Community Fiber Broadband in North Carolina:
A Comparative Analysis

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4/17/2020

Abstract

Private companies are generally viewed as the standard and most efficient providers of high-tech networked services such as broadband. When and under what conditions may other institutions provide these services equally effectively? In particular, what are the conditions under which the public provision of broadband is a viable option for communities? This paper provides a comparative analysis of different models of public and community-owned fiber broadband in North Carolina. I argue that public broadband initiatives, whether provided by a municipality or another community-owned agency, can serve important equity goals aimed at providing, supporting, and accelerating high-speed internet connections in underserved places where private providers are reluctant to provide adequate and affordable broadband. However, equity goals do not automatically presuppose that municipalities, often seen as generalists and notoriously under-resourced in terms of funding and staff, may efficiently and successfully deliver a technically sophisticated service such as broadband. This paper analyzes three case studies of community-owned fiber broadband networks in North Carolina to distill key lessons about the conditions under which public actors succeeded in efficiently providing broadband to their jurisdictions. I find that five significant themes cut across cases of successful public or community broadband in North Carolina. These include: (i) the presence of persistent local market failures that triggered the entry of the public sector into broadband provision in the first place, (ii) prior involvement in other networked services, such as electric and telephone services, on to which fiber broadband would be layered, (iii) the presence of skilled, technically adept administrators on the staff of the municipality in leadership roles, (iv) the presence and recognition of regional market opportunities, as well as the ability to leverage them, and (v) the presence of clear accountability and performance pressures, as well as measures of reciprocity in design, implementation, and management of the service. Results indicate that public actors may successfully undertake broadband initiatives when the proper conditions are present. This paper provides insights for future community broadband efforts, especially in smaller communities with limited market ranges, and offers important takeaways for policy and practice.

Acknowledgements

I would like to thank Dr. Meenu Tewari for the invaluable support and guidance in the development of this paper, and my wife, Becky Godfrey, for her love and care throughout. In addition, thank you to interviewees Will Aycock, Darren Smith, Brittany Smith, and Greg Coltrain for their insights to this paper.

1. Introduction

In the twenty-first century, fast and reliable internet services are critically important for business, commerce, trade, education, and communication of all kinds for communities everywhere. The term “broadband” is defined by the Federal Communications Commission (FCC) as internet speed associated with at least 25 Megabits Per Second (Mbps) download and 3 Mbps upload, but “broadband” is also generally used as shorthand for good, modern internet access (Trostle et al 2019). Broadband is an essential component of many aspects of modern life and work, and access to reliable, high-speed internet service has continued to grow for citizens, governments, and businesses everywhere. Functioning internet systems today are fundamental to the social wellbeing and economic competitiveness of businesses, communities, and regions (Roetter, 2013).

With the dramatic rise in the use of the internet and its social and economic significance, many local governments have begun to take a greater interest in the availability of this infrastructure and resource to their communities. In recent years, often in response to local market failures of inadequate internet service from private providers, we see evidence of some American municipalities or communities becoming involved themselves in building and/or operating broadband networks (Trostle and Mitchell, 2016). This study examines when and under what conditions the public sector can efficiently provide broadband for the benefit of its community and region, and the viability of such non-private models.

In the last decade, the rise of community-owned broadband has also led to significant political pushback against public broadband models (Trostle and Mitchell, 2016). In North Carolina, the state legislature has sought to prohibit the public sector from involving themselves in broadband initiatives. Citing concerns over public interference in private markets, North Carolina’s government adopted strict regulations to limit municipal broadband efforts in the state

(Hoback 2016). The legal and political contention over community broadband in North Carolina has become an epicenter of a larger nationwide contest between private telecommunications companies and public entities. The outcomes of this debate will thus have wider national ramifications.

Today, North Carolina's regulatory environment for public involvement in broadband is shifting again. As high-speed internet continues to grow in importance, many of the state's communities are still being left behind without quality broadband access. This "digital divide" frequently persists in rural communities and is increasingly associated with economic isolation. Without home internet, for example, unemployed people cannot apply to jobs online and are less likely to subsequently report having jobs (Talbot, 2016). Thus, persistent internet market failures and the pressing need for an essential service has bolstered support for community broadband across the political spectrum. A bipartisan bill in the North Carolina state legislature seeks to enable more public involvement in broadband, and is currently under consideration in committee. This bill, the FIBER NC Act, would relax restrictions to enable North Carolina municipalities to form public-private partnerships for supporting and accelerating fiber broadband services. At the national level, during the 2020 Democratic primary several leading Presidential candidates called for significant federal investment in broadband infrastructure via community-owned networks. Senator Bernie Sanders (D-VT) has called for "High-Speed Internet for All" by investing $150 billion through Green New Deal infrastructure grants and technical assistance for the creation and expansion of publicly-owned broadband networks. In North Carolina, the legal and financial landscape of community broadband continues to shift, and may change significantly in the near future.

Perhaps most significantly, recent events surrounding the COVID-19 pandemic have powerfully demonstrated the essential need for reliable high-speed internet. During the course of writing this paper, the virus emerged as a global public health crisis. This ongoing and

devastating pandemic, which has led to the self-isolation of hundreds of millions of Americans in their homes, has shown that residential broadband access is a critically necessary service. At this moment, billions of people around the world are relying upon their residential internet services to perform many of life's core activities from home: work, education, communication, purchasing delivered goods, and accessing resources such as telemedicine and faith-based services. As a result, the equity issues of home internet access have never been starker. For example, right now millions of students in the United States are unable to attend class or complete homework because they lack home internet (Dunne, 2020). If public education is a universal right for all Americans and a public good, then now so too is home internet. The COVID-19 pandemic has proven the urgency of delivering universal broadband (Dunne, 2020). Now more than ever, high-speed internet may be seen as critical for communities' economic and social resilience in the face of current and future public health crises.

As a result of this confluence of events, North Carolina is now poised at the cusp of a period where there will once again be experimentation in community broadband. In today's high-tech, post-pandemic world, local governments in North Carolina will increasingly seek ways to ensure and/or provide reliable high-speed internet for their communities. Many models of community broadband have proven successful across the state. It is timely and important to explore the successes of public broadband services to aid in the development of internet policy and practice. This paper examines some of the existing models of public and community broadband to inform future community efforts in this direction, and to offer lessons for what worked and under what conditions.

1.1. Context and Research Questions

Although the internet is often conceived of as an abstract, virtual world—in reality, the web of the internet is spatially manifested in many miles of physical copper and fiber cables.

The ability to access modern, high-speed internet is largely dependent upon the backbone infrastructure of cables running along connected electrical lines, pipes, and easements. These cables form the broadband network, which connects subscribers to a centralized internet service provider (ISP) offering phone, television, and internet services. In the United States, broadband networks are traditionally owned and operated by private Internet Service Provider (ISP) telecommunications companies.

New telecommunications technologies have played an important role in the evolution of community broadband. The mid-2000s saw the rise of fiber-optics cables as state of the art, "future proof" network infrastructure for the age of the internet. Traditionally, and up until the 2000s, broadband networks were formed by copper wire cables which offered limited connection speeds and bandwidths. But fiber cables, which transmit light signals, offer vastly greater capacities for high-speed internet connections. By the late 2000s, the costs associated with fiber infrastructure started to come down significantly and this vanguard infrastructure became more affordable. As fiber quickly became commercially viable, companies started to offer high-speed Fiber-To-The-Home (FTTH) services to residences and businesses. But despite fiber's growth, many underserved rural communities remained with limited to no access to quality, affordable broadband internet (Trostle and Mitchell, 2016). Frequently, this "digital divide" persists in rural or suburban communities with insufficient cable infrastructure to serve the residents, businesses, and governments in the area. Today, it has been estimated that up to one third of rural Americans (42 million people) lack wired broadband at home (Perrin, 2019; Busby et al, 2020).

In response to these deficits, different communities have pursued varying models and degrees of public sector involvement in broadband. In some cases, municipalities have unilaterally built broadband networks and stepped in as commercial ISPs. In other cases, telephone and electric cooperatives have sought to expand broadband services in rural parts of

North Carolina. The confluence of fiber's growing economic and technical viability and the persistence of broadband market failures created an opening for public initiatives. In North Carolina, cities, towns, counties, and cooperatives have framed community fiber projects as necessary investments for the provision of an essential service. High-speed internet, these communities argue, is a public good. Therefore, the public sector has a role to play. What were the outcomes of the public sector stepping in to provide this service that had hitherto been provided by private telecommunication companies? What prompts this public action, when does the public sector step in, and what are the conditions that have fueled the success of community broadband efforts?

1.2. Methodology

I answer the above questions through comparative analytical case studies of three community broadband initiatives in North Carolina. The primary case anchoring the paper is the story of the City of Wilson and the Greenlight Community Broadband Network. In addition, I examine the cases of Holly Springs and Wilkes Telephone Membership Corporation. All three cases represent different models of successful community broadband efforts. After detailing the case studies, I draw cross-cutting themes to generate insights about different factors that may explain their success. Critical analysis is used to distill lessons from the contexts of the cases. The project direction and methodology were shaped by an analytical literature review. Key informant interviews, policy documents, and relevant literature informed the critical analysis of each case.

The rest of the paper is organized as follows. In Section 2 I provide an analytical literature review of research on community broadband. Second 3 examines the case study of the City of Wilson's Greenlight Network. Second 4 examines the public-private partnership in the Town of Holly Springs, and Section 5 studies the case of RiverStreet Networks, a subsidiary

of the Wilkes Telephone Membership Corporation cooperative. In Section 6, I offer comparative analysis of the cases and draw lessons for planners. Section 7 concludes with implications for planners, policy makers, and practitioners.

2. Analytical Literature Review

I organize the relevant literature in three broad categories for the purposes of this paper: 1) *The Digital Divide Debates*: studies seeking to understand the state of broadband accessibility, 2) *Economic Impacts*: studies identifying and quantifying the economic effects of municipal broadband, 3) *Planning, Policy, and Implementation*: studies, analyses and evaluations of the development and implementation of municipal broadband networks. Collectively, these strands of the literature will inform the background, direction, and methodology of my research. In particular, the literature surrounding municipal broadband policy, planning, and implementation will inform the methodology for evaluating North Carolina's models of municipal broadband. Some of the studies reviewed use interdisciplinary methods, and may fall within more than one of the categories.

Table 2.1: The three themes in the relevant literature:

The Digital Divide	Economic Impacts	Policy, Planning, and Implementation
Quantification of broadband access	Study of job creation and market competition	Case studies
Quantification of cost barriers to consumers	Study of funding models	Analysis of best practices
Incomplete understandings	Study of financial viability	Analysis of role of public actors

2.1. The Digital Divide Debates

This body of literature focuses on defining the geographies of high-speed internet accessibility to identify which communities have access and which are most in need of additional broadband investment. Methods include quantifying the extent of broadband accessibility (spatial extent of infrastructure and services, consumer costs, etc.). These assessments could inform efforts to evaluate whether a community is suitable for municipal or community-owned broadband due to gaps in service and/or quality (and which communities stand the most to benefit).

The current condition of nationwide broadband accessibility is not fully understood. There are many gaps in the available spatial information identifying broadband service areas, and we do not fully understand which areas are adequately serviced by broadband and which areas lack high-speed internet. This is largely due to problems of missing data, as the FCC and the U.S. National Broadband Map only collect service and coverage information at census block level spatial designations (Grubesic, 2012). These granular data means that if just one household within a census block—which can sometimes be a very large area—is served with broadband network services, then the entire census block is reported as serviced—clearly undercounting real access. (Poon, 2020). Due to this data reporting, a recent study estimated that the real number of Americans lacking access to broadband is around 42 million—double the FCC's 2019 count of 21.3 million (Busby et al, 2020).

Without finer scaled data, studies have been limited in their ability to research broadband accessibility despite clear gaps in coverage. The FCC has pledged to require and provide more refined data in the future (Poon, 2020). But given the urgency of this deficit of information, many researchers have sought to identify and quantify these gaps using spatial methodologies (Busby et al, 2020; Grubesic, 2012). Despite some progress, the lack of

geographic specific information has hampered empirical evaluation and policy analysis (Grubesic 2008, 2012). Ultimately, additional spatial data and research will be necessary to more fully understand the geographic patterns of broadband service, affordability, and access in the United States.

An important subset of studies has surveyed household broadband connections on a national scale to quantify levels of access and show why private provision is not always enough. Perrin (2019) found that over one-third of rural Americans did not have a broadband internet connection at home. In addition, relatively high subscription pricing also affects consumers' ability to access quality internet (Talbot 2016). In a study of broadband pricing for rural American communities, Torng (2019) found that 146 million people in the U.S. do not have access to a low-priced plan for residential wired broadband, and that zip codes in the bottom 10% of population density pay up to 37% more on average for broadband than those in the top 10% of population density. Studies have collected surveys of affordability (prices of residential plans) and found that community-owned networks charged less and offered consistent pricing as compared to private networks (Talbot et al, 2018).

As for the consequences of the Digital Divide, grey literature and policy reports have analyzed the varied and emerging economic implications of the continued inaccessibility to high-speed internet by households, businesses, and communities (Talbot, 2017). These reports identify and assess the effects for communities without broadband network services (Crawford, 2018). For instance, Houngbonon and Liang (2017) found that for every 1 percent increase in broadband penetration, mean income rose by 0.14 percent, and that over a four year period, broadband adoption alone contributed towards 80 percent reductions in inequality. This income growth is explained by the fact that individuals used the internet to search for jobs (Crampton, 2018). Crandall et al (2007) found that for every 1 percent in a given state's broadband penetration, there was an increase of up to 0.3 percent in that state's employment rate each

year. In general, these reports demonstrate the socioeconomic significance of high-speed internet and identify equity justifications as to why communities may seek to implement different models of broadband infrastructure and networks.

2.2. Economic Impacts

This stream of the literature has examined the economic effects of municipal broadband networks, as well as their financial performance, assessing both public or semi-public investments. The empirical quantification of economic effects, from fiscal viability studies to job creation estimates, provides mixed results and divergent conclusions. Notably, many studies have shown that the deployment and adoption of municipal broadband networks has positive effects on job creation, unemployment, firm creation, and entrepreneurship (Hasbi, 2019; Holt and Jamison, 2009; Jayakar and Park, 2013). Other studies point to the benefits and stimulating effects of the increased competition provided by municipal providers in telecom markets; empirical evidence has shown that public investment in communications network increases competitive communications firm-entry by up to 63% (Ford, 2007). Yet other economic studies have had inconclusive results and may be confounded by selection bias (Ford, 2018). Still other specific case studies have concluded that for some communities municipal broadband proved to be fiscally unsound, with ratepayers subsidizing losses (Ford, 2017). While some localities have had successful community-owned networks, others have failed. In these failed models, municipalities have sought to retroactively sell off assets, lease out to private retailers, and/or end telecommunication services altogether. In many of these cases, the public actors lacked beneficial conditions, such as market growth or market capture opportunities, or suffered from detrimental conditions such as significant costs and financial risks (Ford, 2016).

Future research in this area could better evaluate other indirect economic effects which may be difficult to quantify, such as the effects of improving firm retention or fostering

innovation. While I do not seek to quantify economic impacts in my paper, these studies shed light on the conditions under which municipal broadband proves fiscally viable and economically beneficial, and when it does not.

2.3. Policy, Planning, and Implementation

There are a range of studies in this theme of research covering historical and institutional analyses of the development and implementation of municipal broadband networks. This body of work bears the most relevance for my research questions, as it provides evaluations and assessments of various municipal and community broadband models. Generally, these works are case studies of one or two municipalities, but some literature categorizes and compares different models across cases. These works also highlight implementation techniques and strategies used in their cases. Some studies examine the reasons municipalities and communities seek to create municipal and community-owned networks, and how municipal broadband is politically justified. On the whole, this body of literature strives to analyze municipal broadband in practice.

The literature comparing different models of municipal broadband frequently examines international cases, and common characteristics of successful broadband policies are distilled (Roetter, 2013). These papers demonstrate the important aspects of various models, for example, Gulati and Yates (2012) employed multiple regression analysis to show that broadband diffusion results in different outcomes depending upon the technological development of countries and communities. Other elements affecting success include the characteristics of public-private partnerships, public funding of broadband, effectively competitive markets, and the role of government intervention (Roetter, 2013). Other factors include the engagement of public utilities, the involvement of the private sector in joint infrastructure projects, the local demand for retail and wholesale services, and the institutional

and regulatory frameworks (Troulous and Maglaris, 2011). Overall, this literature concludes that the roles of government and the private sector must be complementary and the literature makes clear that municipal broadband is indeed highly contextual and variable.

Several U.S. based case studies offer lessons for public broadband initiatives. Hudson (2010) presents a case study of San Francisco's municipal wireless broadband network, examining the reasons for its failure. Hudson concludes with lessons relevant for other municipal broadband initiatives, such as avoiding market entry when there is insufficient local demand. Some of these cases also more closely examine the organization structure of successful business models, identifying the strengths and weaknesses of various models. Davidson and Santorelli (2014) found that government-owned networks were often insufficiently profitable and/or lacked the consumer base to justify the public expenditures. Instead, the authors found, public-private partnerships represented a lower cost and more viable form of community-led broadband (Davidson and Santorelli 2014).

In addition, there are several North Carolina-specific grey literature reports and plans that speak to this theme. Trostle and Mitchell (2016) call for local control of broadband networks as a remedy for connectivity problems in the state. Meanwhile, the State Broadband Plan calls for public-private partnerships as the most robust and efficient business model (Connecting North Carolina, 2017). Collectively these studies provide valuable direction towards this project's methods of researching and analyzing North Carolina's municipal broadband experiences.

In the next three sections, I turn to the three North Carolina case studies that I carried out: 1) The City of Wilson, 2) The Town of Holly Springs, and 3) RiverStreet Networks. Each case represents a unique model of successful community broadband networks.

3. Case 1: The City of Wilson's Greenlight Network

Greenlight is North Carolina's first fiber-to-the-home (FTTH) community-owned broadband network. In operation since 2008, Greenlight is a broadband utility owned and operated by the City of Wilson. It is the outcome of over 15 years of planning and designing. This gigabit high-speed network was built by the City of Wilson in the late 2000s and continues operation as an ISP under the City's authority. As of 2019, Greenlight is accessible to every home and business in the City of Wilson (population approximately 50,000) and the network serves more than 10,000 subscribing customers (City of Wilson, 2020). Since launching, Greenlight has proven profitable and its growth and deployment has expanded from the town to rural Wilson County (O'Boyle and Mitchell, 2012; Gonzalez, 2019). The network and its services have been widely praised by its citizens, businesses, and local officials (Moore, 2014). Greenlight has won several national awards and continues to draw attention in the US and around the world (Moore, 2014; Broadband Communities 2019). In the following sections, I trace the history of Greenlight, examine its origins, and analyze the conditions that contributed to the network's success. I then examine the case critically to draw out themes and lessons that might inform other municipal broadband network initiatives.

The study of the Greenlight network is important for several reasons. Most plainly, Greenlight represents a prime example of good public performance. Its success merits attention as it runs counter to traditional and popular assumptions of the government as an inefficient service provider. Where the public sector is frequently criticized as constrained, overly bureaucratic, and unwieldy, the City of Wilson demonstrates that a local government can efficiently provide highly technical and sophisticated services in a cost-effective and inclusive manner. Greenlight also establishes that a local government can successfully build and operate a broadband network while competing with private providers. In becoming an ISP, the City of Wilson created additional competition within the regional internet service market. The notion of a

public actor generating competition within a private market also runs counter to traditional assumptions of the public sector's role merely as a top-down regulator of the market and its private sector actors. In this sense, the case of Greenlight inverts expectations of the traditional roles of public and private actors. The experience of the City of Wilson in municipal broadband upends standard notions about local government's hands-off role in the provision of services and, in doing so, sheds light on the complicated, nuanced, and important practices of local governments in providing modern services like broadband internet.

Perhaps most critically, the case of Greenlight also highlights how important it is for communities to have access to high quality and affordable internet service. High-speed internet is increasingly critical to communities for competing in the modern world, and for their economic vitality and well-being. Wilson undertook considerable effort and risk to build, maintain, and operate its network. Wilson did so because it believed that the internet is an essential service and a public good, and necessary for the health and integrity of its city and region (O'Boyle and Mitchell, 2012). It is to this story that we now turn.

3.1. Origins: The Digital Divide in Wilson

The City of Wilson is a mid-sized municipality located approximately 40 miles east of Raleigh, North Carolina. Once known as "the World's Greatest Tobacco Market," the economy of Wilson declined through the latter half of the twentieth century with the fall of the tobacco and manufacturing industries (O'Boyle and Mitchell, 2012). Today the City of Wilson has a population of nearly 50,000 people. Like many rural American communities, Wilson has struggled to transition and compete in globalized markets dominated by urban centers. And like other cities, Wilson has seen many of its younger citizens leave due to a lack of local opportunities. Today, Wilson has an older population and a higher rate of poverty than North Carolina as a whole, with 1 in 4 of its residents living below the poverty line (O'Boyle and

Mitchell, 2012). As Wilson's downward trends continued into the twenty-first century, the city was looking for ways to mitigate economic decline and promote vitality.

To make matters worse, in the early 2000s, much of the city was network-underserved by incumbent private telecommunications providers. Many subscribers complained about slow-speeds, unreliable service, and high costs for telephone and cable. Within rural Wilson County, other communities entirely lacked access to broadband. Wilson City staff were regularly fielding complaints about cable price hikes, and rain storms frequently knocked out service to a recreation department building (O'Boyle and Mitchell, 2012). In this situation, the City had a distrustful relationship with its private telecommunications providers. City records from the 1990s and early-2000s detail "tense relations" with the incumbent cable franchisee (later Time Warner Cable, now Spectrum). Council minutes from February 19th, 1998 document Time Warner Cable "walking out of a meeting" over franchise renewal terms. In addition, longtime Mayor Bruce Rose voiced frustration over the incumbent provider having removed popular television channels like CNN from its basic services (O'Boyle and Mitchell, 2012).

3.2. The Lead-up to Greenlight

As a result of the perceived market failures of inadequate telecommunication services, Wilson's leadership became interested in methods of gaining control over its telecommunications. In April 2001, the City of Wilson offered to purchase the local cable network from the incumbent provider, but its offer was rejected with the company responding that it would "rather go for a zero customer base versus sell any system" (History: The Story of Greenlight, 2019). The relationship between the City and Time Warner Cable (TWC) deteriorated further in early 2004, when the City commissioned a rate-regulation consultant to analyze the company's proposed annual rate increase. The City felt that TWC's price increase was too high and unfair to citizen subscribers, who had virtually no other options to access

cable services. However, the consultant determined that TWC's price increase was not in violation of the Federal Communication Commission (FCC) rules and must be approved. City officials lamented their inability to control cable prices and services and pointed to the telecommunication industry's political power in Washington (O'Boyle and Mitchell, 2012).

The following year, in 2005, there was another disagreement over price increases. This time, the City's consultant determined that TWC's network previous upgrade fee had violated FCC rules by charging basic tier customers for upgrades that were meant for its premium tier service. With this justification, the City then rejected the upgrade fee approval request. TWC responded with a legal challenge, appealing the decision to the FCC (O'Boyle and Mitchell, 2012). Ultimately, TWC settled with the city and gave all its basic tier customers a $17 credit, returning an estimated $200,000 to residents (Wilson City Council Minutes, Sep 21, 2006).

In the first few years of the century, powerful preconditions for municipal broadband were emerging in Wilson. Longtime market failures of inadequate telecommunication services alienated citizen consumers in Wilson. When Wilson successfully intervened against TWC on behalf of the community, the city gained institutional confidence as well as political fuel from community support.

3.3. First Steps Toward Fiber: "You can be the competition!"

As Wilson continued to spar with its private providers over inadequate and expensive services, the city leadership still remained frustrated at their lack of control over network services. In response, the City council commissioned a number of consultant-led feasibility studies examining the viability of the Wilson building and operating its own municipally-owned cable network. These studies were performed in 2004 and 2005 by Uptown Services, LLC and Action Audits, LLC. The consultants recommended that Wilson could indeed build a network,

but that instead of traditional cable, the City should pursue the next-generation technology of fiber-optic cables (O'Boyle and Mitchell, 2012).

Then and today, fiber represents the future of network infrastructure technology. As the technology of light-transmitting fiber-optic cables emerged in the mid-2000s as a commercially viable infrastructure, fiber came to be known as "future-proof" because of its ability to provide orders of magnitude more bandwidth than traditional broadband cables. With its ability to accommodate nearly unlimited expansions of high-speed internet users, fiber continues to be seen by experts as an essential component of the future of internet connection. And so in the mid-2000s, Wilson's consultants encouraged the City to adopt the emerging technology of fiber and create a next-generation, municipally-owned fiber-to-the-home (FTTH) network system. As the Action Audits consultant Catherine Rice summarized, when the City Council expressed frustration over their issues with the private internet service providers, and asked "is there any way for us to encourage competition?" her team responded, "yes, *you* can be the competition!" (Hoback, 2016).

With the advice of its consultants, Wilson began taking incremental steps towards a future FTTH network. As a preliminary action, the City directed its municipally-owned electric utility, Wilson Utilities, to build a fiber "backbone" across the city connecting its own institutions and electrical substations (O'Boyle and Mitchell, 2012). Fortunately for Wilson, its electrical utility had already been operating for over a 100 years. Wilson's municipal electrical services were created by voter referendum in the 1890s when the technology of electricity was emerging as an essential part of life. At that time, Wilson was too small of a community to attract any private electrical providers. As a result, voters in 1890 overwhelmingly supported the issuance of bonds for the City to build and operate an "electrical light plant" (Electric Distribution, 2019). By the twenty-first century, Wilson Utilities was the fourth-largest municipal electric distribution system in North Carolina, serving over 100,000 people over many miles of electrical lines and

easements. This meant that Wilson Utilities had more than sufficient technical skills, administrative capacities, and budgetary resources to unilaterally string a fiber backbone along its existing electrical network.

By the end of 2005, the Wilson Utilities had successfully deployed fiber cables linking all of its municipal electrical substations in Wilson. Quickly afterwards, the fiber backbone was extended to all of Wilson's government institutions. In this way, a fiber backbone was built around the entire city, and designed in such a way that it could later be scaled-up and expanded to handle thousands of connections to residents and businesses, if necessary (O'Boyle and Mitchell, 2012).

There were no roadblocks preventing Wilson from laying fiber for its own purposes. Indeed, the City had powerful justifications for doing so for its own purposes, as its internal fiber system created high-speed connections between substations and government services. This internal fiber network improved the government's connection speed and reliability. This in turn enhanced government efficiency and service delivery. For example, the internal fiber backbone enabled improved electrical utility grid monitoring. Additionally, the city pointed to fiber as critical for public safety as well, due to the need for reliable, high-speed connections for emergency response services. In an interview, Will Aycock, general manager of the Greenlight Network, asserted that "at its core, broadband utility supports other types of infrastructure" (Aycock, interview, Oct 1, 2019).

As Wilson Utilities was constructing its fiber backbone, it began reaching out to local community and business leaders about a possible FTTH network. Wilson officials publicly emphasized that the City was building essential internet infrastructure, not just a cable network for television (O'Boyle and Mitchell, 2012). Although the business plans for a FTTH network called for offering television services to attract subscribers to generate revenues, Wilson officials

prioritized publicly framing fiber as critical for the emerging internet-reliant future of modern life and work.

Local community and business leaders were instrumental in providing support for the creation of a municipal fiber network. The presidents of Wilson's two leading educational institutions, Barton College and Wilson Community College, both wrote public letters expressing their support for the initiative. Perhaps most critically, executives at BB&T Bank determinedly lent their support to Wilson's efforts. BB&T is a large national bank that was founded in Wilson and remains a significant employer in the City. In 2006, Leon Wilson, a senior Vice President of BB&T, published a letter in the Wilson Daily Times enthusiastically supporting Wilson's goal of building its own network. The banker emphasized that "our success would not be possible without infrastructure" and that "the city of Wilson has a proven track record of sound infrastructure investments" such as its water supply, utilities, and roads. Importantly, BB&T had provided underwriting for Wilson's initial debt issue to fund the construction of its fiber backbone.

Most crucially, Wilson was able to build off its existing electrical system to "layer" a new type of infrastructure on top of it. With over a century of experience in electrical service, most of the mechanisms were already in place for cable deployment, including staff administrative and technical skills, electrical substations, utility poles, easements, etc. For City officials at this time, building a fiber network represented a unique window of opportunity to provide an emerging technology that could help the community compete in the global economy, lure and retain business, and improve residents' quality of life (Moore, 2014).

3.4. Attempting a Public-Private Partnership

With its fiber backbone in place, in 2006 the City approached both incumbent cable and telecommunication providers and asked if they would be interested in partnering to complete a

modern fiber-to-the-home network. Despite past conflicts with its private providers, the City attempted to pursue a public-private partnership while simultaneously laying its own backup plans to independently build and operate its own network. Time Warner Cable quickly declined a partnership opportunity, but the City entered negotiations with Embarq (now CenturyLink). Wilson and Embarq came to agree on a Memorandum of Understanding, with the idea that both the city and the company would benefit from a shared partnership. This public-private partnership would be based on Wilson laying fiber infrastructure cables and Embarq handling the provision of telecommunications services and navigating federal regulations. But in the end, Embarq and Wilson could not come to a final agreement and negotiations were indefinitely suspended (O'Boyle and Mitchell, 2012).

3.5. Implementation

With its initial debt service payments for its fiber backbone coming due, the City was under increasing pressure to "move quickly and get revenues flowing" (O'Boyle and Mitchell, 2012). After unsuccessfully attempting to partner with private providers, Wilson determined that it had little choice but to independently realize its goal of the creation of a citywide high-speed network. In November of 2006, the Wilson City Council unanimously voted to finance the construction of a formal FTTH network. The city opted to finance its FTTH network using Certificates of Participation (COPs), a financial instrument that is similar to a revenue bond. COPs use the network itself as collateral—thus, no taxpayer funds were used to finance the network. The COPs stipulated that taxpayers would only be liable for the debt only if the network's revenues ultimately proved insufficient to pay its costs. Wilson borrowed around $35 million up front through two rounds of COP funding in 2007 and 2008 (Aycock, interview, Oct 1, 2019). Both rounds of COPs were for a term of 15 years, with interest rates ranging from 3.25 to 5.2 percent (O'Boyle and Mitchell, 2012). The city's business plan projected that their network

would break even within 12 years and the entire debt would be repaid within 15 years (O'Boyle and Mitchell, 2012).

With the funding in place, the city moved quickly to scale-up its network. Fiber cables continued to be deployed throughout the city. By June 2008, video, voice, and internet residential services were launched under the branding of "Greenlight". By September 2008, Greenlight had subscribers in over 1,000 homes (History: The Story of Greenlight, 2019). With its existing fiber backbone, Wilson was able to relatively easily string cables from the existing lines to nearby subscribers.

Aycock explained that the first extensions of Greenlight's network branched from the existing fiber backbone (built mainly along electrical lines) to those places where shorter lengths of cable could pick up as many customers as possible. This implementation strategy and business model allowed Wilson to rapidly scale-up its operations by pursuing the "low hanging fruit," whereby many subscribers could be reached with minimal overhead infrastructure costs. With a rapid and steady influx of new subscribers and revenues, Wilson was able to confidently push forward with its network. In this manner, Wilson's scaled, iterative implementation of fiber infrastructure fueled its rapid cable deployment, programmatic growth, and financial success. Moreover, Wilson gained confidence that it could indeed achieve successful, efficient municipal broadband services.

As a public actor, the City emphasized its equity commitment to provide services to all of the city's customers who desired broadband. City officials and Greenlight staff felt that they were a "community resource" with a responsibility to deliver quality services to its citizens. Indeed, political pressures were a constant incentive for public actors in Wilson to achieve good performance. As Mayor Bruce Rose put it, "I can be fired in the next election if I don't do a good job here" (Hoback, 2016). The public sector pressures of democratic accountability motivated

Greenlight's administrators to deliver, and to visibly demonstrate their efficiency and success. In addition, the fact that Greenlight was based within the community gave subscribers greater access to Greenlight staff. This is the so-called "strangle effect", which creates a high level of organizational accountability (O'Boyle and Mitchell, 2012).

In order to build on its image as a values-driven, equity-focused provider, Greenlight's prioritized determined marketing strategies as a means of gaining subscribers and fueling political support. Even before the network could formally offer residential services, Greenlight hired a sales person to visit local businesses and explain what they had planned as next steps. To demonstrate the power of the network, Greenlight utilized a mobile trailer with three computers, TVs, and a telephone to take to local events (O'Boyle and Mitchell, 2012). The trailer would then be connected to the fiber network where citizens could demo-test Greenlight's fast connection speeds.

Another powerful marketing strategy Wilson used for Greenlight was to emphasize its "local flavor" to differentiate the network from incumbent providers (O'Boyle and Mitchell, 2012). Greenlight has consistently touted itself as "Wilson's Community Network" and reminded consumers that money spent on Greenlight stays in the community and is reinvested locally. With these creative and compelling marketing strategies, combined with the legacies of distrust and neglect that many consumers felt towards their existing private providers, Greenlight was able to quickly and effectively compete for subscribers. The internet market failures that had persisted for so long in Wilson meant the conditions were ripe for an innovative competitor to enter the market and win over disaffected consumers.

By January 2009, a year ahead of schedule, Greenlight achieved universal access for every home and business in the corporate limits of the City of Wilson (History: The Story of Greenlight, 2019). At that time, Wilson reported it had exceeded its business plan projects,

having signed on 1,840 subscribers, including 110 commercial-level subscriptions. By May 2009, Greenlight had 2,700 subscribers. By March of 2010, Greenlight had over 4,600 subscribers and continued to grow (O'Boyle and Mitchell, 2012).

3.6. Greenlight Services

With the launch of its first services in 2008, Greenlight's connection speeds were immediately higher than its competitors. In addition, Greenlight's basic tier of service was—and continues to be—competitively priced relative to the private provider (Svitavsky, 2016). In 2011, Greenlight became the first provider in North Carolina to offer residential consumers 100 Mbps service (O'Boyle and Mitchell, 2012). By 2010, Greenlight had moved outside the city to serve Wilson County schools. And by 2011, just three years after it first offered services, Greenlight's revenues exceeded its expenditures, surpassing business projections (History: The Story of Greenlight, 2019). In early 2012, Greenlight began providing 1 Gbps (gigabit per second) service to the community's largest employer, and completed a fiber ring linking all county schools, lowering their costs while increasing available speed and network reliability (History: The Story of Greenlight, 2019)(O'Boyle and Mitchell, 2012). By the summer of 2012, Greenlight became a "Point of Presence" and a Tier 1 internet provider, creating an opportunity for Wilson businesses to connect at significantly lower costs. That same year, the city setup free WiFi hotspots around Wilson's downtown, sports complex, airport, and library (History: The Story of Greenlight, 2019).

In 2013, Greenlight upgraded its residential network to gigabit capacity, making Wilson North Carolina's first "Gigabit City" (History: The Story of Greenlight, 2019). A gigabit is the equivalent of 1000 megabytes per second—an extremely fast connection which was being offered to consumers at a lower price than what some nearby communities paid for a 10 Mbps connection (Boyle & Mitchell 2012). By 2015, Greenlight was serving the community's top 10

employers, all government institutions, as well as over 7,000 businesses and residents. In addition, Wilson was selected to participate in InnovateNC, a competition sponsored by NC State University's Institute for Emerging Issues for sparking innovation (History: The Story of Greenlight, 2019). Wilson and Greenlight were honored by the then-Secretary of Housing and Urban Development, Julian Castro, for providing low-cost internet service to public housing residents as well as for its creative pre-pay subscription plan (History: The Story of Greenlight, 2019). The Greenlight network had reached maturity and was well on its way to success.

3.7. Roadblocks

In the summer of 2011, North Carolina's Republican-controlled state legislature successfully passed bill H129. This new law sought to curtail local government's abilities to become involved in network infrastructure and to compete with private providers. Large private telecommunications providers, such as TWC and AT&T, backed the legislature's efforts to stop municipal broadband in North Carolina (Mitchell, 2011). H129 inhibited the ability of municipalities to fund and own broadband infrastructure. H129 allowed the existing Greenlight Community Broadband to continue operating, but with limitations. The new law stipulated that Wilson's Greenlight service area could not extend beyond the Wilson County Line, despite the fact that Wilson's electrical service area reaches into six surrounding counties (Trostle and Mitchell, 2016; Hoback, 2016).

Wilson officials were frustrated by the legislature's preclusion of Greenlight entering new markets. Wilson felt that it was not only being denied new customers, but also being denied the ability to offer an essential public good to its underserved regional neighbors. In July of 2014, Wilson petitioned the FCC with a request for the authority to bring fiber to its rural neighboring communities outside of Wilson County. These communities included Pinetops, NC and Vick Family Farms, who were within the city's electrical service area and had requested fiber internet

service from Wilson. Seven months later, the FCC intervened nationally and preempted H129 and a similar law in Tennessee. The Obama-administration FCC Chairman, Tom Wheeler, put it plainly, “if the people, through their local government, decide they don’t like the quality of service their getting, they ought to be able to organize through their government, and say, ‘I want something better, including the government building it.’” (Hoback, 2016).

With this federal intervention, in 2015 Wilson’s City Council approved the extension of Greenlight services to Pinetops and Vick Family Farms (History: The Story of Greenlight, 2019). By 2016, Greenlight was serving rural Pinetops with gigabit fiber connections but was then abruptly ordered to turn off network services when a Sixth Circuit court decision reversed the FCC’s preemption that enabled Greenlight’s deployment outside the county. To make matters worse, this court order to cease service came at the same time that Hurricane Matthew hit the region, rendering some Pinetops residents financially insecure or even homeless (History: The Story of Greenlight, 2019).

Rather than cut off Greenlight’s network services to Pinetops, Wilson’s officials “bureaucrafted” a creative solution (Joshi and McCluskey, 2018). The regulations stipulated that Wilson could not provide internet service outside of the City *for a paid fee.* To circumvent this order, the Wilson city council decided to provide internet service at no cost to Pinetops’ residents for six months. Rather than terminate Pinetops’ service when their neighbors needed it the most, Wilson instead chose to give Pinetops free high-speed internet. This led to the City of Wilson receiving the “National Leadership Award” by the Coalition for Local Internet Choice. In 2017, the City agreed to stop-gap legislation that authorized Greenlight to continue providing service to Pinetops until a private sector provider could offer FTTH connections.

By 2018, a private provider had set up in Pinetops, but rather than disconnect Greenlight, Wilson made another creative move. Instead of “turning off” its fiber network

indefinitely, the City decided to sell its Pinetops fiber network to a third-party private provider, National Lightnet (History: The Story of Greenlight, 2019). This led to the unusual situation of Pinetops, a small rural village, suddenly having access to two different private fiber subscription services. Greenlight's entry into a rural internet service market generated competition such that Pinetops' internet access and quality rapidly and dramatically improved. This once-forgotten hamlet went from one exclusive private provider (offering low-connection speeds) to two high-speed fiber subscription options in just a few short years.

3.8. Greenlight: Growth, Successes, and Impacts

Greenlight's dramatic growth has had numerous downstream impacts for Wilson. By 2012, Greenlight had over 6,000 subscribers and a 30 percent share of the Wilson market (O'Boyle and Mitchell, 2012). Greenlight's high speed internet was rapidly fostering economic development and creating spillover economic benefits. In addition, the Greenlight network created competition within local internet markets, which in turn universally improved providers' internet quality while reducing consumer costs. The consultant Catherine Rice analyzed TWC rates for Wilson and surrounding communities. Rice found that TWC did not increase the rates it charged subscribers in Wilson in 2007 or 2008—but did increase them substantially during the same period (up to 40%) in the nearby Raleigh metropolitan region where it had no municipal competition (Rice, 2009). Rice also found that Wilson residents in 2008 were now paying less for TWC broadband than surrounding communities, while also enjoying a heightening of internet speeds that Wilson's neighbors did not see. A separate analysis found that Greenlight's competitive pressures contributed to $1 million in consumer savings each year for Wilson's TWC subscribers (O'Boyle and Mitchell, 2012). This evidence demonstrates that Greenlight's entry into the market spurred private providers to reduce consumer costs and improve service delivery.

Importantly, the counter-running market forces of competition also worked to spur Greenlight's good performance. Unlike Greenlight, which for regulatory reasons necessarily offers set pricing for its service packages, TWC can offer discounts and free additions to new subscribers as incentives to attract customers. Greenlight staff documented instances of TWC offering consumers free premium channels, cost-free DVR rental, and significantly discounted rates. These "signing bonuses" by TWC often undercut Greenlight's prices and packages. While this situation was disadvantageous for Greenlight's short-term subscriptions and revenues, ultimately this added force of competition served to put additional pressure on Greenlight to provide excellent service. Thus, Greenlight's administration was further induced to deliver reliable, affordable, high-speed internet as its only competitive advantage against alleged "predatory pricing" strategies used by TWC.

Unsurprisingly, Greenlight has contributed significantly to economic development in Wilson. As Aycock emphasized, Greenlight helps "drive efficiencies" in both the public and private sectors. Today, nearly all of Wilson's major employers are using Greenlight's services. In addition, Wilson has seen multiple firm relocations to the City—with some relocations pursued precisely because of Wilson's high-speed network. One notable example has been the film special effects firm Exodus FX, which relocated to Wilson from Los Angeles to lower costs, but also because of their business needs for greater bandwidth and reliable internet service (Moore, 2014). There has also been significant redevelopment and investment in downtown, and Wilson's corporate park continues to attract new employers. Recent investments include BB&T's new downtown facility, the expansion of the Fresinius Kabi facility, and construction of the Neopac plant (Allem, 2019).

It may also be reasonably surmised that Greenlight has helped mitigate or prevent economic losses. It is likely that some local firms and workers may have chosen to relocate away from Wilson if they had never gained access to quality, affordable, reliable internet

services. Indeed, Wilson's industrial sector remains relatively robust compared to many formerly industrial cities. And as Aycock pointed out, in the last decade Wilson has been one of the few rural North Carolina communities in its peer group to have gained population rather than lost it (Aycock, interview, Oct 1, 2019).

The City has further sought to leverage its fiber network for economic development by creating Gig East, a new technology hub in downtown Wilson. As a subsidiary of Greenlight, Gig East serves as a conference space, an incubator, and a shared co-working space. In addition, the Gig East Summit is an annual conference that brings together national leaders in business, technology, and education for discussions around innovation. Gig East also partners with RIoT (Raleigh Internet of Things), the Triangle-based advocacy group working towards Smart City efforts. By creating and operating Gig East, the city of Wilson effectively leverages its fiber network to market its internet services, foster innovation, and stimulate economic development. Wilson's entry into the creative innovation economy for the benefit of its community offers new paradigms of the role of local government in stimulating economic development.

3.9. Conditions of Success in Wilson

Many conditions contributed to the success of Wilson's Greenlight network. Greenlight's fiber deployment was made possible by existing infrastructure, easements, right-of-ways, as well as technical expertise. Most notably, Wilson's existing municipal electrical system was integral to their ability to enter the internet business. With Wilson's history of electrical services and other infrastructure, two themes emerge. First, Wilson's legacy of investment in large-scale infrastructure created the institutional confidence, administrative capacities, and public support necessary to undertake municipal broadband. Communities with a "history of providing essential infrastructure have tended to operate the most successful community broadband networks" (O'Boyle and Mitchell, 2012). In pursuing fiber, city leaders were also able to justify public

investment by pointing to Wilson's successful development of a large reservoir for water supply and recreation.

Secondly, both in the 19th and 21st centuries, Wilson's relative size created windows of opportunity for their municipal involvement in infrastructure and service provision. In the 1890s, Wilson was too small to attract private electrical providers—but it was just large enough to build and operate its own electrical service. In the 2000s, Wilson was again not large enough to attract sufficient broadband investments from private providers—but the City was just large enough and capable enough to build and operate its own broadband network. Then and today, Wilson's relative spatial size proved to be "just right" for the conditions leading to municipal investments.

As the case of Wilson also demonstrates, the sequencing of events is critical. How the story played out ultimately worked in Greenlight's favor. The city attempted every available avenue before embarking on a unilateral mission to build municipal broadband. Wilson tried again and again to work with private providers, and so when these efforts failed, the City had strong political and legal arguments to justify public sector involvement. At that time, conditions were ripe for market entry. Fiber was emerging as the new technology of internet connection. Furthermore, in the mid-2000s there were little to no regulatory constraints preventing Wilson from pursuing municipal broadband. And with private providers having created so much ill-will in the community, Greenlight was quickly able to sign-on disaffected customers. Furthermore, the internet market failures also induced the bureaucratic and technocratic leadership of Wilson to consistently and publicly support Wilson's efforts in municipal broadband. This broad base of political and institutional support catalyzed into public action when the opportunity for fiber became practically viable. Ironically, after being neglected and overlooked by service providers for so long, Wilson became the epicenter of a larger state and national political battle over municipal broadband. This "David and Goliath" dynamic of Wilson versus the telecom lobby

proved to be a powerful political fuel for city officials to proceed with municipal broadband efforts knowing they enjoyed broad local support from the community.

Throughout Greenlight's evolution, various pressures worked to enhance performance and service delivery. Intrinsically, Greenlight staff members and street-level bureaucrats were induced to high levels of performance because they were accountable to the community through the democratic process. Additionally, Wilson was able to deliver fiber in a way that not only provided excellent internet services to Greenlight subscribers, but in such a manner that it also generated competition within the market. Furthermore, the pressures of competition within the internet service market "went both ways" and universally improved Wilson's internet access, speed, and affordability. Wilson's inverted role as a co-competitor amongst a market of private firms inverts the traditional role of the public sector as a regulatory overseer of markets. In this case, Wilson was able to achieve quality internet for its citizens through market forces instead of top-down regulation.

With its tobacco and agricultural heritage, Wilson also benefited from a legacy of urban-rural cooperation with its neighbors. This informed Wilson's efforts to provide high-speed internet in Pinetops, a tremendously successful political move for the City. For Greenlight, these rural areas also represented regional market opportunities. Where demand for high-speed internet was unmet in Wilson County, Greenlight could effectively target customers and increase revenues. Today, Aycock sees Wilson as a "focal point for micropolitan smart city efforts" that is part of the larger "North Carolina technology and innovation ecosystem" (Allan 2019). He advocates for regional cooperation with the Research Triangle and the entire state for shared prosperity. Thus, Greenlight emphasizes local and regional economic cooperation and development at multiple levels. In Pinetops, the City of Wilson saw that extending Greenlight to its rural neighbor—even, for a time, at no cost—was a worthwhile investment because it would ultimately lead to a stronger regional community and economy. "None of these

accomplishments are because of Greenlight specifically," Aycock said, "but rather [because] Greenlight is a part of a team both within the City and across the broader community that all work together to build our future" (Allem, 2019).

3.10. Wilson: Conclusion

The case of Wilson's Greenlight network is a prime example of good public performance. Greenlight demonstrates that, under the right conditions, a local government can efficiently provide modern internet services and generate economic development. Wilson's success shows that even in a relatively small municipality with significant challenges and budgetary constraints, the public sector can responsibly involve itself in the delivery of highly technical services. Wilson's case also demonstrates that cities can pursue municipal broadband in a way that enhances competition within private markets. Greenlight's success upends popular notions about the public sector as an inefficient service provider.

Furthermore, the story of Greenlight offers powerful lessons about the conditions of successful municipal broadband efforts. In Wilson, a variety of existing and emergent factors contributed to Greenlight's successful implementation. Throughout its evolution, Greenlight benefitted from existing and emergent conditions. Importantly, the timing and sequencing of events and situations shaped favorable conditions that contributed to Greenlight's birth and development. First and foremost, Greenlight was layered on to the city's history of having provided electrical network services. Thus it grew from a host of historical and social legacies, longtime private market failures, and Wilson's existing infrastructure. As Greenlight evolved, the network built upon its efficient implementation strategies and deftly adapted as new conditions emerged. And of course, the business model and implementation strategies pursued by Wilson officials helped to drive Greenlight's efficient delivery of services and profitability. In this way, the

case of Greenlight may offer important lessons for other communities seeking to invest in broadband.

Greenlight also highlights how important quality internet service is for many struggling communities. With high-speed internet proving increasingly essential for modern work and life, Wilson was willing to undertake tremendous risks and costs to build and operate its own municipal broadband network. Despite significant obstacles, the city moved forward with Greenlight because it lacked other options, because it had the ability to do so, and because the city saw the internet as an essential service and public good.

Today, with H129 still essentially in place, Wilson remains one of the only wholly municipally-owned broadband utilities in North Carolina—giving the community a competitive advantage over its neighbors. Municipalities seeking to pursue broadband efforts would do well to learn from Wilson's example. If and when local internet markets fail, and the proper conditions are present, Wilson has shown that the public sector can unilaterally step in to successfully provide wholly municipally-owned internet services. Now we will turn to the case of Holly Springs, a hybrid model of community fiber in which the Town pursued a public-private partnership.

4. The Town of Holly Springs

The Town of Holly Springs provides a different model of municipal broadband in North Carolina. Holly Springs successfully pursued a public-private partnership to create a fiber network and bring FTTH services to the community. Between 2013 and 2014, the Town of Holly Springs designed, engineered, and constructed its own backbone fiber network to connect municipal facilities. Then in 2015, the Town partnered with Ting Internet, a startup private telecommunications provider, to extend high-speed fiber services to residential and commercial customers. Holly Springs leased the excess capacity in its fiber backbone to Ting, allowing the

company to quickly and efficiently build a “last mile” FTTH network for subscribers. Holly Springs’ public-private partnership in municipal fiber broadband may be categorized as a model of “Private Investment, Public Facilitation” (CTC 2017).

Holly Springs is a suburban community approximately 15 miles from downtown Raleigh and has seen rapid growth in population beginning in the 1990s. The town’s population increased from 900 in 1992 to nearly 25,000 in 2010 (Dean 2011). In 2018, the Town’s population was approximately 37,000 people (U.S. Census 2019). The majority of Holly Springs residents hold a college degree, and many residents commute to work professional jobs in the nearby Research Triangle (Town of Holly Springs 2019). Holly Springs enjoys a strong connection to major centers of commerce and creativity.

Yet around the time when the economic recession was subsiding, the community’s internet infrastructure was still lagging behind. No high-speed fiber connections were available in the local market. When, in 2014, Google Fiber announced its intention to expand into the Research Triangle metro area, the company deferred on entering many suburban markets like Holly Springs. Instead, Google chose to focus on more urbanized and centrally-located communities like Morrisville and Raleigh. Officials in Holly Springs expressed frustration at being left out of Google Fiber’s plans (Ohnesorge, 2017). In the meantime, Holly Springs was still without fiber internet for homes and businesses. The Town was looking for an effective way to attract private investment.

Around this time, Jeff Wilson, IT Director for the Town of Holly Springs, said that Holly Springs was “at a crossroads of what to do related to facility interconnectivity needs and the need for increased broadband speeds” (Reed 2017). The Town’s contract with Time Warner Cable was set to expire soon, and so the Town sought to do their “due diligence” in terms of looking at all providers, calculating costs, and reviewing options. During the process of projecting what the Town’s recurring expenses would be, town staff determined that they needed to “look at what some surrounding municipalities had already done,” which was to build

municipally-owned fiber infrastructure (Reed 2017). Officials in Holly Springs could look to the progress made in nearby Wilson as evidence of the viability of public investment.

In order to understand the feasibility of municipal broadband, the Town's IT department hired the infrastructure consulting firm Columbia Telecommunications Corporation (CTC) to provide a "very high-level" analysis of what was needed to build a network (Reed 2017). This preliminary analysis was then presented to the Holly Springs Town Council in 2013. The Council was interested in studying the topic further and approved hiring CTC to create a full business case and cost-benefit analysis. The consultants spent the next months studying the feasibility of a municipal fiber system for Holly Springs' public facilities.

CTC presented their report in June of 2013 and determined that the town had a strong case for constructing its own fiber network. The consultants found that public investment in municipal fiber would help the Holly Springs' government, its schools, and public safety. CTC claimed that by building an advanced communications infrastructure, Holly Springs would further its ability to provide government services, promote economic development, and to ensure that local broadband infrastructure evolved to meet the community's needs (CTC 2013).

Central to the consultants' recommendations were the cost-benefit findings. Municipal fiber was justified for the Town because it made financial sense. CTC concluded that a Town-owned fiber infrastructure network was "the most cost-effective approach for meeting internal Town networking needs in the long-term" (CTC 2013). The consultants found that the Town would pay approximately the same or less each quarter to build and operate the fiber than to continue leasing services from Time Warner Cable. CTC developed a preliminary engineering and financial analysis of requirements for deploying a fiber optic network to connect Town facilities and estimated the cost of construction at $1.5 million (CTC 2013).

Critically, the amount of money the Town spent on telecommunication provider services was projected to increase substantially due to bandwidth needs and bringing new facilities online (Town of Holly Springs, FAQ, 2019). The consultants framed a municipal fiber investment

as a mechanism to “mitigate the risk” that the Town’s future needs would exceed the capacity of services it could afford. Municipal fiber would help to reduce risk exposure to price increases, while offering new high-capacity connections. CTC claimed that if Holly Springs chose to continue leasing circuits, it would likely pay higher annual prices *ad infinitum*, all while being stuck with less-than-adequate connections. Importantly, CTC noted, Town-owned fiber could “be upgraded to higher capacity at no increase in recurring costs” (CTC 2017). The case for municipal fiber in Holly Springs was strong.

The CTC business case report also explicitly considered that a public fiber network could potentially be leveraged to enable a private sector partner to serve local businesses and residences. The report specifically developed recommendations for incremental strategic investments in expanding municipal broadband infrastructure as a means of incentivizing and enabling the expansion of private sector broadband offerings and competition (CTC 2017). For example, the report’s Priority 1 and Priority 2 construction plans for initial fiber deployment called for building in key locations nearby target markets of the kinds of larger businesses that are attractive subscribers for private providers.

The CTC report also emphasized other types of benefits from municipal fiber. The report frequently pointed to fiber’s benefits for public safety and emergency response efforts, echoing justifications from Wilson’s case. The business case report highlighted the need for network reliability and infrastructure redundancy in situations involving police, fire, medical, and emergency response public services. The report also articulated the long-term ancillary education and economic development benefits of high-speed fiber. Building fiber, CTC claimed, represented a long-term investment in “future-proof” infrastructure technology that may readily accommodate much higher speeds and capacities. This excess connection capacity, known as “dark fiber,” could then be leased on a non-discriminatory basis to competing private ISP providers.

CTC claimed this “dark fiber” strategy was favorable because there was virtually no risk or cost to the Town in providing excess capacity to a private partner. The dark fiber backbone infrastructure could be built at a relatively low cost, and it would then help to incentivize a private provider to partner with the Town. A private ISP could then build its own fiber network off of the municipal backbone, extending its last-mile network and providing services to nearby homes and businesses. This new private partner could, in turn, also stimulate additional competition within the local broadband market where none currently existed. Incidentally, leasing dark fiber to a partner provider could also generate modest revenue for the Town, which could be reinvested in the network. CTC recommended Holly Springs make the new fiber infrastructure available to the private sector under predefined terms. With the business case in hand, in the summer of 2013 the Holly Springs Town Council unanimously approved moving forward with a full engineering design, RFP, and build-out. The goal of the timeline for construction was to complete and operate the network by the time when the Town’s TWC subscriptions were due to expire (Reed 2017).

Holly Springs’ initial 13-mile network was completed in mid-2014 (Ohnesorge 2015). The entire network base cost approximately $1.5 million, including professional and engineering services (Town of Holly Springs, FAQ, 2019). To fund its fiber, the Holly Springs Town Council approved a 10-year loan for up to $1.5 million. The Town stated that its loan payments are roughly equivalent to what it was previously spending on private facility interconnection services (Town of Holly Springs, FAQ, 2019). However, the difference with its fiber investment is that the result of the payments will eventually be a wholly Town-owned fiber backbone network.

In October of 2015, Holly Springs announced its partnership with Toronto-based Ting Internet. Holly Springs and Ting, an agile startup telecommunications company, were a compatible fit. Though long overlooked by Google Fiber, for Holly Springs there was nonetheless interest by a smaller telecommunications company which could deliver next-generation broadband on a targeted basis (Hovis et al 2017). After negotiations, the Town

granted Ting a license to access its unused fiber and to build connected fiber lines out to homes and businesses (Ohnesorge 2015). Over the next few months, Ting deployed and prepared its own fiber infrastructure. In January of 2017, Ting held a “lighting” ceremony for the fiber and opened its first FTTH connections in Holly Springs. Ting continued expanding its fiber lines into the neighborhoods surrounding the municipal backbone. By October of 2019, Ting had completed its buildout in Holly Springs (Wlodarczyk 2020).

Ting has said that existing city networks accelerate FTTH builds, and that using municipal backbone networks allows Ting to quickly scale its fiber deployments. The Vice President of Networks for Ting Internet stated that Holly Springs’ fiber backbone was highly attractive to Ting, because it meant that the company could easily build without the initial costs and delays of constructing its own network backbone “through the middle of town” (Buckley 2017). For the historical local private providers in Holly Springs, like TWC and AT&T, ownership of large existing networks may have disinclined the companies from partnerships of diminished returns. But Jeff Wilson has claimed that for all providers, open-access dark fiber as “a way to accelerate the time to market and to simplify the builds in already congested rights of ways along our highways and streets” (Reed 2017).

In addition to investing in fiber infrastructure, the Town government also developed policies and strategies designed to attract private broadband investment (Hovis et al 2017). Holly Springs positioned itself as a good partner by offering streamlined government processes, access to information and facilities, and project facilitation and support (CTC 2017)(Hovis et al 2017). The Town’s competent and confident administration successfully demonstrated that Holly Springs was a worthwhile investment opportunity for a telecommunications company.

In addition to Ting, the ongoing excess of fiber capacity in the municipal backbone still presents opportunities for new private providers to partner with the Town. Holly Springs is a neutral provider, open to anyone in the market. This is known in the broadband industry as an Open-Access Network (OAN). The Town pledges to offer the same leasing, level of guidance,

and support to other potential partners. Indeed, officials publicly encourage new providers to enter the market and stimulate competition (Reed 2017). There is also some evidence that Ting's entry into the market has spurred legacy private competitors like CenturyLink and AT&T to expand their fiber networks and service offerings in Holly Springs and elsewhere in the Triangle (Ohnesorge 2017).

Today, Ting offers gigabit speeds to homes and businesses across Holly Springs. Ting's fiber network runs many miles throughout the town. The benefits of fiber have been seen across the community. Town operations (police, fire, public utilities, etc.) are more efficient and have reduced costs. Holly Springs also provides free wireless internet in most public gathering locations and is hugely popular (Reed 2017). And though it may still be early to account for fiber's economic development benefits, it is clear that the Town and Ting have provided local businesses, schools, and citizens with a major telecommunications asset.

Throughout the process of partnering with the Town, Ting developed a strong relationship with the government and the community. In 2017, the company announced it would be the official naming sponsor for the new Ting Park in Holly Springs. Furthermore, Ting also leveraged its presence in Holly Springs as a jumping-off point expansion into nearby communities. By 2019, Ting had entered into three nearby markets in Wake County: the towns of Fuquay-Varina, Rolesville and Wake Forest. Indeed, the Town of Fuquay-Varina, five miles from Holly Springs, pursued a similar strategy by also first investing in a municipal fiber backbone and then later partnering with Ting.

Holly Springs' close partnership with Ting is serving the community well during the COVID-19 pandemic. As an accountable, customer-oriented partner to a municipality, Ting has begun providing services above and beyond its business model in order to help Holly Springs residents. Ting has automatically upgraded all subscribers to gigabit speeds for 60 days, free of charge. In addition, Ting is offering drive-up Wi-Fi hotspots in key locations in Holly Springs. The

public-private partnership model induced Ting to look for ways to help in the communities they serve while making the safety of the community a primary concern (Moore-Crispin, 2020).

4.1. Factors that contributed to Holly Springs' Success

Several conditions contributed to the success of Holly Springs investment in municipal broadband. Factors of timing, sequencing, and context created an environment of favorable conditions for the Town's initiative. The case of Holly Springs shares many of the same types of conditions that contributed to the success of the City of Wilson's Greenlight Network. Most prominently, Holly Springs' successful investment was also sparked and driven by a local market failure. The absence of fiber infrastructure justified and enabled the Town's initiative. In both Wilson and Holly Springs, inadequate services from private providers created pressures for the public control of infrastructure. The timing of this market failure was also a window of opportunity for municipal investment. Without private options, Holly Springs was financially, legally and politically justified in unilaterally investing in its own fiber network, especially if this internal network could later be used to spur private partner investment.

Holly Springs is a good example of a public-private partnership model of municipal broadband in practice in North Carolina. By virtue of their governmental organization, both Wilson and Holly Springs were induced to high-levels of performance. Both municipalities were pressured towards high levels of performance by the "strangle effect" and the inherent processes of democratic accountability. This meant that customers with problems could more easily find a local bureaucracy to (metaphorically) "strangle," helping to improve officials' focus on serving customers (Walljasper, 2014). Furthermore, both communities saw it as part of their responsibility to serve the public, and justified their fiber initiatives by emphasizing values and by using strategic framing. Like the City of Wilson, Holly Springs' ability to frame its municipal broadband project in terms of other types of benefits and values, such as public safety and education, helped contribute to success. The two municipalities' emphases on factors like

improved government services, reduced costs, security and reliability, education, and economic development helped to justify the investment and fuel success.

Common themes of business models, organization, and strategy are present in Wilson and Holly Springs. Notably, before pursuing FTTH, both communities took an incremental first-step by investing in backbone fiber networks for internal governmental use. Both communities also had the technical skills and capacities to build and manage network services. This strategic sequencing later enabled the rapid extensions of FTTH networks. In both cases, this backbone foundation served as a jumping-off point for deploying commercial fiber to homes and businesses.

Regional market failures in high-speed internet near Holly Springs also meant larger business opportunities were present. In both Wilson and Holly Springs, the void in regional fiber services allowed both Greenlight and Ting to expand beyond their initial scope-limited projects into neighboring communities. In Wilson, Greenlight was able to quickly expand into the county and beyond, gaining subscribers and scaling-up operations. Holly Springs also proved successful because conditions were such that regional market opportunities buoyed the partnership with Ting and the deployment of FTTH services. Ting invested in Holly Springs in part because it served as a jumping-off point for their expansions into neighboring Wake County towns. In both cases, the availability of larger regional markets of customers created favorable financial and operational conditions for FTTH investments.

Other themes echo across the cases of Wilson and Holly Springs. To explore the viability of municipal broadband, both Wilson and Holly Springs first sought to learn more by soliciting the recommendations of consultants. In addition, both municipalities benefited from a “champion” leader guiding an organization with the vision and technical expertise to successfully deliver. There is also evidence that both Holly Springs and Wilson were able to stimulate competition within local broadband markets, with private providers later deploying fiber and improving services. Indeed, both communities publicly encouraged competition. Like Wilson,

Holly Springs' competition with private rivals (i.e. Google Fiber) spurred public officials to high levels of performance and delivery. Like Wilson, Holly Springs successfully generated a local FTTH market by acting as a co-competitor, not a regulator.

Some conditions contributing to Holly Springs' success were unique as compared to Wilson. The foremost contrast with Holly Springs' municipal fiber model was the relatively small geographic scale of the investment. The Town's 13-mile, $1.5 million backbone deployment was a more compact, affordable, lower-risk investment. Holly Springs itself is a jurisdiction of about 15 square miles, meaning infrastructure investments in the community were relatively modest in scope. Thus, the condition of a limited service area in a smaller geographic scope meant that project costs and roadblocks were limited for Holly Springs. The scale of the project made it financially viable, giving the Town the ability to sell the project politically.

Furthermore, unlike Wilson, Holly Springs' municipal fiber initiative was justified even without commercial FTTH services. Whereas Wilson's fiber business model necessitated capturing subscribers and revenue, Holly Springs' fiber project was viable even without FTTH. The Town's municipal fiber project had its own independent reasons and benefits, such as saved telecommunication costs and improved municipal service delivery. Holly Springs' fiber backbone made sense even if the Town proved unable to successfully attract a private partner like Ting.

Finally, Holly Springs' unique use of a public-private partnership model meant that the Town bypassed many of the risks and roadblocks that Wilson faced. Holly Springs' reliance on Ting to deploy network infrastructure and offer FTTH services meant that the Town did not need to take on considerable financial or legal risks. Critically, because Holly Springs never sought to become a commercial ISP, it never faced the lawsuits and preemptions that Wilson battled. By undertaking a limited municipal fiber deployment and partnering with Ting, Holly Springs successfully avoided the risks and roadblocks that may arise for wholly municipally-owned and operated broadband projects.

4.2. Holly Springs Conclusion

Holly Springs is an excellent example of a public-private partnership in municipal fiber in North Carolina. The Town successfully used a low-risk strategy of municipal fiber deployment to attract a private partner and rapidly induce high-quality FTTH services in their community. Simply put, the decision to invest in fiber was a practical decision for the Town of Holly Springs. Municipal fiber made sense for many reasons, and it was justified through a variety of frames.

Several conditions contributed to Holly Springs' success. Factors such as the Town's timing during a period of market failure allowed for a window of opportunity in deploying fiber technology and enabling Ting to capture market shares. The Town's incremental, compact backbone deployment was instrumental in keeping project costs down while maximizing the attractiveness of Holly Springs to private partner investment. Other inherent conditions contributed to success, such as Holly Springs' "strangle effect" accountability structure, the presence of regional market opportunities, and strong leadership from technically competent officials.

The case of Holly Springs is important because it upends and inverts traditional expectations of local government involvement. Contrary to popular notions of government as an inefficient service provider, Holly Springs is an example of good public performance in delivering an important and highly technical service. Like Wilson, Holly Springs also upends the standard role of government at a top-down bureaucratic regulator. Instead of seeking to control private companies, Holly Springs effectively served as a facilitator and competitor within local markets. Finally, Holly Springs has shown that a resource-limited local government can successfully invest in municipal fiber in a low-risk manner. In this way, Holly Springs demonstrated the viability of public-private partnerships for bringing about FTTH services in a community.

The lessons drawn from Holly Springs' experience may prove particularly relevant for the near-future of municipal broadband in North Carolina. The FIBER NC Act bill, currently under

consideration in the State General Assembly, would codify more flexible standards enabling municipalities across the state to invest in fiber through a public-private partnership model. The FIBER NC Act would create clear authority for counties and municipalities to build and lease broadband infrastructure, and it would also remove legal restrictions to allow for long-term leases. Should this bill become law, communities across North Carolina may look to Holly Springs' experience as a model of public-private partnership in fiber.

5. A Collective Model of Public Broadband: North Carolina Cooperatives

Some of North Carolina's fiber networks are also being built and operated by another form of publicly-owned broadband: cooperatives. Many of North Carolina's rural areas are served by telephone and electric cooperatives. North Carolina has 8 Telephone Membership Corporations (TMCs) and 26 Electric Membership Corporations (EMCs), These nonprofit organizations were formed in the 20th century by rural communities who were unable to access private services. Each cooperative has its own unique structure and organization, but all co-ops are based on collective ownership, with member-voters being users of its services. Cooperatives are primarily controlled by a board of directors that is elected by members. A co-op's members may inform and/or control key decisions in the organization. In the last decade, co-ops have been at the forefront of fiber deployment in rural, unincorporated areas in North Carolina. Nationally, approximately 31% of all fiber services available in rural areas are provided by cooperatives (Trostle et al, 2019). Co-ops are not specifically municipally-owned or operated--instead they represent a form of collectively-owned/community-owned broadband and operate for the benefit of members.

5.1. RiverStreet Networks

RiverStreet Networks is a prominent example of a telephone cooperative building and operating FTTH networks in North Carolina. RiverStreet Networks is the broadband business of

Wilkes Communications, Inc., a subsidiary of Wilkes Telephone Membership Corporation (WTMC). WTMC is a non-profit, cooperative corporation organized under Chapter 117 of the NC General Statutes. WTMC has provided telecommunication services in and around Wilkes County, North Carolina since 1951. WTMC's wholly-owned subsidiary, Wilkes Communications, Inc. (WCI), began offering competitive fiber broadband services in areas around WTMC's service areas in 2005 (Call and Strickland, 2019). By 2014, Wilkes Communications had completed its buildout in Wilkes County (Cramer 2019). Today, the cooperative's rebranded broadband business, RiverStreet Networks, serves residential and business customers in over 27 counties across North Carolina and Virginia (Arnason, 2017).

Wilkes County is in the foothills of the Appalachian mountains in northwest North Carolina. Wilkes County is historically predominantly rural and is not in close proximity to a major metropolitan area. This geography created conditions such that Wilkes County, like much of the state, lacked utility services well into the 20th century. After World War II, about 40% of the homes in North Carolina lacked telephone service. Many Wilkes County veterans had been exposed to the telephone during the war, and returning home they emphasized the necessity of telephone services for the wellbeing of their communities (NC Broadband Cooperative Coalition 2020). So in 1949, a group of local Wilkes County citizens petitioned the Central Telephone Company for phone service. They found themselves unsuccessful in attracting commercial telephone services because their dispersed community was not a profitable market for investor-owned telephone companies. The Wilkes community continued to seek some means of developing telephone services. Then in 1949, Congress extended the benefits of the Rural Electrification Act to telephone service and authorized TMCs. With federal and state enabling legislation, in 1951 a group of 23 people attended a meeting officially creating the Wilkes Telephone Membership Corporation cooperative (Wilkes Communications, 2020).

The cooperative's original territory in Wilkes County was a geographic "doughnut" around the center of the county, where only the twin townships of Wilkesboro and North

Wilkesboro had access to existing private telecommunications. Outside of town, the co-op offered telephone services in the more isolated rural areas. This separation of service areas extended into the broadband-era, with private telecommunications providers like CenturyLink offering broadband internet within Wilkesboro, but not outside of town.

As Wilkes County progressed into the twenty-first century, Wilkes Communications "started looking at places that needed broadband" and felt that there were "a lot of areas...left behind by some of these larger carriers" and without any clear prospect of broadband in the future (Gonzalez, 2016). In order to better serve and benefit their members, the co-op's leadership decided to enter the broadband business. To do this, WTMC created a new wholly-owned subsidiary company categorized as a CLEC, a competitive local exchange carrier. This new company, known as Wilkes Communications, allowed the co-op to formally compete with other carriers in broadband. Today, Wilkes Communications offers high-speed internet, digital television, security systems, and personal emergency response system services.

In 2009, Wilkes Communications made the decision to improve broadband services by strategically deploying fiber and offering FTTH internet. This service proved to be high demand, and the company grew quickly. Wilkes Communications continued to build its fiber network and gain subscribers. Soon the network began expanding into other counties. In just a few years, Wilkes Communications deployed a fiber network of 355 miles serving close to 3,000 customers (Keinbaum, 2019). By 2015, operating well outside of Wilkes County, it rebranded its broadband business as RiverStreet Networks (a reference to the company's home address). In the years since, RiverStreet Networks has grown tremendously and it has made its fiber network its core business strategy.

In the last three years, RiverStreet's rapid growth has led to a new stage of development for the organization. The company has seen a number of recent mergers and acquisitions, and it has expanded its fiber network across North Carolina and Virginia. In 2018 alone, the co-op both acquired and merged with other companies: In the summer, WTMC acquired Peoples

Mutual Long Distance Company, a south-central Virginia based cooperative. This was a cash transaction valued at about $21 million (Hubbard, 2018). Later in the year, WTMC merged with TriCounty Telephone Membership Corporation, another co-op serving the eastern North Carolina Counties of Washington, Beaufort, and Hyde. The merger was agreed to because of RiverStreet's ability and motivation to provide higher-quality services at a lower cost to its users. By the end of 2018 (Keinbaum, 2019), Wilkes Communications/RiverStreet Networks had doubled in size. RiverStreet continues to pursue other acquisitions around North Carolina and Virginia. These acquisitions have been spearheaded by RiverStreet's management, who has pursued the mergers and acquisitions in order to be more competitive and to gain additional revenues. RiverStreet's expansion efforts were, in part, to make them more competitive with receiving federal grants. In addition, Riverstreet has framed its expansion strategy as helping to efficiently provide an essential service to rural populations in need.

As a cooperative, Wilkes Telephone Membership Corporation is member-owned. RiverStreet's customers are members, but WTMC's traditional Wilkes-based membership holds voting power. In 2016, there were 8800 voting members (Gonzalez, 2016). At the end of each fiscal year, the co-op's profits are either paid as dividends to members or reinvested in the network (Keinbaum, 2019). As a cooperative, WTMC operates on a non-profit basis and benefits from a tax-exempt status with the Internal Revenue Service. But formally, WTMC's subsidiary company Wilkes Communications/RiverStreet operates as a for-profit enterprise. This unique organizational arrangement means RiverStreet Networks operates its business in a cooperative manner. RiverStreet, like its parent co-op, is highly focused on delivering utility services to its members within historically underserved rural communities. As explained by Greg Coltrain, Vice President Business Development for RiverSteet, the company uses the "same principles" as the cooperative because "it's in our DNA." (Mitchell, 2020).

RiverStreet is a successful model of co-op fiber broadband in North Carolina. Wilkes' version of publicly-owned broadband has been able to rapidly deploy FTTH infrastructure and

services. In recent years, the company's high-performing business model has fueled dramatic regional expansions. Today, RiverStreet Networks' 137 employees serve tens of thousands of customers across North Carolina and Virginia (Mitchell, 2020).

5.2. RiverStreet: Analysis

The case of RiverStreet Networks shares several themes with the story of Wilson's Greenlight Network. As in Wilson, several conditions contributed to the success of RiverStreet Networks. In both cases, the community's legacy of being un- or underserved created conditions of social, political, and economic support for public investment. Indeed, it was the condition of local market failure that acted as a catalyst for public utilities. In Wilson, the community's inability to attract private electric services in the late 19th century led to its forming a municipal electric utility--the case for Wilkes County is analogous. Where conditions in these rural communities led to legacies of being underserved, it fostered cultures of self-reliance. In both places, market failures stimulated the growth of social and institutional arrangements for supporting public investment.

Another theme that emerges is RiverStreet Networks' strategic use of its nonprofit status to frame their efforts. RiverStreet succeeded in part because of its ability to leverage its service-oriented, values-based approach through strategic framing. Like the City of Wilson, the conditions of RiverStreet's public service organization translated into effective marketing. Both broadband networks were able to rapidly attract customers, and to capitalize on rural markets where community ties were strong (and where sometimes there was a culture of distrust with private providers). Indeed, by being the first service provider to offer fiber in rural markets, both broadband networks reinforced their presentations as effective, user-oriented service providers. It was precisely RiverSreet's legacy in supporting underserved communities that prompted the company towards investing in fiber. Moreover, RiverStreet touts high-speed internet as an essential service and public good which improves the community and supports economic

development. RiverStreet's cooperative organization enables it to strategically frame itself and its operations as equity-driven. This framing enables RiverStreet to be highly competitive, and to successfully serve, attract, and retain customers.

Like Greenlight, RiverStreet also benefited from conditions of regional market opportunities. The absence of quality broadband in rural markets meant that both networks were the first to capitalize on unmet demand. The opportunity for rural regional expansion allowed both networks to rapidly gain customer bases and get revenues flowing. Other themes also echo across the cases of Wilson and RiverStreet. Both organizations were existing utility operators. In this way, both Wilson and WTMC had the technical expertise, the utility poles, the easements, the right-of-ways, etc. This condition was a powerful precursor for success in deploying fiber and providing internet service. Furthermore, both Wilson and RiverStreet benefitted from champions leading highly competent administrations. Moreover, both organizations succeeded, in part, because of internal and "strangle effect" accountability measures. Wilson's municipal structure and RiverStreet's voting owner-membership meant that network staff were induced to high levels of performance.

Some of the conditions that contributed to RiverStreet's success are unique to its case. In particular, RiverStreet's receiving of a number of substantial grants has directly enabled the company's fiscal viability and success. Because WTMC is a federally-designated rural cooperative, the organization is eligible for a variety of federal grants and loans (a condition that North Carolina's municipalities do not share). The co-op has received several grants through the American Recovery Act, through the United States Department of Agriculture's ReConnect rural broadband program, and through county governments. These financial resources have powerfully supported RiverStreet's operations and directly enabled their success.

WTMC's co-op status also allowed it to pursue other unique business strategies. In particular, WTMC was legally able to acquire and merge with other co-ops. This business strategy served to open new markets, increased RiverStreet's customer base and revenue

flows, and made the company more competitive for grants. In addition, WTMC's cooperative status allowed it to pursue partnerships in ways that municipalities are unable to do. A 2019 law at the North Carolina state level enabled TMCs to lease fiber assets from Electric Membership Corporations (EMCs). WTMC has taken advantage of this opportunity and is actively pursuing partnerships with EMCs. The following section introduces Electric Membership Corporations and examines an EMC partnering with WTMC to deploy fiber and bring FTTH services.

5.3. Electrical Membership Corporations

Electrical Membership Corporations are cooperatives that were formed to provide electrical services in underserved rural areas. There are 26 EMCs in North Carolina. These EMCs serve about 2.5 million North Carolinians in 93 of the state's 100 counties (NC Electric Cooperatives, 2020). In the last decade, some EMCs have sought to provide and/or initiate broadband services for their members. Various EMCs have pursued different business models. Some EMCs have themselves successfully deployed fiber networks and currently operate commercial FTTH services. In the northeastern part of North Carolina, the Roanoke Electric Cooperative has entered the fiber internet market with its own for-profit broadband subsidiary, Roanoke Connect. But most of North Carolina's EMCs have little to no experience in internet services. However, a recently adopted state law has changed how EMCs may involve themselves in initiating fiber. In May 2019, Governor Roy Cooper signed Senate Bill 310, "Electric Co-op Rural Broadband Services," which makes it easier for the state's electric cooperatives to leverage their fiber networks to form partnerships for providing broadband services in rural areas lacking high-speed internet (NC Electric 2020).The Bill made key statutory changes that removed hurdles to electric co-op participation in broadband deployment through partnerships, including the authorization of EMCs accessing federal funds, clarifying flexible lease terms with broadband partners, and limiting EMCs exposure to liability (NC Electric 2019).

In 2019, North Carolina's Electric Cooperatives (the family of organizations supporting the State's 26 EMCs) announced a statewide partnership with RiverStreet Networks to enable the expansion of high-speed internet access to unserved and underserved rural communities (NC Electric 2020). This partnership, formed in light of Bill 310, executes several pilot demonstration projects that could become models for providing broadband services using electric cooperative fiber networks (NC Electric 2020).

One EMC partnering with RiverStreet is the Piedmont Electric Membership Corporation. Located in north-central North Carolina, Piedmont EMC serves the rural areas of Orange, Alamance, Durham, Caswell, and Granville counties. Incorporated in 1939, Piedmont EMC was also formed because investor-owned utility companies could not profitably electrify rural communities. Today, Piedmont EMC serves approximately 32,000 meters (Mitchell 2020). Like other co-ops, Piedmont's mission and focus is on serving its member-owners.

Susan Cashion, Vice President of Piedmont EMC, stated that over the last several years, one of the foremost concerns voiced by their members has been the lack of broadband services. But Piedmont's core services are electrical, and not broadband, and so the EMC was unsure how to effectively support broadband efforts. Piedmont's leadership felt they needed to find a novel way to help their communities gain access to high-speed internet. In particular, Piedmont sought to "figure out how to leverage existing assets to help bridge the gap for a critical need" (Mitchell 2020).

In exploring options after Bill 310's adoption, Piedmont co-op began talks with RiverStreet Networks. The two co-ops' shared principles contributed to an organizational attraction and cohesion, and soon a formal partnership formed. Piedmont saw in RiverStreet a partner who could build a last-mile fiber network and manage ISP operations. On their end, Piedmont co-op could support RiverStreet's efforts by building and leasing EMC fiber assets. As of 2020, Piedmont EMC is currently in the process of building out its own internal fiber backbone network. This backbone serves two purposes. Firstly, it drives efficiency for the electric co-op.

Piedmont's fiber backbone will enable improved utility monitoring and reduced operational costs. Secondly, Piedmont's partnership with RiverStreet leasing the fiber backbone will support the rapid and efficient provision of FTTH services to their members.

In December of 2019, Piedmont EMC officially launched its pilot program with RiverStreet Networks. This pilot seeks to explore how RiverStreet could most effectively deploy its last mile fiber network. The pilot program has sent out communications to all of the EMC's members to survey levels of interest. The co-op partners will attempt to analyze the data to see where the most interest is. This solicitation process will help RiverStreet drive efficiencies by deploying FTTH where it makes the most sense first. By onboarding the maximum number of customers with as little cable length as possible, RiverStreet can maximize revenues while minimizing costs.

Across North Carolina, electric co-ops are successfully operating their own models of publicly-owned fiber broadband. Some EMCs, like Roanoke, have pursued fiber strategies themselves. Other EMCs are now seeking to partner with TMCs and lease fiber backbone assets. Whatever the arrangement, cooperatives will continue to be at the forefront of fiber deployment in rural parts of the state. The newly authorized cooperative partnership model may prove to be a particularly efficient means of bringing fiber to underserved rural communities in North Carolina. The emerging case of RiverStreet's pilot program with Piedmont may offer valuable insights and lessons about the conditions of success for cooperative fiber broadband partnerships.

6. Comparative Analysis Across the Cases and Lessons for Planners

Comparative analysis of the case studies reveals several thematic conditions which contributed to successful community broadband efforts. This section identifies and examines the primary conditions present across the cases. The thematic conditions of success that emerged from across the three cases are as follows:

- Market Failure - The community was inadequately served by existing private internet providers
- Historically Underserved - Strong local legacies of the inadequate provision of services and utilities
- Strong Prior Legacy of Public Investment - Strong local legacies of investing public resources in the provision of public goods — e.g. in electricity, telephone, and/or water
- Existing Utility Operator - The public actor was already involved in operating networked telephone or electrical services
- Compact Geographic Scale - The deployment of fiber was spatially limited and therefore less costly and more feasible
- Values & Framing - The public actors leveraged their values-based, nonprofit, service-oriented structures to strategically frame their efforts and compete for customers
- Consulted - Hired professional broadband consultants
- Internal Fiber First - The public actor first pursued an internal backbone fiber network to support its own operations
- Technical Skills - The public administration of broadband efforts was led by highly competent, technically skilled staff--often led by a champion official.
- Stimulated Competition - There is evidence that community broadband efforts stimulated competition with private providers within local markets
- Regional Market Opportunities - Larger market failures in rural areas throughout the region presented market opportunities for capturing customers
- Capacity to take High Level of Financial Risk - The public actors required significant loans and undertook considerable financial risks
- Accountability Performance Pressures - Community broadband actors were induced to high levels of performance through democratic accountability

- Pressure for Public Control of Infrastructure - For one or more reasons, political pressure for public control of infrastructure motivated public intervention
- Grant Eligible - The receiving of federal grants buoyed community broadband operations
- Used Partnerships - The community broadband networks partnered with other organizations to deliver fiber services

Table 6.1: Conditions of Success in Cases of NC Community Broadband

	Wilson	Holly Springs	Wilkes TMC
Market Failure	✓	✓	✓
Historically Underserved	✓		✓
Strong Prior Legacy of Public Investment	✓		✓
Existing Utility Operator	✓		✓
Compact Geographic Scale		✓	
Values & Framing	✓	✓	✓
Consulted	✓	✓	
Internal Fiber First	✓	✓	
Technical Skills	✓	✓	✓
Stimulated Competition	✓	✓	
Regional Market Opportunities	✓	✓	✓
Capacity to take High Level of Financial Risk	✓		
Accountability Performance Pressures	✓	✓	✓
Pressure for public control of infrastructure	✓	✓	
Grant Eligible			✓
Used Partnerships		✓	✓

In all cases, persistent local broadband market failures served as the primary driver for community broadband. All of the cases were rural/suburban North Carolina communities which suffered from a lack of access to high-speed broadband. These conditions of local market failures led equity-minded public agencies to step in to provide an increasingly essential service and public good. Furthermore, in both Wilson and WTMC, strong prior legacies of public investment worked in tandem to bolster community support and subscriber adoption. In addition, there was clear political pressure for public control of infrastructure in both Wilson and Holly Springs, further spurring public broadband efforts.

Another significant theme of success for the community fiber networks was the condition of prior involvement in networked services. The public ownership of infrastructure, as well as the technical experience in network technology, greatly enabled success in both Wilson and in Wilkes. In both cases, the community fiber network was able to layer onto existing assets, operations, and administrations. Though Holly Springs did not have prior involvement in networked services, this theme nonetheless represents a critical condition of success.

In all cases, highly skilled and motivated technical administrations. Public champions like Will Aycock in Wilson and Greg Coltrain in Wilkes led high-performing staff. These street-level bureaucrats were induced to high levels of performance by nature of their accountability pressures. All three cases revealed how democratically-controlled administrations are held accountable to deliver— both through the “strangle effect” and the ballot box. Furthermore, the cases highlight how public and cooperative officials within institutional cultures of equity and public service are motivated and pressured to succeed. Serving customers was inherent in each of their business practices. Indeed, for all of the three cases, the community fiber networks purposefully emphasized their values and missions to strategically frame and justify their efforts, and to quickly attract customers.

Regional market opportunities for the community fiber networks also represented a powerful and perhaps necessary condition of success. In all of the three cases, the condition of local and regional market failures represented business opportunities to capture market share. For both Greenlight and RiverStreet, the ability to expand into more nearby rural markets, and gain many more subscribers, directly supported the fiscal viability of the network. Holly Springs also successfully attracted a private provider partner because of its strategic market location. With other underserved suburban communities nearby, Holly Springs became an anchor for Ting's regional expansion. A related condition of success was the presence and creation of competition within local-regional internet service markets, which expanded fiber service and reduced consumer prices in both Wilson and Holly Springs.

Many other conditions of success were present across cases. My results point to the many different ways that varied community fiber network models have achieved success. These cases indicate that public actors may successfully provide broadband services under a variety of conditions. The precise elements of success are contextual, and therefore future planning efforts for publicly-owned broadband may learn from these different models to tailor efforts for their unique assets and their particular community needs.

7. Conclusion and Implications for Planners

Community broadband efforts have been at the forefront of fiber deployment and internet services in North Carolina, though traditionally private companies have been the standard providers of such services (TWC, AT&T, etc.). Cases of demonstrated success point to the important roles that public actors may play in providing, supporting, and accelerating fiber networks. Where market failures exist alongside other conditions, the public sector may step in to efficiently provide an essential public good. Five significant themes of conditions of success echo across the cases. Most prominently, these include: (i) persistent local broadband market

failures served as the primary catalyst for publicly-owned fiber efforts, (ii) prior involvement in networked services, (iii) the presence of highly skilled and motivated technical administrations, (iv) the presence and recognition of regional market opportunities, (v) accountability measures, performance pressures, and reciprocal incentives.

Other critical conditions of success may be found in themes such as conditions of local historical legacies of being utility-underserved—or conversely, in communities with prior legacies of public investment. Still more conditions were significant contributing elements of success, including themes such as the focus on values and framing, the use of consulting, the presence of local market competition, and the phased implementation of a fiber backbone.

Community broadband will continue to evolve in the near future. The North Carolina legislature remains in consideration of the FIBER NC Act, which would authorize public-private partnerships. At the national level, there are growing calls for federal investment in municipal fiber across the country. Perhaps most significantly, the COVID-19 pandemic has shown broadband to be an essential service and public good. It is sure that equity-focused public agencies will increasingly seek ways to ensure and/or provide reliable high-speed internet for their communities.

This paper informs future community broadband efforts and offers important takeaways and lessons for local governments seeking to invest in fiber. It has never been more important to understand the conditions under which these services may be provided in economically viable, inclusive, and efficient ways. Insights into the conditions of success enable public actors to make well-informed decisions about tailoring broadband efforts to their own communities and their own needs. Based on a community's context, different models of community broadband may prove more efficient and viable for delivering fiber. In particular, public-private partnerships, enabled by the passage of the FIBER NC Act, may represent a flexible, low-risk business model

for North Carolina's local governments to accelerate fiber services. Going forward, one thing is certain: community broadband networks will continue to play an important role in delivering high-speed fiber internet across North Carolina.

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