how do they come to be? ● How does the IRRRB help local entities with their planning efforts? ● What are some of the difficulties or challenges that you've encountered in the process?
Santa Cruz County, CA		
James Hackett	COO at Cruzio Internet	● What happened to the national providers? Why do they not build, or why do they choose not to upgrade their technology? ● How did this broad coalition of partners come about for this project? ● What are the future plans for Equal Access Santa Cruz and Cruzio?

Jason Borgen	Chief Technology and Innovations Officer at Santa Cruz County Office of Education	● What led the County Office of Education to start working on broadband issues? ● How did the County Office of Education get involved in particular with EASC come April or March 2020? ● How did collaborations between stakeholders come together?
Kevin Heuer	Director of Engagement & Impact at Community Foundation Santa Cruz County	● What led the Community Foundation to start working on issues on broadband? ● How is the process of raising money for Equal Access different from how the Foundation would normally approach fundraising? ● What were some of the difficulties that the Foundation encountered in this process?

5. CASE STUDIES

5.1 City of Brownsville, TX

Brownsville, TX, has long suffered from subpar broadband connections. Over the past decade, it has appeared multiple times on the National Digital Inclusion Alliance's "Worst Connected Cities" list and topped it twice in consecutive years (NDIA 2019; 2018; 2017). By 2019, the city was motivated to get rid of this infamous label, and disruption from COVID-19 intensified Brownville's efforts. Using $19.5 million of its ARPA funding, the city entered into a public-private partnership (PPP) with Lit Communities, which is committed to providing an additional $70 million, to construct a publicly-owned middle-mile network connecting last-mile local networks to high-capacity national and regional backhaul and connect everyone within the city limits. When it finishes in three years' time, Brownsville will have 100 miles of public open-access fiber middle-mile backbone and 550 miles of private last-mile fiber connections to homes and businesses (Treacy 2022; Walker and Zolezzi 2022; Gonzalez 2022).

5.1.1 The Problem: Histories of Poverty and Private Market Inefficiencies

Brownsville's lack of broadband stems from legacies of poverty, which the city still suffers from today, and market failure in broadband. Founded on cycles of violence against Mexican and native residents in the 19th Century, Brownsville was the result of "repeated waves of Spanish, Mexican, Texan, and American colonization for economic gains (MacWillie et al. 2021)". The local economy, based on trade and agribusiness, has failed to flourish, resulting in the city's frequent appearances in "America's poorest cities" rankings (MacWillie et al. 2021; Hlavaty 2013; DePietro 2021). Residents often face insufficient and volatile income streams, lack access to credits and financial institutions, and lack health and

retirement benefits (Diaz-Pineda 2021). The Colonia communities surrounding Brownsville lack basic infrastructure and consist of mostly substandard housing (Barton, Perlmeter, and Marquez 2015). Legacies of poverty meant that there "simply wasn't [enough profit motive] for [private ISPs] in the Brownsville marketplace," says the city's assistant city manager, causing a market failure that has left Brownsville's Internet needs unmet.

The Internet access situation in Brownsville is deeply inadequate. A city-sponsored survey in 2022 showed that 66% of the city's residents lacked DSL, cable, or fiber access, and 23% had no broadband access of any kind, including cellular data plans; additionally, 32% of residents had connection speeds below the 25/3 FCC standards, and 65% had download speeds below 100Mbps (Lit Communities 2022). The American Community Survey similarly shows that only one census tract around Brownsville has fiber, cable, or DSL subscription rates higher than the Texas state rate of 68.77%, with the lowest census tract at only 9.57% (U.S. Census Bureau 2021). Interviews with city officials show that local emergency departments sometimes report difficulties communicating with each other due to poor network connection, and a Brooking's report found that companies have left the Brownsville region due to inadequate levels of broadband connectivity and adoption that constrained business growth (Tomer et al. 2020).

5.1.2 Getting Started: We Just Decided To Move

Although Brownsville's broadband issues had been known for a decade, it took real determination from community digital champions to get improvements underway in 2019.

The first champion is the then-newly elected mayor. After seeing the city named one of the nation's "Worst Connected Cities," he was determined to act as he knew that for Brownsville "to be a thriving community, the issue of broadband must be one of [his] top

priorities" as he wrote in an opinion piece for *Route Fifty* (Mendez 2022). In his 2019 State of the City address, he stated that "access to Broadband will determine [the city's] future… [and that he had] heard many stories that [students], the future leaders of [the] community, struggle with not having access to the internet, whether it's because of affordability or just lack of infrastructure to their homes (Barton 2021)." He called the situation "unacceptable," and quickly got to work to rectify it (Barton 2021).

Another important community digital champion was a community development banker and senior advisor for the Federal Reserve Bank of Dallas who city officials referred to as the "original instigator [of Brownsville's broadband project]" (Cameron 2022). During her research into infrastructure in the border Colonias in the early 2010s, she made a surprising discovery about the importance of broadband. Even though broadband was not included in any questions asked during the research, residents in Colonias shared countless stories of how limited internet access was constraining children's schoolwork and residents' ability to participate in the job market (Barton 2021; Barton, Perlmeter, and Marquez 2015; Barton 2023). Realizing broadband's critical role in economic development, she made it her research focus to learn about the root causes of, as well as the practical solutions to, the digital divide, and managed to build relationships in the field with communities, policymakers, and providers in the process.

The two community champions soon combined forces after the mayor's inauguration. The mayor began organizing key community stakeholders in Brownsville, including economic development agencies, the local community college, the school district, and local utilities, to meet and discuss solutions, and the community development banker was invited to join (Treacy 2022; Walker and Zolezzi 2022). The community development

banker gave presentations on best practices and options based on her prior work with the City of Pharr, TX, and other communities in their process to improve broadband. Further, she introduced the city to organizations that could offer help, including Brownsville's eventual PPP partner, Lit Communities.

The COVID-19 pandemic deepened the political realization of broadband's importance and hastened Brownsville's action. During the worst pandemic waves, the lack of reliable Internet connectivity significantly hampered the Brownsville economy and the daily lives of its residents, notes the city official. Close to 70% of its labor force could not work because connections were not fast enough to sustain remote work. Children could not access school materials. People struggled to access telehealth appointments during the height of the pandemic. COVID-19, according to the assistant city manager, "really laid very plain, raw and bare exactly what are the consequences born by a community that is digitally disconnected."

Immediately in the summer of 2020, the city started planning for broadband improvement first by conducting a survey to understand the existing broadband services (Walker and Zolezzi 2022; Gonzalez 2022). The survey showed that many residents were paying high prices for substandard services, and showed that many fundamentally lacked access to affordable, quick broadband (Lit Communities 2022; Gonzalez 2022; Walker and Zolezzi 2022).

5.1.3 Project Development: PPP and ARPA

Information provided by the feasibility study led the city to conclude that to truly address its broadband deficiencies, it needed to connect every home and business with fiber. However, when the city costed out the entire plan, it realized that it alone lacked sufficient

funding to complete the project. According to city officials, the city had initially considered debt financing or rate recapture via the municipal electric utility to pay for the broadband construction, which would have delayed progress on the project. When the city was allocated over $60 million in ARPA funding in 2021, the city suddenly found itself with the ability and resources to "make [its] own investment, … have an ownership stake, … and control [its] own destiny," says the assistant city manager ("Cultural and Tourism Grant Fund" 2022). During this process, the city administration had multiple rounds of discussion with the city commissioners regarding the best approach for the project (Walker and Zolezzi 2022; Barton 2023). In the end, after weighing all costs and benefits, the city's commissioners decided that a PPP model would be the best approach for Brownsville's digital future. The city would use $19.5 million of its ARPA funding, which was made available to Brownsville in early 2021 during the broadband discussion, to construct an open-access middle-mile network, and would enlist the help of private providers to connect to homes and businesses. Reflecting on the decision, Brownsville's assistant city manager said,

> [By utilizing the PPP model], we had some skin in the game. And I think that was important to our Commission too. That way, we would be able to assert ourselves and assert the role of the city and its responsibility to the community. Our commission felt very strongly that there had been a market failure by the capitalist approach towards private investment. So they want to be able to have some skin in the game, and they thought by owning the middle mile, that would be a way to hold accountable whoever would be the purveyor of the last mile. Now we are going forward, and it also too meant that we could then create a competitive marketplace, because then we could open [the middle-mile network] up to other ISPs for their participation.

With the PPP approach decided, the city sent out Requests for Proposals in search of a private partner. The city collected 20 responses, with no bid from the traditional ISPs

(Walker and Zolezzi 2022). The city administration engaged in conversation with 8 providers and shortlisted 4 (Walker and Zolezzi 2022). After a series of negotiations, the city eventually settled on a partnership with Lit Communities (hereafter Lit). Brownsville's $19.5 million contribution was able to leverage a $70 million commitment from Lit (Treacy 2022). Under the agreement, the city's money will pay for a publicly-owned open-access middle-mile fiber network that can generate revenue for Brownsville via leases to potential ISPs, and Lit's portion will help establish private fiber-to-the-home connections to all residents and businesses. In addition to constructing both the middle-mile and last-mile networks, Lit will be responsible for operating and maintaining the consumer-facing network (Walker and Zolezzi 2022).

Reflecting on the entire project development process, city officials believe that ARPA money really helped propel the project forward, calling the federal funding "a once-in-a-lifetime opportunity to make a singular investment that could have transformational change" for Brownsville. Without the ARPA funding as an initial investment, the city would not have been able to leverage as much private funding and start construction this quickly. The project would have taken many years to realize.

5.1.4 Benefits of PPP for Everyone

The partnership between Lit and Brownsville has many benefits to both parties and the city's residents. First, the PPP model allowed the city to increase its return on investment. With $19 million, Brownsville leveraged an additional $70 million in private investment, more than tripling the amount of capital the city could provide on its own. Second, the city will be able to earn revenue and promote competition with its open-access middle-mile network. Future providers wishing to use the municipal middle-mile network to

expand their customer base will need to pay Brownsville a user fee (Gonzalez 2022). The open-access nature of the network should help increase competition and lower broadband prices in Brownsville because such networks lower the infrastructure cost for new market entrants. When asked about why Lit would willingly agree to constructing and maintaining an open-access network, its chief strategy officer said that Lit's model in Brownsville "only needs roughly around half of the serviceable locations to give [it] the take rate that [it needs] to give [it] the ROI that is acceptable to not only [it] but [its] investors," and its survey show that 93% of residents would register if enhanced broadband services if made available (Lit Communities 2022). Third, public utility operators are able to leverage the broadband infrastructure to modernize its infrastructure as the city and Lit actively engaged each other during route planning. City hall, police stations, and other community institutions will be connected, and the local public utility is building new automatic metering technology off of the broadband network (Gonzalez 2022; Walker and Zolezzi 2022). Fourth, Lit is committed to training a cohort of local residents to work on installing and maintaining the network, creating new job opportunities in the area. To this point, Lit's representative said in an interview, "What better people to take care of a network than its own citizens and its own people from its own community?" Fifth, the partnership agreement between Lit and the City guarantees that lower-income individuals will receive 100/100 speeds capped at $30 per month even if the federally funded Affordable Connectivity Program (hereafter ACP) is discontinued as Lit is committed to working with local non-profits to continue the program (Walker and Zolezzi 2022; Gonzalez 2022). The city, tagging onto Lit's effort, also plans to step up its work on enhancing digital equity in general by introducing device provision programs with public and private institutions (Walker and Zolezzi 2022).

One additional benefit of Brownsville's PPP model is that it ensures the city will not face hurdles with regard to state preemption on municipal broadband (Casper 2021). For starters, the Texas municipal broadband prohibition was less than absolute after the city of Mont Belvieu obtained permission from state courts to build and operate its municipal broadband network (Silverman 2019). Brownsville had followed the case closely and was aware of the possibilities of direct public provision. In fact, Brownsville even applied parts of the Mont Belvieu ruling to its own advantage when it was planning its broadband project. Initial strategizing with the city commission, as the ruling allowed, happened behind closed doors, allowing the city to keep its cards close before it was ready to make any public announcement (Walker and Zolezzi 2022). More importantly, Brownsville will remain unaffected by the apparent preemption laws because the partnership with Lit means the city is not directly providing broadband and therefore does not fall under the scope of the state preemption (Gonzalez 2022). Additionally, the city simply saw more advantage in involving private entities in the process compared to direct public provision as the former approach allows the city to reduce maintenance and customer service responsibilities while promoting competition (Walker and Zolezzi 2022).

5.1.5 Hurdles: Incumbent Opposition

A surprising barrier to Brownsville's ambitious broadband improvement project was opposition from the incumbent, large ISPs. Despite not participating in the PPP bidding process or promising service expansions, existing ISPs made various attempts to stall the project (Walker and Zolezzi 2022).

Leading the opposition were AT&T and Charter Communications. An AT&T press release, first reported by the *Rio Grande Guardian*, argued that "some local officials in the

Rio Grande Valley are pushing to spend federal funds to build government-owned networks that would connect only public and government buildings – not households," and that "networks owned by local governments often fail due to lack of expertise and money, leaving taxpayers responsible for millions of dollars of debt (Taylor 2022b)." AT&T's Vice President for External Affairs, J.D. Salinas, further stated to *Rio Grande Guardian* that Brownsville's approach hampers security,

> What's important to know is patching together a network with multiple providers presents operational risk, cybersecurity risk, and continuity issues. AT&T is committed to building, operating, maintaining and upgrading our networks so that our customers have high quality and secure experiences. We cannot maintain that standard of excellence when utilizing a middle-mile network maintained by another provider. Quality and security may be compromised when a network is pieced together in a middle-mile scenario (Taylor 2022b).

Charter made similar comments according to reporting by *Rio Grande Guardian*, with the communication company's Vice President for State Government Affairs Todd Baxter arguing that "Brownsville is very well served and ubiquitously served by the private sector," and questioned whether it is "a good use of taxpayer dollars" to overbuild the private sector (Taylor 2022a).

Beyond criticisms, incumbents paid for advertising campaigns to boast their services (Gonzalez 2022; Walker and Zolezzi 2022). Incumbent providers went as far as enlisting the local chapter of the Council for Citizens Against Government Waste to file Freedom of Information Act requests demanding the release of Lit's proprietary business model (Gonzalez 2022).

Fortunately, such efforts were unable to derail the city's broadband project. Incumbents' claim that Brownsville's model is built only for public purposes is untrue, says city officials, as it has always been the city's goal to connect every premise within city

limits. The city also had survey data to show that incumbent providers do not deliver affordable, reliable broadband services to Brownsville residents. In the end, the mayor delivered the best response to the incumbent opposition via the *Rio Grande Guardian*,

> AT&T had their chance. Spectrum had their chance. All they did was try to prevent us from connecting ourselves as a community. We did not find they were willing to come to the table with any sort of solution. It was more about trying to convince us that everything was okay when obviously it was not. So, we are moving forward (Taylor 2022b).

5.2 St. Louis County, MN

Expanding broadband in St. Louis County is no easy task. Its administrative area is large, extending from the Canadian border all the way down to the western tip of Lake Superior. Its population is also spread wide across – despite having over 200,000 residents, its density is only around 32 individuals per square mile (U.S. Census Bureau n.d.). Adding to its geographic challenge, the county is located on the Iron Range, which is notorious for its hard rocks, making infrastructure construction difficult and expensive (Borbiconi 2023; Gustafson 2022). Furthermore, residents in the county are often limited by their economic resources as the county's median income sits at $57,480, over $10,000 below the nation's median (Donovan et al. 2021). These factors combined have led to low broadband penetration rates in St. Louis County particularly in its rural areas as private providers are unwilling to serve unprofitable regions. Less than 80% of its residents have access to 25/3 speeds and less than 10% 100/100 speeds, placing the county on the lower ends in broadband access within the state (Connected Nation 2022).

Due to these challenges and limited public resources, community action led by dedicated local advocates became the primary method of broadband expansion. The county, particularly after the COVID-19 pandemic, has recognized the importance of community

action and is taking steps to actively support them. Beyond dedicating $2 million of its $54 million ARPA funding to further community broadband efforts, the county and regional economic development organizations also provide technical and additional financial support (St. Louis County 2021a; 2021b).

5.2.1 Cherry Township and Community Advocacy

An exemplary story of community action in St. Louis County comes from Cherry Township. Because of how rural the township was, it had no broadband connection. A long-time resident who was a former mining company worker and became a local broadband advocate recalls eagerly waiting for phone companies to connect the township with cable but eventually realizing that "it wasn't happening" due to economic considerations – hotspot from his cell phone became the only way he could connect to the Internet, he said in an interview.

While he had been a tech enthusiast for most of his life, his involvement in broadband was more accidental than formal. In the mid-2010s, a state representative came to Cherry and was seeking funding to organize a group of local communities in the Iron Range to fight for broadband grants. The town board donated some money to the cause, but as no one on the town board had any knowledge of broadband, he became the township's eventual liaison to the Iron Range Broadband Committee along with other representatives from nearby Chisholm/Balkan Township, Hibbing, and Mt. Iron/Buhl as he frequented town board meetings and had some background in technology (Kruse 2018b; Borbiconi 2023).

The group met with various providers in the area in attempts to find willing partners as the communities are just too small to build and operate any potential broadband network on their own, and it even hired an outside consultant to outline a road map for the

communities in 2018 (Kruse 2018a). The committee settled on fiber with a "go big or go home" mentality as they saw fiber was the way for the future according to the advocate. After studying various funding methods including bonds and grants, the committee settled on pursuing a USDA ReConnect grant for Cherry Township (Borbiconi 2023). While it was the committee's goal to connect every community, various political reasons and strict USDA grant eligibility requirements limited the initial scope to Cherry as it was the only community that remained entirely unserved within its borders according to USDA definitions (Kruse 2018b; Borbiconi 2023).

With the grant application in mind, the broadband advocate began going door to door in Cherry to gather support. He needed to find 20 agricultural businesses in the area with broadband needs to meet the USDA grant requirement, and he needed to demonstrate that the community in general had a broadband demand to be able to entice any private provider to Cherry. He was soon surprised by how much need for broadband there was in such a rural community. Professionals could not work from home, a local farmer could not sell her chicken eggs, and elderly patients could not get their monitoring devices connected to the Internet all due to "crummy" connections, as the advocate describes. The most heartbreaking stories he heard were how younger generations do not want to visit for Christmas, or couldn't wait to leave, because they could not stand being digitally disconnected from the outside world.

The local advocate's persistent action united the community in its pursuit of broadband, and in the end he found the 20 businesses he needed, and more importantly, he found a willing partner in CTC, a Minnesota-based telephone, cable, and Internet co-op. When the community was trying to identify a private partner for network construction and

operation, it sent out invitations to many telecommunication providers in the area. Some, according to the advocate, never bothered to come to the negotiation table. When CTC came to the community in an attempt to preliminarily assess broadband demand in 2018, the advocate made sure to rally the whole town by handing out flyers and advertising the event all over the local area. Needless to say, everyone showed up. Reflecting on the event, the advocate said in an interview that in his 25 years in Cherry, he has "never seen that town hall so full" and that the staff from CTC has "never seen a town hall so packed" either; the cookies and coffee he brought was "nowhere near enough" for the crowd.

The overwhelming community showing not only convinced CTC, which became the township's broadband partner, it also resulted in a successful USDA ReConnect grant application. In what the advocate described as "winning the lottery," Cherry, along with nearby Great Scott township, was awarded $5.2 million worth of USDA grant in January 2020 to build out fiber connection to all 700 homes and businesses in their administrative boundaries with CTC investing another $1.7 million as the 25% grant match (Borbiconi 2023; Gillespie 2020; Buttweiler 2020). Although the project construction was delayed by the COVID-19 pandemic, it has been completed with CTC providing 250Mbps symmetrical speeds at $50 per month; CTC has also begun a yearly digital literacy training session in Cherry's town hall (CTC 2020; Borbiconi 2023).

Cherry's success, and all the friendship and people the advocate built and met during the process, has made him an adamant supporter of community-led efforts. Reflecting on his community organization work, the advocate says, "It was a task but I don't think it was hard to do. I just think that…people need to get involved. Your politicians can go so far, but it's the common people that make it happen. We're the ones that are buying it. We're the ones

that need it." He is proud of the effort he put in, and other Cherry residents are as well, thanking him at a local high school basketball game. "We won the lottery when we decided to do what we did," he emphasizes, "You know, it's amazing what you can get done if you just try."

St. Louis County's broadband efforts are heavily community-driven with individual communities often taking the lead to develop and advance projects because the county has historically lacked resources to develop and fund projects across the county. A St. Louis County planner commented on this issue by saying that "Internet is needed everywhere [in the county], and [the county doesn't] have enough money, unfortunately, to go around." According to the planner, however, this community-driven approach led by local broadband champions has produced notable successes in the county.

5.2.2 COVID as a Tipping Point in Attitude

Although various organizations have been involved in advancing broadband access in St. Louis County long before the COVID-19 pandemic, the pandemic became a tipping point for broadband development, says a community development representative at Iron Range Resources & Rehabilitation Board (hereafter IRRRB), which provides funding and technical assistance for broadband projects in the region. When Cherry's advocate was organizing community action for broadband earlier, he considered public officials' negative reaction to broadband initiatives a major obstacle, recalling meetings in which "older fellas" were saying "[residents] don't need any of that [broadband]." When the pandemic forced most residents to work from home and kids to learn remotely, attitudes both within St. Louis County and at federal and state levels shifted. "[COVID] made it where you were kind of pushing a rock up a mountain and trying to get everyone on your team, to now everyone's

screaming, they need broadband," reflects the IRRRB staff as she believes broadband projects require the involvement of not just dedicated community champions but also buy-in from those "who can make decisions." The general realization of broadband's importance brought newfound energy, initiatives, and funding into the broadband space.

5.2.3 Program Innovation: Planning Before Building

Learning from the success in Cherry Township and elsewhere, an innovative aspect of St. Louis County's broadband action is the decision to emphasize not just project construction but also project planning by dedicating $250,000 of the county's ARPA funding to assist local planning efforts (St. Louis County 2021a). In the county's rural communities where shovel-ready broadband projects are not developed in advance, the planning grant serves as an opportunity for these communities to assess demand and identify partners, essentially building the first step toward a project that can be realized now or in the future. Because of its low population density and difficult geographies, rural St. Louis County is often ignored by internet service providers on grounds of low demand or unprofitability. The county planner summarizes the lack of service and the extreme actions required to gain service the best: "[W]e're so rural that a lot of the communities [...] need to do a feasibility study to get a service provider on board to even think about doing a project in their community." The planning grant, with each grantee eligible to receive a maximum of $25,000 for a 1:1 match, enables municipalities to pay for feasibility studies to "put a project together, figure out what the rough estimated cost is going to be and who's going to want the service in the community," remarks the planner. Communities can then use the information to find a service provider willing to construct the broadband and apply for additional local, state, and federal funding. Even if projects are not immediately realized, the

data gathered and plans developed with the planning grants can still inform and be modified into future broadband projects or grant applications. St. Louis County's separation of the planning grant from broadband construction grants also allows municipal governments more flexibility as they do not have to immediately propose a complete project, but can instead take a more measured first step in broadband expansion.

Another way the county supports local community action is via technical assistance. The county now administers a broadband survey, which communities could use to assess demand for potential projects. The county's broadband survey was originally launched as a county-wide attempt to learn about local broadband gaps. However, the county has gradually found more "success [administering] it community by community when they're looking to start the process [of expanding broadband]" according to the county planner. "Instead of paying a consultant to do a feasibility study," the planner continues, "[communities] will use our survey." The county then receives and processes the surveys and returns the findings to the communities. By using the survey in such a manner, the county affords dual purposes to its surveys. Not only are the surveys able to generate feedback for broadband deficiencies, they also provide communities with an inexpensive way to measure demand, which can help facilitate communities' process of recruiting service partners.

Technical assistance also comes from other regional organizations, including the Blandin Foundation with a long-established track record in Minnesota, and the IRRRB. With more community organization efforts, local agencies are building technical expertise in broadband that can be used to assist future community action in St. Louis County. The IRRRB staff member, for example, is proud of how much she has learned and how she is

now able to offer technical support that enables communities to make informed decisions on broadband-related issues,

> [Through planning studies and community engagement], we've gotten to the point now where we have this underlying — so me at the agency, [the planner] at St. Louis County — we have enough of an understanding where we can go… McDavitt township can call us and be like, we're interested in broadband. Well, we can come out and say, this is what broadband is, this is what the state goal is, this is why we're here, we're trying to meet the state goal. These are the different providers working in your region, or in your township, or next to your township. We'll talk about the maps: here's where you're served, here's where you're unserved. We have a local speed test. Here's the dots in your township and the speeds they're getting. So, in the past, a private consultant has come in and led that and initially, that's what happened. But now we've found that me and [the county planner] could go out to a township and deliver that for them at no cost. And then we can connect them with potential providers. I've had townships say, we're okay with fixed wireless, we understand the difference between fiber and DSL, and we're okay that fixed wireless is going to be the solution in our community. But at least they're understanding it and making the decision on their own versus just Frontier essentially coming in and saying this is just what it is.

5.2.4 Issues Encountered

While St. Louis has had some success in expanding broadband access in its cities and towns, it has also encountered its fair share of challenges.

The first issue is that the county, like rural areas in general, is dependent on grants for their broadband efforts. Any change in grant programs will impact the project, mostly negatively. In Rice Lake, MN, for example, a local cooperative applied for $10 million of federal grant funding for a multi-township project. However, the project was not fully funded, causing the co-op to scale down the scope of work to focus on just the city of Rice Lake (Gustafson 2022).

In the grant aspect, St. Louis County also shows how grants at different levels of government sometimes feature program designs that are incompatible with one another. The county planner noted that a provider had been awarded a significant amount of money to

connect rural St. Louis County via the Rural Digital Opportunity Fund (RDOF) administered by the FCC. However, according to him, there was "no way that [the grantee was] going to be able to do these kinds of projects]" at such a large scale. Yet, some communities within the grant area that had already been awarded funding through the state's Border-to-Border program had their grants pulled (Colburn 2021). Additional issues with the RDOF grant's bidding process led the FCC to temporarily withhold funding, leaving communities in dire need of broadband without the support they were promised (Goovaerts 2021).

The last issue regarding grants in St. Louis County concerns the local match requirement. The county planner states that the state's Border-to-Border grant's "50% [maximum state] match [requirement]...is not feasible in [the county]" as local government and smaller ISPs do not have the necessary funding. It is in the state's interest to award money to projects that are willing to provide a larger share of local match as this allows the state to spend its money more efficiently on more projects. However, rural and low-income areas most in need of broadband funding are also the ones with the greatest difficulty paying for them, and program design must consider whether the money is better spent by awarding projects that require a higher match. The pilot program from Minnesota that allows applications for up to 75% state match of up to $10 million could be a significant help to rural communities (Office of Broadband Development Minnesota 2023).

Another issue hindering the county's broadband efforts is the lack of information sharing between and from ISPs. The county planner asserts that "it would definitely be better if [ISPs] work together" and that he thinks collaboration "could definitely get everybody connected faster" as effective information sharing between companies in areas

deemed unprofitable without subsidy can help reduce unintentional overbuilding when broadband access is the key concern.

5.3 Santa Cruz County, CA

Santa Cruz County, CA has long endured substandard internet connections, especially in its rural areas. When COVID wreaked havoc on the county's education system, community organizations – including local school districts, the local Community Foundation, and a local ISP, Cruzio – built on each other's strength and delivered fast broadband connection to some of the country's poorest and most isolated communities. Hundreds of thousands of dollars' worth of donations, grant funding, and Cruzio's own match have made the project a reality that has continued to expand.

5.3.1 Challenges: Market Failure from Geography and Demographics

Santa Cruz County is unique in its geography. The southern end of the county sits along the California coastline and is dotted with residential and farming communities. The northern end of the county, however, is occupied by the Santa Cruz mountains and covered by rocks, valleys, and other challenging terrains.

This terrain, coupled with lower population densities in northern Santa Cruz County, makes it difficult for Internet providers to build high-speed connections at a profit. According to an executive at the local ISP, Cruzio Internet, areas in the "Santa Cruz Mountains…were until recently still reliant on an old DSL service, which has recently been pretty much discontinued. And now pockets of [the county's] populations are left with no option other than satellite service or cell service."

Terrain and geography, however, are not the only roadblocks to Internet access in Santa Cruz County. Unlike northern Santa Cruz which has more ties with Silicon Valley, southern portions of the county are dedicated to agriculture, and migrant farmworkers, often struggling with financial independence and living in remote farming communities, do not serve as strong incentives for major ISPs to enhance broadband service (Hackett 2022; Heuer 2023). Around 60% of students in the county's education system are English learners, and a similar percentage are socioeconomically disadvantaged (Borgen 2023). In Pajaro Valley Unified School District, which serves around half of the county's students whose parents are farmworkers, 79.2% of students are socioeconomically disadvantaged and 40.3% are English learners (Monroy 2021; Borgen 2023). The broadband needs of students and their families are not met. As an example, the Buena Vista Migrant Center, home to 103 farmworkers and families located among fields in southern Santa Cruz, has no internet access; at one point, recalls one resident, AT&T offered DSL connections, but the service was discontinued without clear explanation (Monroy 2021).

5.3.2 Impetus: The Pandemic Changed Everything

While access and affordability issues long existed in Santa Cruz and some attempts, including providing devices in local libraries and schools and conducting a broadband survey, have been made to address the issue, it was the outbreak of the COVID-19 pandemic that finally rallied the community to examine the broadband situation in detail and venture for more systemic solutions (Dolgenos et al. 2020; Isenberg 2018; Borgen 2023).

The pandemic, and its negative impact on children's education, was the most important driver for action in Santa Cruz County. When the pandemic hit, the county's Office of Education (hereafter COE) realized that "all of a sudden from one week to the

next, all the kids, all the classes are going online and all the kids need to have a broadband connection," says the Cruzio executive, "And oh, look, suddenly we've discovered 80% of the kids in this school district don't have an adequate connection." A director at the COE said in an interview that the digital divide within the county "really hit home during the pandemic" as "some students could not connect and have weekly connections with their teacher because they didn't have broadband and access, didn't have connections, didn't have devices, [and] the families didn't know how to connect." For the COE director and educators in Santa Cruz, action had to be taken to "[make] sure [they] had a mechanism to give students access and [let students be] able to be on the same playing field [...and] have the same opportunities as their more privileged peers."

Something had to be done quickly, so the COE and Cruzio came together in March 2020 to imagine ways to provide students with Internet connections. The first idea executed by April 2020 was extending the Internet connection already available in schools to their parking lots using Cruzio's wireless technology (Dolgenos et al. 2020; Borgen 2023). This allowed students and their families to park and access the Internet while maintaining social distancing. However, this was not enough. Students living in rural areas depended on school buses to get to school, but the buses did not run while the schools remained closed, and students therefore could not access free Internet; a director at Community Foundation Santa Cruz County recalls stories of students from remote areas sitting outside fast-food restaurants near Santa Cruz with their laptops open trying to attend school with the restaurants' free WiFi. More had to be done.

5.3.3 Partnership: It Takes a Trio

Equal Access Santa Cruz (hereafter EASC) was thus created out of the necessity to do more to address broadband inequalities in the county. By June 2020, the strategy had shifted to bringing connections to where students lived: the rural and low-income neighborhoods. The key to EASC's success lies in the partnership between a local ISP, the school districts, and the Community Foundation. The ISP provided the technology and equipment, the school districts helped identify those in need and provided valuable real estate for network expansion, and the Community Foundation provided the financial resources.

The school districts and COE were important to EASC because they had the most intimate knowledge of those in need of broadband. The Cruzio executive states that working with school districts has been "a real key to how [EASC has] been able to be successful because [the school districts] already had access to all that data [regarding whether families have a connection or not]" as these families are the school district's constituents. The COE created a survey that connected with the individual school districts to verify whether students qualified for affordable broadband service, which saved Cruzio and the county significant administrative costs around eligibility and ensured students' information stayed private (Hackett 2022; Borgen 2023).

Further, schools aided the physical expansion of EASC's network. According to the Cruzio executive, schools in the county "tend to be distributed evenly around a community and the folks who go to the school are in a pretty nice catchment area around them." Therefore, schools become ideal wireless internet distribution hubs. Coordination between COE, the school districts, and Cruzio allowed the ISP to access the rooftops and place

wireless equipment, helping EASC expand without having to apply for additional permits elsewhere and seek alternative locations (Hackett 2022; Borgen 2023).

The Community Foundation (hereafter Foundation), and to an extent the Santa Cruz community at large, were vital in providing the project with the necessary financial resources. When Cruzio realized that it needed more funding to expand the network quickly, it went to seek help from the Foundation as the latter had charitable status and could take donations. A special fund for the EASC was established at the Foundation. However, the Foundation believed that instead of relying on small donations from ordinary individuals, it needed "big gifts to power the [project] early" as expanding the network required paying for equipment costs upfront, according to a director at the Foundation. Its outreach strategy paid off when Driscoll, a locally based major agricultural company, and other major donors tied to Silicon Valley contributed $500,000 to EASC (Heuer 2023; Hackett 2022). The money became the seed grant for a demonstration project in Buena Vista Migrant Center and ensured some families can get up to 2 years of free broadband and others at a discounted rate (Heuer 2023; Monroy 2021). The local Rotary Club and individual community members also chipped in to help connect underserved and unserved communities.

The Foundation also helped coordinate media outreach that further boosted donations to the project. The narrative of helping rural and underprivileged students gain Internet access and facilitate their education really struck a nerve in the broader Santa Cruz community. A Foundation director says that "people that have always been passionate about giving to kids and education just saw this as something they really wanted to be a part of, trying to help close this [broadband] gap." Reflecting on the success of the donation campaign, the director continues,

> [Many donors] had kids, they had grandkids, they knew how hard it was for any kid during remote learning. And to know that some kids didn't have a device, were off the map, that opened up a lot of checkbooks. And that gave [EASC] the flexibility to focus on places where the need was greatest, rather than maybe the lowest hanging fruit or what was technically already very easy to do, but just needed money. We really dug in and said, let's try and help those that have the most at stake here of falling behind.

"The Community Foundation and the philanthropic efforts that they made to fund the whole thing…gave Cruzio the ability to have the seed capital that allowed [it] to build into those areas that would never make sense from a purely business perspective," says the Cruzio executive.

Cruzio translated the partnerships and its experience working in the area into timely completion of fast broadband services for students and county residents. When asked about why the company opted for wireless technology as opposed to fiber-to-the-premise, the executive at Cruzio stated that "there's nothing like fixed wireless for speed of deployment and bang for your buck." Using the Terragraph technology developed by Facebook, Cruzio was able to guarantee homes in the service catchment area 100Mbps symmetrical with the possibility of expanding to full gigabit symmetrical using just wireless technologies (Hackett 2022). Additionally, Cruzio built its networks with ample redundancy in mind to ensure low latency on its networks (Hackett 2022). With EASC and the school districts' efforts, the percentage of students without connectivity has decreased from 20% pre-pandemic to around 3 to 5% (Borgen 2023).

5.3.4 An Eye for the Future

While it is common for local programs to be discontinued after initial funding runs out, EASC faces less of such risk as program and financial sustainability is built into

program design. The combination of new wireless technology that can support many users simultaneously and Cruzio's redundancy-focused network-building approach allowed EASC distribution points to offer service to both subsidized and regular consumers without degrading service quality (Hackett 2022). Qualified users pay just $15 a month or receive free Internet services and regular customers pay the market price; the service is the same for both sets of customers and there is no distinction between the two groups in Cruzio's network (Hackett 2022). Having market-rate customers help pay for some of the operating expenses of EASC serves as a "golden handcuff" to Cruzio since "there's no way [it] could close [EASC] down without having a hit on [its] business," the Cruzio executive recounts.

With the success of early EASC pilots, Santa Cruz County and nearby Monterey County pledged $500,000 and $350,000 respectively from their ARPA funds for Cruzio to construct additional EASC wireless hubs (Tovar 2022; Hackett 2022). The success and speedy implementation of the partnerships with local school districts and the Foundation served as a "shovel-ready" and proven method to expand broadband access, giving Cruzio an easier time with legislators and grant supervisors as individual donations to the EASC will inevitably dry up and grants and public-sector support will be needed to connect more isolated areas (Hackett 2022; Heuer 2023). The Cruzio executive said that EASC's earlier success "makes it much easier for folks in county government to say, 'That's something that we can fund. That's something that makes sense to us.'" He further stated that "even the most tech-phobic county supervisor can understand [how EASC works and how it will succeed] and get behind it and say okay, that sounds like good value."

The EASC project has also led to broader community synergies to address digital equity issues. The COE and school districts are looking to expand their digital literacy

training programs via family outreach and other tactics (Borgen 2023). The county is now part of a regional digital literacy partnership shiftED, which works with the California Department of Education to build a digital literacy roadmap that includes developing digital lessons for core curriculum, parent training, and evaluations (Borgen 2023; Santa Cruz County Office of Education 2022). The COE and the Foundation have also submitted a new grant request to California Public Utilities Commission to address the digital divide by providing connectivity, devices, and digital training for parents (Borgen 2023; Heuer 2023).

6. ANALYSIS OF MECHANISMS FOR BROADBAND DELIVERY

The analysis of broadband delivery mechanisms broadly follows the community resilience framework. The conjectured mechanisms that may help broadband delivery include existing community resources, development and engagement of community resources, active agents, collective and strategic action, equity, impact, and the crisis-cum-opportunity provided by the COVID-19 pandemic. Examining the cases in detail, it is found that existing community resources, by themselves, do not significantly impede broadband delivery. The development and engagement of community resources, the presence of active agents, a project's positive impact, and the opportunities provided by the pandemic served as mechanisms that enhanced broadband delivery. While collective and strategic action and equity considerations can enhance broadband delivery, nuances within the mechanisms must be analyzed carefully.

6.1 Existing Community Resources

Undoubtedly, having more community resources positively impacts broadband development. Urban and suburban areas in the U.S. have consistently been ahead of rural areas in terms of broadband penetration over the past 20 years (Vogels 2021). Low population density, which results in high cost of broadband deployment, have been cited repeatedly by ISPs as the main reason not to provide service to rural America (Ali 2021; Grubesic and Mack 2015).

However, from the case studies, it is clear that the initial lack of community resources does not have to be detrimental to broadband deployment. All three locations profiled suffer from varying degrees of low population density, persistent poverty, and rough topography. No location had the financial capital outright to expand broadband, and

none had sufficient political capital to pressure existing providers to expand or upgrade broadband access. Brownsville's attempt was criticized heavily by incumbent providers, none of which bid for the expansion project; the broadband advocate from Cherry Township described waiting in vain for service expansion from existing providers; and AT&T withdrew DSL service from Buena Vista Migrant Center in Santa Cruz County. While Santa Cruz County and St. Louis County had local ISPs with sufficient technical knowledge to expand broadband access, both locations lacked the financial capacity to realize such projects. Additionally, "sense of place" did not appear outstanding at these projects' outset. Linkages between the institutions and actors that later played major roles in pushing forward broadband projects in all three locations were far from outstanding. Yet, all three locations later developed robust broadband programs. This shows that the initial lack of community resources is not the main inhibiting factor for broadband success.

6.2 Development and Engagement of Community Resources

The development and engagement of community resources is one of the key mechanisms responsible for delivering broadband projects in all three locations.

In Brownsville, starting the broadband project first required the development and engagement of social resources. The involvement of industry experts and key local institutions created positive synergies for the project, and the city's relationship with its eventual private partner was born out of initial engagement meetings. Brownsville's project development also involved building up political capital for the project: the broadband survey conducted showed that the city's residents overwhelmingly lacked reliable and fast access, providing the city administration with clear evidence against incumbent providers'

opposition. Further, Lit's commitment to training a local broadband workforce can effectively develop the local capacity to maintain and even expand broadband networks, potentially enhancing future broadband delivery.

In St. Louis County, the development and engagement of social capital played a key role in enhancing broadband delivery. Without the local advocate's door-to-door engagement efforts, the community would not have turned up to the critical town hall meeting that eventually convinced the ISP that sufficient demand existed in Cherry Township. The community advocacy approach the county is championing also relies heavily on local residents engaging with existing social resources and developing new ones in order to generate momentum for broadband improvement.

In Santa Cruz County, EASC's success came from its development and engagement of the community's social and financial capital. All three institutions involved in the project: the ISP, the Foundation, and the COE, have all existed in the community for a long time. However, it is their collaboration and their decision to utilize each other's institutional strengths that made the project work. The development of social connections between these institutions was key. In addition, the Foundation was able to utilize the pandemic and the local media to effectively publicize the project and create empathy for the project among wealthier individuals and corporations in the community. This successful engagement of existing financial resources resulted in donations that provided the seed money to jumpstart the project.

6.3 Active Agents

As illustrated in the case studies, several key actors played important roles that led to broadband success in the three localities. These actors, as theorized in Doussard and Schrock

(2022), utilized organization and expertise to draw attention to particular issues, engaged in direct communication with people with decision-making power, and used success elsewhere to better facilitate local project implementation. Additionally, active agents in some cases even rallied financial support for the project and helped fend off opposition.

According to Doussard and Schrock (2022), the power to direct attention to particular issues can be derived by active agents in two ways: through popular organization and protests outside the system as activists, or through the utilization of data and expertise inside the system as policy entrepreneurs. Both approaches are considered here and are indeed present in the case studies. In the case of Cherry Township, actions by the community activist outside the political and administrative system rallied the town. Without the residents' enthusiastic town hall showing, ISPs may never have been convinced to expand service to the town. Later efforts in wider St. Louis County, though, illustrate the importance of policy entrepreneurs working within the system. The broadband point person for the county government and IRRRB, respectively, have gained sufficient knowledge in broadband and are actively involved in ensuring local communities as well as higher levels of government pay attention to broadband issues. Additionally, they provide invaluable support of technical knowledge to communities looking to start their broadband efforts. Brownsville's broadband success can also be traced in some form to the earlier research and advocacy work by the former Federal Reserve Bank of Dallas researcher. Throughout Brownsville's project development phase, the researcher was able to use data and expertise she gained through her research to demonstrate local communities' broadband needs and connect city government with industry partners, both of which facilitated the city's eventual success.

Active agents utilized their connections with local decision-makers to advance broadband projects. In Brownsville, the researcher's working relationship with city administration eventually resulted in the partnership between Lit and the city first for the demand survey and later for the entire network construction and operation. Cherry Township's success can be partially attributed to the local advocate's close connection with the township board: he was entrusted by the board to join the local broadband coalition as he actively participates in board meetings as a concerned citizen. The advocate used the connection to reduce the board's doubt about pursuing broadband deployment. In Santa Cruz County, Cruzio's executives worked directly with education officials from the county and from the county's many school districts to hasten the rollout. Overall, active agents' ability to connect with on-the-ground decision-making officials helped advance projects.

Active agents also use innovation from elsewhere to guide local program development. In Brownsville, the researcher presented best practices for broadband development and closing the digital divide she had gathered from elsewhere to city officials and stakeholders. In Santa Cruz County, Cruzio collaborated with Facebook and utilized new Terragraph technology to deliver fast wireless connections.

Active agents can also facilitate community resources for projects and serve as advocates against opposition. In Santa Cruz County and Cherry Township respectively, active institutions and individuals helped rally sufficient financial and social resources that proved crucial to project implementation. In Brownsville, the municipal staff and project partner, supported by local knowledge and data, offered strong and convincing counterarguments against the narrative provided by national ISPs attempting to impede the city's broadband efforts.

6.4 Collective and Strategic Action

Collective and strategic actions are major reasons for the broadband success in all three locations to varying degrees. Examined here are the six aspects that facilitate collective and strategic action: preconditions of trust and good reputation, common agenda, shared measurement systems, mutually reinforcing activities, continuous communication, and backbone support organizations. Overall, mutually reinforcing activities and constant communication are present in all projects and contribute positively to collective action; preconditions of trust and common agenda are present to some degree; shared measurement systems and backbone support organizations are lacking in all cases, but their absence did not negatively affect collective action.

The importance of the precondition of trust and good reputation between actors is most noticeable in Santa Cruz County. Both the Foundation and Cruzio have existed in the region for many years and have established themselves as trustworthy organizations within the local community. The Foundation has the explicit goal of using philanthropic efforts to help various community efforts and has been involved in the local areas for decades, garnishing a good reputation from the community. Cruzio had a similarly stellar reputation. Speaking about the project, a director from the Foundation said that "if this were AT&T, [he does not] think [the project] would have worked." Explaining in detail, the director said, "Cruzio was a very well-respected local company. There's a lot of very fierce 'buy local' mentality here and support small businesses. And Cruzio has been around for 30 years. It's a lot of the same people, same family that kind of owns it. And they had a lot of trust to go off." The good community reputation of the two organizations helped establish a level of trust even in the earlier stages of the project, leading to a quick and successful fundraising

campaign that kickstarted the project. In Cherry, eventual partner CTC's reputation as a regional co-op was certainly a plus in the opinions of the local advocate. "I'm just so happy that CTC came to play — what a company they are," he said. He was pleased by CTC's status as a co-op, which contrasted greatly with his perception of CenturyLink, which he claims was "out there telling people things that aren't true" regarding its broadband deployment.

While the precondition of trust and good reputation can be important, it may not be the determining factor for the success of collective and strategic action. In Brownsville, the eventual project partner Lit Communities was a relatively new company in the broadband field. The fact that an executive was born and raised in Brownsville, according to himself, helped bring Lit to the table in earlier planning phases. The city's decision to undergo an open bidding processes for both the initial broadband survey and for network construction, and the fact that it had selected another provider for construction before the provider withdrew, however, suggest that it was willing to build trust with other partners as long as they meet certain objective standards set by the city.

In terms of common agenda, the agenda between different stakeholders in the three cases are aligned in the most important way, but some divergence remains. In Brownsville, the city's agenda of improving broadband access for its citizens aligned well with Lit's mission of engaging the community and providing community-oriented solutions to the digital divide (Gonzalez 2022). In Santa Cruz, the Foundation's mission to improve the community aligned well with Cruzio's focus on investing in the local community. The two organizations' community-focused approaches certainly align well with the county and the education institutions' mission. In St. Louis County, it is clear that the county's and regional

organizations' mission is now aligned with its rural communities in terms of increasing broadband access. These agenda alignments reduced communication barriers and led to the fast implementation of projects, particularly in Brownsville and Santa Cruz.

It is important to note here, however, that the profit motive does play a role in these broadband projects. Without internal financial data, it is impossible to determine to what extent it matters, but it is clear it is significant. In Brownsville, Lit claims that it can already offer a return that's acceptable to its investors by serving only half of the locations of the project, and it has built into its contract with the city that it will have exclusive access to the city's middle-mile network for the first 12 months after project completion, possibly in an effort to gain more customers (Gonzalez 2022). If the project progresses as planned, Lit will, as the interview suggests, be generating profit from the Brownsville project. Similarly in Santa Cruz, regular fee-paying customers are put on the same network as subsidized customers, meaning that the recent broadband expansion has the potential of extending Cruzio's service area and generating more profit. Kania and Kramer (2011, 39) observe that "differences [in agenda between organizations] are easily ignored when organizations work independently on isolated initiatives, yet these differences splinter the efforts and undermine the impact of the field as a whole." In the broadband cases, while the private stakeholders' profit motives presumably differ and perhaps even contradict the public organizations' public service agenda, such profit cannot be realized before the broadband network is completed. Therefore, the difference in agenda did not lead to project disruption; in fact, the profit motive may have hastened project progress.

Surprisingly, mutually shared systems measuring success were not a major part of any of the broadband projects, and did not appear to be a hindrance to the projects. In

Brownsville, the only shared measurements came from broadband condition surveys before the expansion project commenced. It is unknown whether there will be systems tracking broadband adoption once construction is completed. In Santa Cruz, a director from the Foundation described intent to ask the school districts to evaluate academic, attendance, and family engagement metrics for students before and after receiving broadband access and suggested that such metrics could be "powerful" in ensuring greater project sustainability. However, according to the COE, such broadband-related data is not measured and would be difficult to record. It does not appear that there exists a system in the county that continuously tracks changes in broadband adoption as a result of the project, and reports of the positive effects of broadband have remained anecdotal. Similarly in Cherry and broader St. Louis County, there is no continuous local tracking of how broadband access, adoption, and affordability have changed due to particular projects. The key reason that these broadband projects still resulted in positive outcomes may be due to the fact that the broadband accessibility prior to the projects is poor in all locations, and that there is a strong belief that these projects will offer the change needed. This strong belief, combined with anecdotal evidence from local users that accessibility has improved as projects are being implemented, may have been strong enough to indicate to all organizations that the projects are achieving the intended effect without needing to create an elaborate monitoring system.

Mutually reinforcing activities, on the other hand, can be seen throughout the three cases: each party, by doing what it is most adept at, makes other parties' job easier. In Santa Cruz, each one of the three project partners played its best role and thereby enhanced each other's actions. The ISP focused on building the network with their technical expertise, the Foundation concentrated on fundraising which sped up the initial deployment, and the

school districts used their understanding of and connections with the community to ensure qualified households and students received necessary service. The collaboration meant that no agency had to work outside its knowledge base, and everyone working within their respective fields also helped speed up deployment. In Brownsville, the city government facilitated communication with the local public utilities to smooth out potential issues regarding pole access, and the private provider, by taking full responsibility for network management and customer service, helped remediate the city's lack of capacity to operate a commercial broadband network. In Cherry Township, the community advocate's organization helped ease the provider's concern of low demand, and the ISP partner provided all the technical and customer support. Broadly in St. Louis County, technical knowledge gained by county and local officials is helping communities better plan their approaches at reduced costs.

Constant communication was also present in all three cases. In Brownsville, the city organized strategizing sessions with local stakeholders from the very beginning, and was in close contact with the project's bidders throughout the contract negotiation process. In Cherry Township, the ISP was responsive to the community's concerns during the construction phase as the local advocate recalled the provider responding swiftly to address a construction mishap in a resident's yard at no cost to the resident. In Santa Cruz County, the three major stakeholders involved all mentioned frequent communication especially during the earlier phase of the project as they deliberated about project detail and timeline.

Backbone support organization, meanwhile, is not present in any of the three cases. Per Kania and Kramer (2011, 40), a backbone organization requires "a dedicated staff separate from the participating organizations who can plan, manage, and support the

initiative through ongoing facilitation, technology and communications support, data collection and reporting, and handling the myriad logistical and administrative details needed for the initiative to function smoothly." In all cases, one or more of the participating organizations are directly responsible for managing the operations of the projects. No additional third-party agency was hired in any of the cases to execute support functions for the project. This lack of support organization, however, was not detrimental to any of the projects as the parties involved, both private ISPs and local government units, often had sufficient planning and management experience thanks to each organization performing mutually reinforcing activities.

6.5 Equity

Equity is present in the program design of all cases; however, concerns remain regarding how equity can be maintained in the long run. In Brownsville, the broadband project aims to deliver fiber to all homes and businesses inside the city. Lit confirmed that it would participate in the federal ACP program and that it was "committed to working with [its] philanthropic partners and [its] foundation partners and nonprofits to essentially, whenever the time comes, if need be, to create an ACP-like program." In theory, the Brownsville project makes fast broadband accessible and affordable to everyone; in conjunction with the city's planned push for digital literacy, the project and Brownsville can make the local broadband scene significantly more equitable. However, the ACP in its present form is set to exhaust its funding in 2024 and its renewal remains unlikely due to political deadlock at the national level (Pociask and Scherer 2022; Dawson 2023). It remains to be seen how community partners in Brownsville can secure sufficient funding to ensure a local version of the ACP. In Santa Cruz County, Cruzio has built in its EASC program

structure mechanisms that will continue to guarantee qualifying households pay reduced costs after the end of ACP. However, its network operates on a smaller scale in comparison to the Brownsville project and is not universally accessible to all residents in the county. While EASC's focus on low-income communities and existing broadband deserts certainly enhances the overall equity of the local broadband landscape, it would be too early to conclude its exact impact on equity as it is uncertain how fast and sustainable the network can expand to other areas lacking access. In Cherry Township, while everyone within the boundaries of the township was connected and thereby enhancing local broadband equity, the project did not cover any areas outside the town due to grant restrictions (Borbiconi 2023). Considering the small size of Cherry Township, the overall broadband landscape in the region changed little with the project. Similarly, the broader St. Louis County lacks sufficient funding to cover the entire county with affordable, fast, and reliable broadband. While the community-by-community approach certainly helps address broadband inequality within certain political boundaries, the broader landscape remains deeply unequal.

6.6 Impact

Impact, in terms of the community resilience framework proposed by Magis (2010), represents the process of success in building resilience generating more success, or a better development trajectory for the community to ensure it is successfully guarded against future crises. In the broadband case studies, the success of the respective projects indeed generated positive impacts in the community and surrounding regions, leading to enhanced impact.

In Brownsville, the project constructs for the city a public middle-mile network. Already the city is using the project as an opportunity to explore ways to enhance digital literacy by collaborating with public and private entities to provide more digital education.

In addition, the city and other providers have the ability to leverage the city's backbone network and use wireless technologies to expand broadband access to nearby towns. In St. Louis County, the success of Cherry Township has led to more financial and technical support being provided to local governments for broadband development. In Santa Cruz County, Cruzio is already in conversation with other regional ISPs, looking to expand the tri-party model used in the county to nearby access-poor counties and towns (Hackett 2022). Cruzio and the COE and its various school districts are actively seeking and have received additional grants to support EASC and additional digital literacy projects as well. Further, Cruzio and ISPs in the region are actively monitoring California's public middle-mile broadband network buildout and exploring how to ensure it can support EASC-type projects in the region ("State of California Middle-Mile Broadband Initiative" n.d.).

6.7 COVID-19 Pandemic, Timing, and Outside Resources

"A crisis is a terrible thing to waste," the economist Paul Romer once said (Rosenthal 2009). Of all the mechanisms examined here, arguably none played a greater role than the COVID-19 pandemic in enhancing broadband delivery in the U.S. As argued in an earlier section of this thesis, the pandemic concretized, in painful ways, the devastating impacts of having inadequate broadband access and the depth of America's broadband inequality. The pandemic's exposure of broadband issues persuaded the federal government to allocate a substantial new investment via two major legislations. First, ARPA, passed in 2021, allocated $350 billion to state, territorial, local, and Tribal governments in Coronavirus State and Local Fiscal Recovery Funds, under which broadband infrastructure projects are a permissible use of funds ("Coronavirus State and Local Fiscal Recovery

Funds" n.d.). Additionally, the Infrastructure Investment and Jobs Act of 2021 provides $65 billion more in broadband funding ("Current Broadband Funding" n.d.).

The three communities profiled clearly seized the opportunity that came alongside the pandemic. In Brownsville, while the broadband project started prior to the pandemic, the pandemic significantly accelerated its effort. Seeing residents' difficulties with Internet connectivity strengthened the city's resolve to act, and the ARPA funding drastically reduced the city's funding burden. Instead of undergoing the arduous process of issuing tens of millions of dollars of new debt as planned, Brownsville used only parts of its allocated ARPA money and leveraged three times the private-sector investment. The project, fully funded, is already in progress with a projected completion date of late 2024 (Martinez 2023). Without the pandemic and the subsequent additional funding, it is likely that the project would have taken much longer to complete. In St. Louis County, the pandemic brought a sea change in the attitude local officials have towards pursuing broadband projects. Those previously skeptical of the need for broadband are now demanding broadband projects. In Santa Cruz County, the pandemic and the subsequent school closure were the impetus of the project. Without the dire need to connect students, EASC may not have reached its current scale or have been developed at all. Additionally, the pandemic made potential project donors realize the difficulties students were having trying to learn remotely, which resulted in timely and substantial donations that facilitated a faster start to EASC. The pandemic, though unfortunate in the human suffering it caused, spurred awareness and additional investment in broadband, both of which served as crucial mechanisms that eventually led to more successful broadband projects.

7. POLICY RECOMMENDATIONS AND CALL FOR ACTION

This thesis' policy recommendations broadly echo calls by Ali (2021): solutions to rural broadband deployment lie not with national providers, but at the local level empowered by coordinated policies at the federal level. As seen throughout the case studies, there exist active agents and collective actions that have successfully combined to enhance broadband provision organically at the local level even with resource constraints. Local successes, compared with the lackluster history of past and existing federal funding programs and their approach to increase broadband coverage via subsidies to large ISPs, should serve as evidence that a well-coordinated policy and funding scheme that support the various local mechanisms enhancing broadband delivery may and can work better.

For federal and state governments, the time has come to pay closer attention to various local approaches, to identify the mechanisms of success, and to encourage and support those mechanisms. A number of ideas may significantly aid local actors. Higher levels of government can collect and provide better and more accurate broadband access, affordability, and adoption data, all of which can supplement existing local resources and aid local planning efforts, reducing the local burden to prove existing service deficiencies. Federal and state governments can reestablish and further emphasize their roles in forming local broadband coalitions by using their various extension offices at the local level, such as the USDA field offices or state broadband offices. By taking charge to organize local stakeholders, higher levels of government can serve as the initial active agents that jumpstart more local collective action. Overall, federal and state governments can and should embrace local approaches and use their broad budgetary and legislative authority to eliminate barriers to local projects. ISPs that refuse to collaborate or actively hinder local action, state and

localities with strict preemption on public networks, and utilities providers charging exorbitant pole attachment fees should not receive various federal and state funding support or should have their franchising rights removed. In addition, higher levels of government should actively examine and solicit feedback from local entities about additional barriers that prevent broadband deployment and seek to address them. These additional barriers include but are not limited to right-of-way restrictions for broadband equipment, burdensome environmental review processes, unclear broadband service area maps, and complicated funding requirements disproportionately hindering smaller or less wealthy localities with less staff capacity (Brereton 2022).

While local approaches have proven successful and a focus on supporting local approaches is needed, it does not mean that localities are entirely self-sufficient. Through issuing bonds, increasing taxes, forming PPP, and various funding mechanisms, it is entirely possible for communities such as Brownsville to eventually develop and pay for better broadband services on their own over a long period of time. The existence of federal funding support, however, has significantly hastened the project timeline for all projects studied here. Federal grants allowed local governments to leverage better deals with private partners, to build on a larger scale than previously designed, and have made financially impossible projects for small and rural communities possible. Continued or even expanded funding support that specifically targets unserved and poor communities can go a long way in complementing and encouraging broadband development.

For local governments, entities, and activists, the recommendations here follow calls by Chen et al. (2022) and Faulwell et al. (2022). Additionally, as this thesis shows, initial resource constraints are not necessarily inherent barriers to broadband development. Local

activists, partnerships, and coordinated action can combine to meaningfully improve local broadband. Local governments, other entities, and individuals wishing to encourage action in the broadband space should actively seek out partnerships and explore connections with various community stakeholders. In addition, there are strong advantages in acting now as there is sufficient money in the broadband space thanks to various new funding provided by the Biden administration via ARPA and IIJA.

8. CONCLUSION

The digital transformation in the past 20 years has made broadband a necessity for modern living as our lives now depend on the Internet — the COVID-19 pandemic made this point painfully obvious. However, the existing broadband landscape in the U.S. is a landscape of inequality marred by market and policy failures, leaving the most vulnerable population in remote and low-income areas without reliable and cheap access to broadband. Facing these challenges, communities around the U.S. have taken matters into their own hands and started to act to improve local broadband infrastructure. Through case studies of three communities from Texas, Minnesota, and California, this thesis finds that the development and engagement of community resources, the presence of active agents, a project's positive impact, and the opportunities created by the pandemic are mechanisms that positively enhanced broadband delivery in underserved and unserved communities. Further, this research finds that the initial lack of community resources does not have to be detrimental to broadband infrastructure delivery as long as community actors collaborate to promote collective impact. The effect of equity considerations requires further observation.

While this research helps shed some light on how local action can enhance broadband delivery, it is by no means comprehensive. Communities of all forms and kinds have special circumstances, and each abides by different sets of laws set by the various states and municipalities. Mechanisms highlighted here may not be applicable to other localities outside the jurisdiction of the three states. Additional research is needed to more fully understand the connection between the various mechanisms and broadband delivery. Does funding or community action matter more in terms of realizing a project? How much do property ownership, rights of way access, pole attachment fees, and environmental

review truly affect project delivery, and how do communities address these issues? What are mechanisms that can ensure long-lasting commitment to equity and affordability? Are mechanisms identified here in broadband generalizable to the delivery of other infrastructure systems that require renewal, such as water and power distribution? These are questions beyond the scope of this thesis but require scholarly attention as the next generation of infrastructure takes shape.

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