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2022

Broadband Development in Lexington: A Study of Access and Equity

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Recommended Citation

Sergent, Alex, "Broadband Development in Lexington: A Study of Access and Equity" (2022). *MPA/MPP/MPFM Capstone Projects*. 343.

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BROADBAND DEVELOPMENT IN LEXINGTON

A STUDY OF ACCESS AND EQUITY

ALEX SERGENT

Abstract:

Broadband equity is at the forefront of today's issues. Those that have the ability to access the internet regularly from home are given an opportunity to participate in countless social, work, and learning opportunities that those without access must forgo. It is difficult to determine where broadband infrastructure fails. Through this study of Lexington-Fayette Urban County, it was found that connection within Urban Service Boundaries is on par with national goals, while rural areas are left out. This paper contains a descriptive analysis of the overall broadband access equity of Lexington-Fayette county.

Introduction

Broadband internet has become a part of daily life for most Americans. As of 2021, 93% of US adults use the internet in some capacity and 77% of adults use broadband in their own homes (Pew Research 2021). Broadband can be described as cable or satellite provided, high speed internet. According to the Federal Communications Commission (FCC), for an internet connection to qualify as broadband, the connection must always be on, and must be considered “faster” than traditional dial-up services. There are six ways to distribute broadband: Digital subscriber line, cable modem, fiber, wireless, satellite, and broadband over power lines. While all of these are available in most places, cable modems are most prevalent in subscriber-based systems. Subscriber based systems consist of companies such as Spectrum, Windstream, or Comcast.

Fiber optics is the newer, faster counterpart to cable. Many service providers are beginning to switch to fiber, but the cost of switching can be prohibitive. In a market like Lexington’s, broadband access is predicated on having providers that will connect to your home and provide service. Many of these providers have found the high cost and fragile nature of fiber to outweigh the benefits of higher speed data transfer.

Cities across the United States have had to reckon with numerous dilemmas associated with the long-term implications of broadband use:

- Is broadband a public utility or a private service?
- How can we guarantee that broadband internet connection is available, accessible, and reasonably priced everywhere in our cities?
- How can a city use broadband to promote entrepreneurship and innovation?

These questions only scratch the surface of the complex policy issues and implications surrounding internet usage.

Some cities have chosen to make their internet service public. An excellent example of a successful public internet option is Chattanooga, Tennessee. The city of Chattanooga is one of the world's first "gigabit cities". A gigabit city is a city that has access to at least 1 gigabit download speeds within their city limits. Chattanooga has used its public broadband utilities board to provide special grants and programs to low-income families, which dramatically increases equity of access. According to Chattanooga's site on its gigabit city, "Chattanooga's community-owned electric utility EPB is installing a 100% fiber to the premises network. Built to run America's first true Smart Grid and offer residential high speed Internet, video and telephone services, the network was also built to empower our community in new ways...Because bandwidth is no problem, Chattanooga's Fiber Optic network enables upload and download speeds 200 times faster than the current national average, and 10 times faster than the FCC's National Broadband Plan (a decade ahead of schedule)." (Chattanooga Gig)

An example of a successful privatized internet option is the Google Fiber City program. The Google Fiber City Program is where mid-major to major cities across the United States are able to create a public-private partnership with Google to provide the infrastructure necessary to become a gigabit city. (Gigabit Fiber Optic Internet). The public-private nature of the Google Fiber City Program is similar to the public-private partnership between Lexington and Metronet. This option seeks to combat inequality of access by adding a high-quality competitor for low prices, driving other competitors prices down. Examples of Google Fiber Cities include Nashville, TN, Salt Lake City, UT, and Orange County, CA.

During the Covid-19 Pandemic, the United States was faced with an unprecedented decision to shut down the country. While people spent months at home during the early pandemic, the availability of broadband internet became integral to work-from-home measures that were put in place. Here in the United States and especially in Kentucky, a massive inequity was uncovered in broadband availability during the peak of the Covid-19 Pandemic.

There is a clear and well-studied divide between urban and rural broadband connectivity, but the causes of this divide are often attributed to discrepancies in development. The goal of this study will be to construct a narrative explanation of data showing the quality and cost of broadband in an urban area that is largely connected. Exploring the possibility of low distribution levels and monopolistic tendencies of ISPs in an Urban setting may give a clear picture of the broadband inequities that existing and expanding communities may face.

This piece will attempt to break down the general issues cities face when considering broadband policy and will use Lexington, Kentucky as its subject.

Policy and History of Lexington

The Lexington-Fayette Urban County Government (LFUCG) has upheld an Urban Services boundary since its inception. The Urban Service Boundary exists to promote the building of housing and urban infrastructure within city boundaries, leaving the horse farms on the exterior of the service boundary less viable as subdivisions and less susceptible to urban sprawl. LFUCG controls its own trash pickup services, but outsources its other utilities such as water to Kentucky American Water, and electricity and gas to LGE and KU. With respect to broadband as an

infrastructure piece, Lexington has allowed many companies to take up residence, the most prevalent being Charter Communications, Spectrum, AT&T, and the newest competitor, fiber-optic based Metronet.

Lexington has recently made positive policy steps towards bringing a low-cost high value competitor into the market. Metronet has invested millions of dollars to lay fiber-optic cable throughout the interior of the Lexington Urban Services boundary, most notably throughout its central and southernmost districts.

Metronet entered a public-private partnership with LFUCG in 2017 and finished in 2020. This is an example of the policy stance that LFUCG has taken, which is to encourage competition by subsidizing a major competitor. The effects of Metronet's entry into the market were likely felt immediately by many of those who were connected with high-speed internet in the downtown areas, and again during Metronet's expansion further into the Urban Service Boundary. We can see some amount of change in the addition of Windstream's gigabit service and Charter Communications' 940-megabit package, both of which were competitors that were forced to change their service in order to compete with the fiber optic speeds of Metronet.

Broadband equity is defined as equal access to high-speed internet regardless of the income makeup of a given area. This paper serves to describe the current conditions of broadband equity in Lexington, Kentucky.

Problem Statement

Are there broadband inequities based on location within a city such as Lexington? Can they be traced to low-income areas? As the internet becomes more integral to our daily lives those that are underserved are being left out.

Discussion of the Issue

*In this context Broadband refers to Internet Service Provider plans that have speeds of 25 Mbps download and 3Mbps upload.

According to a report from New America called “The Cost of Connectivity: 2020” the United States is among the most expensive places in the world to purchase broadband connectivity (Chao and Park 2020). Their reasoning behind this claim is that the US has a system in place which promotes monopoly and duopoly scenarios in most areas. Coupled with issues of monopolization are issues of dishonest pricing. Chao and Park found that after the initial contract of 1-2 years ran out monthly rates went up by \$22.25 on average. In low-income areas, this sort of price gouging is particularly detrimental. Many citizens may have to choose between access to the internet and primary living expenses. This ultimately leaves them out of many social and employment activities.

There is reason to believe that locations within cities such as Lexington were discriminated against during their development. So much reason, in fact, that Lexington created a Housing and Gentrification Subcommittee to examine the effects of discriminatory development through the history of the city. Reading the findings of this report would lead one to believe that there are many issues with the development of underserved neighborhoods within the city limits due to

redlining and Blockbusting efforts during segregation (Lexington Commission for Racial Justice and Equality Housing and Gentrification Subcommittee 2020).

Since the creation of the Federally Backed Mortgage there have been stipulations and regulations that were designed to exclude minorities, specifically, African Americans this policy was known as redlining. Redlining has been linked with increased poverty and inequality, as well as underdevelopment regarding infrastructure and social programs. An example of this is the Connect Your Community and National Digital Inclusion Alliance report on the “Digital Redlining” of underserved areas in Cleveland (Callahan 2017). This report defines digital redlining as income-based discrimination against residents of lower-income urban neighborhoods.

As of November 15th, 2021, President Biden signed the infrastructure act into law. In the infrastructure act, there is a significant portion dedicated to the advancement of broadband access and broadband equity. This initiative, along with the funds that will be dispersed by the FCC, hold the possibility of broadband infrastructure expansion for many communities. This report could serve as the basis of Lexington’s inquiry into its own equity and could help identify areas of improvement for future funding opportunities. Part of the rollout of the Infrastructure Act is to complete surveys of areas within communities that experience digital redlining. (President Biden’s Bipartisan Infrastructure Law)

Expectations

Based on a review of literature and an understanding of the nature of the private market, broadband expansion, I imagine there will be major issues of disparity in access among low-income zip codes and those that have higher income.

Description of Data

Lexington-Fayette Urban County Government has provided me with data collected in the first quarter of 2021. This dataset includes price, speed, provider, location, and many other variables that are useful. This will be the data that I use to determine speeds, location, and providers of broadband. It will also be one of the main overlays that I use to build the distribution maps on ArcGIS.

The data consists of 32 variables and has roughly 3600 individual data points. After removing the providers that served less than 50 customers, and removing incomplete surveys, the data represented 1,260 unique data points. The area divisions were based upon the Census County Divisions that are delineated by the US Census Bureau and each point was given latitude and longitude. Zip codes were used to further break down areas that were paired with areas that were dissimilar in the CCD divisions.

Census Data:

The U.S. Census Bureau will have valuable data for understanding the population of Lexington through demographics research. Data includes the percentage of houses with a computer and the percentage of houses with broadband internet. I will utilize this data in order to create the demographic basis for my analysis. With this data, I will have an idea of population, race, and age demographics, as well as the usage percentages of broadband in the area.

Most data available for the zip codes come from the 2020 5-year Estimate Data Profiles for the American Community Survey. The Census Bureau has data summaries for each of the zip code areas.

ArcGIS:

ArcGIS has a dataset that will allow me to examine redlined areas in Lexington (Lavery 2020). This data will allow me to compare the speeds and availability of Broadband throughout Lexington. This is the most important data because it will place meaning on the locations with lower broadband connectivity and speeds.

Research Design

The goal of this study is to understand the development of broadband as infrastructure in Lexington and its equity or lack thereof. Using speed and price as measures of broadband quality is imperative here because speed tests are indicative of the quality of data available. Price is used as an indicator of quality as well. Generally, price and speed relate to one another, however there could be some discrepancies in areas that are underserved and possibly overcharged.

I will be using data from early 2021 to get the most recent understanding of Broadband in Lexington. The data for the redlining is on ArcGIS so using maps and mapping software will be integral to the analysis of broadband disparities. Using mapping technology will visualize the data given by LFUCG into digestible portions and will give insight into the development of broadband in Lexington at the census county division and zip code level.

There were too few data points in the LFUCG data set to justify breaking them down into census tract points. Fortunately, the census has a wide array of data available for the city, including internet usage and broadband availability statistics that could give greater context for this study.

The problem is that historically, the development of redlined districts has been slower than other areas due to the disparate impact of inequitable mortgages on generational wealth. Infrastructure in these areas is often inadequate, in examples such as Flint, MI, and its water crisis, and can sometimes be outright destructive like the removal of low-income, minority-heavy neighborhoods for road projects and car-centric infrastructure like parking lots.

My objective is to understand whether broadband inequities have followed suit. While broadband infrastructure is not as intrusive, it can still heavily affect the development of children and families that are reliant on the internet for jobs and schooling. In the modern work environment, more and more well-paying jobs are offering hybrid and work-from-home options. If underdeveloped areas are kept from participation based solely on location and development, there could be disparate financial impacts for generations to come. The data that I am using to develop my capstone will allow me to paint a picture of the current state of broadband. This information will hopefully serve as the basis for policy regarding broadband expansion in Lexington, and in other cities that have been affected by unequal distribution of broadband infrastructure.

Analysis

In this analysis, broadband equity is based on multiple factors. The first being overall speed of broadband, the second being cost, the third being the demographic makeup of the area. These work together to create an idea of the race, income, and education of an area so our understanding of internet speed and pricing can be informed by the knowledge of how people in these areas live.

The chart below is a master chart of all Census County Divisions with their affiliated zip codes. Some Zip codes appear in multiple divisions. The most notable thing about this chart is that nearly all of the divisions are operating at or slightly above the national goal speed of 100 mbs/sec download.

<u>Census County Division</u>	<u>Zipcode</u>	<u>Data</u>		
		<u>Average of dl</u>	<u>Average of ul</u>	<u>Average of cost</u>
<u>Lexington-Fayette Central CCD</u>	<u>40502</u>	<u>103</u>	<u>73</u>	<u>\$ 81.48</u>
	<u>40503</u>	<u>106</u>	<u>44</u>	<u>\$ 73.02</u>
	<u>40504</u>	<u>96</u>	<u>49</u>	<u>\$ 71.33</u>
	<u>40505</u>	<u>117</u>	<u>33</u>	<u>\$ 74.17</u>
	<u>40507</u>	<u>96</u>	<u>21</u>	<u>\$ 66.00</u>
	<u>40508</u>	<u>106</u>	<u>63</u>	<u>\$ 65.19</u>
	<u>40511</u>	<u>103</u>	<u>42</u>	<u>\$ 75.24</u>
<u>Lexington-Fayette Central CCD Total</u>		<u>103</u>	<u>56</u>	<u>\$ 74.17</u>
<u>Lexington-Fayette Northeast CCD</u>	<u>40505</u>	<u>108</u>	<u>79</u>	<u>\$ 71.69</u>
	<u>40509</u>	<u>91</u>	<u>50</u>	<u>\$ 75.31</u>
	<u>40516</u>	<u>136</u>	<u>94</u>	<u>\$ 101.00</u>
<u>Lexington-Fayette Northeast CCD Total</u>		<u>97</u>	<u>58</u>	<u>\$ 76.45</u>

<u>Lexington-Fayette Northwest CCD</u>	<u>40505</u>	<u>84</u>	<u>54</u>	<u>\$ 115.94</u>
	<u>40511</u>	<u>95</u>	<u>53</u>	<u>\$ 86.87</u>
<u>Lexington-Fayette Northwest CCD Total</u>		<u>94</u>	<u>53</u>	<u>\$ 90.81</u>
<u>Lexington-Fayette Southeast CCD</u>	<u>40515</u>	<u>112</u>	<u>65</u>	<u>\$ 72.18</u>
	<u>40517</u>	<u>96</u>	<u>44</u>	<u>\$ 71.70</u>
<u>Lexington-Fayette Southeast CCD Total</u>		<u>105</u>	<u>55</u>	<u>\$ 71.96</u>
<u>Lexington-Fayette Southwest CCD</u>	<u>40503</u>	<u>83</u>	<u>41</u>	<u>\$ 74.00</u>
	<u>40510</u>	<u>17</u>	<u>8</u>	<u>\$ 102.67</u>
	<u>40511</u>	<u>78</u>	<u>45</u>	<u>\$ 66.32</u>
	<u>40513</u>	<u>119</u>	<u>78</u>	<u>\$ 75.16</u>
	<u>40514</u>	<u>111</u>	<u>76</u>	<u>\$ 74.46</u>
<u>Lexington-Fayette Southwest CCD Total</u>		<u>101</u>	<u>64</u>	<u>\$ 74.59</u>
<u>County Average</u>		<u>101</u>	<u>57</u>	<u>\$ 75.75</u>

Lexington-Fayette Northeast CCD

- Zip Codes: 40505, 40509, 40516
- The Northeast CCD covers the range from Bryan Station near Paris Pike to Richmond Road. The center of the CCD contains Winchester Road and the historic Liberty

Neighborhoods. This area can be characterized as a mix of old and newer Lexington development.

- This area is representative of the easternmost boundary of the Urban Services boundary and had a lower response rate to the LFUCG survey.
- Northeast CCD has a median household income of \$68,626.

Lexington-Fayette Southeast CCD

- Zip Codes: 40515, 40517
- This area stretches from the southern side of Richmond Road to Nicholasville Road. This CCD is a good mix of urban and rural areas. Old Richmond Road is an example of rural luxury homes and farms, while the interior more central portions include areas like Stoneybrook and Armstrong Mill.
- This area has a higher broadband usage rate in comparison to the others.
- The median household income of the Southeastern CCD is \$55,656.

Lexington-Fayette Southwest CCD

- Zip Codes: 40503, 40510, 40511, 40513, 40514
- The Southwestern CCD contains some of the newest suburban development on the Harrodsburg Road area, as well as some middle-aged development of single family and multi-family homes in the Clays Mill, Man O' War area. This area was heavily developed in the 1950's and 1960's, and again in the 2000's to the present. There is good uptake of broadband, but it lags its counterparts, the Central and Southeastern CCDs.
- This area has a median household income of \$87,969.

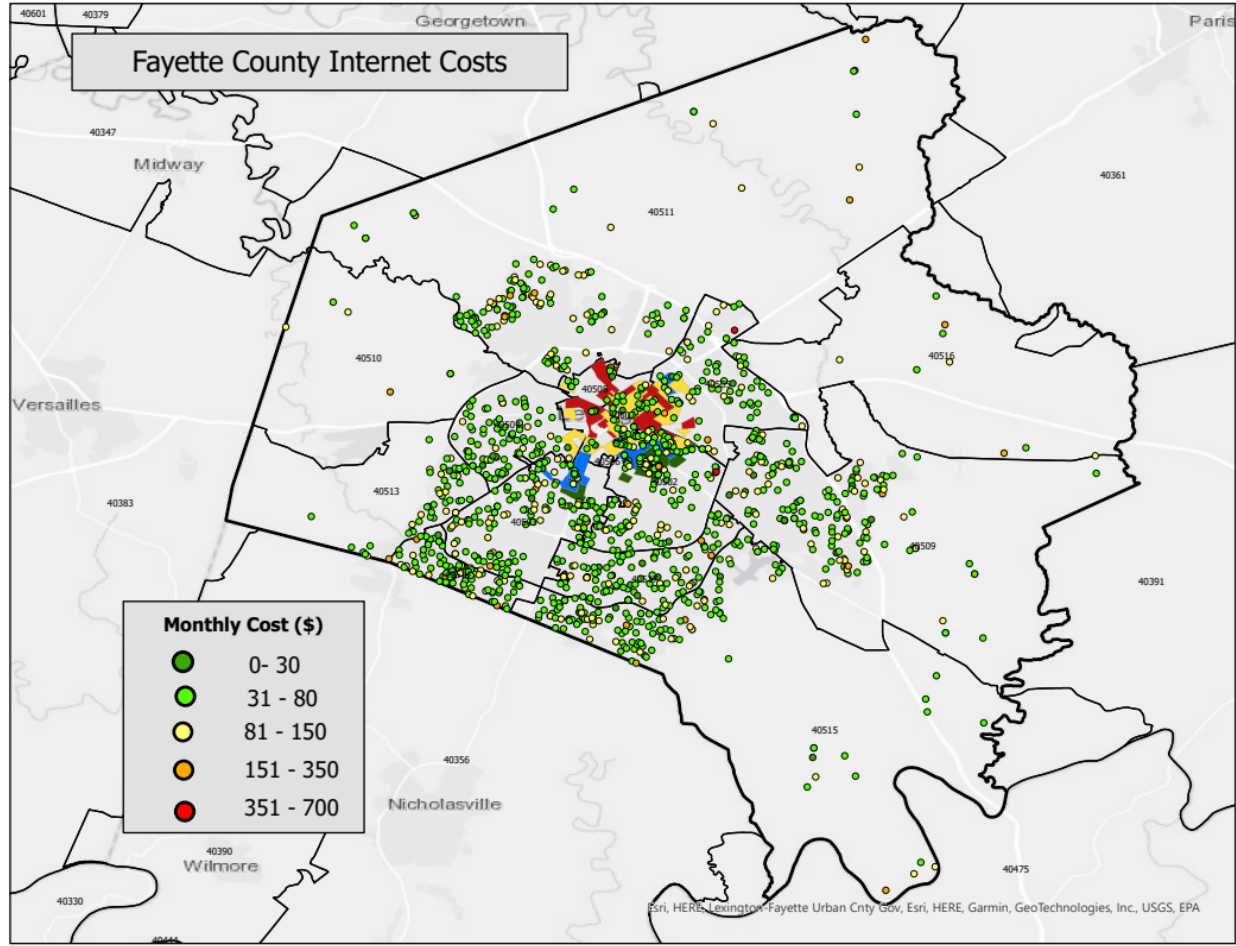
Lexington-Fayette Northwest CCD

- Zip Codes: 40505, 40511
- This area consists of Leestown Road, Iron Works Pike, and ends at Paris Pike. This area is made up of large, rural populations in the northernmost portion of the county and large minority populations closer to the city center.
- The median household income of this area is \$63,136 and has the largest spectrum of rural and non-rural areas.

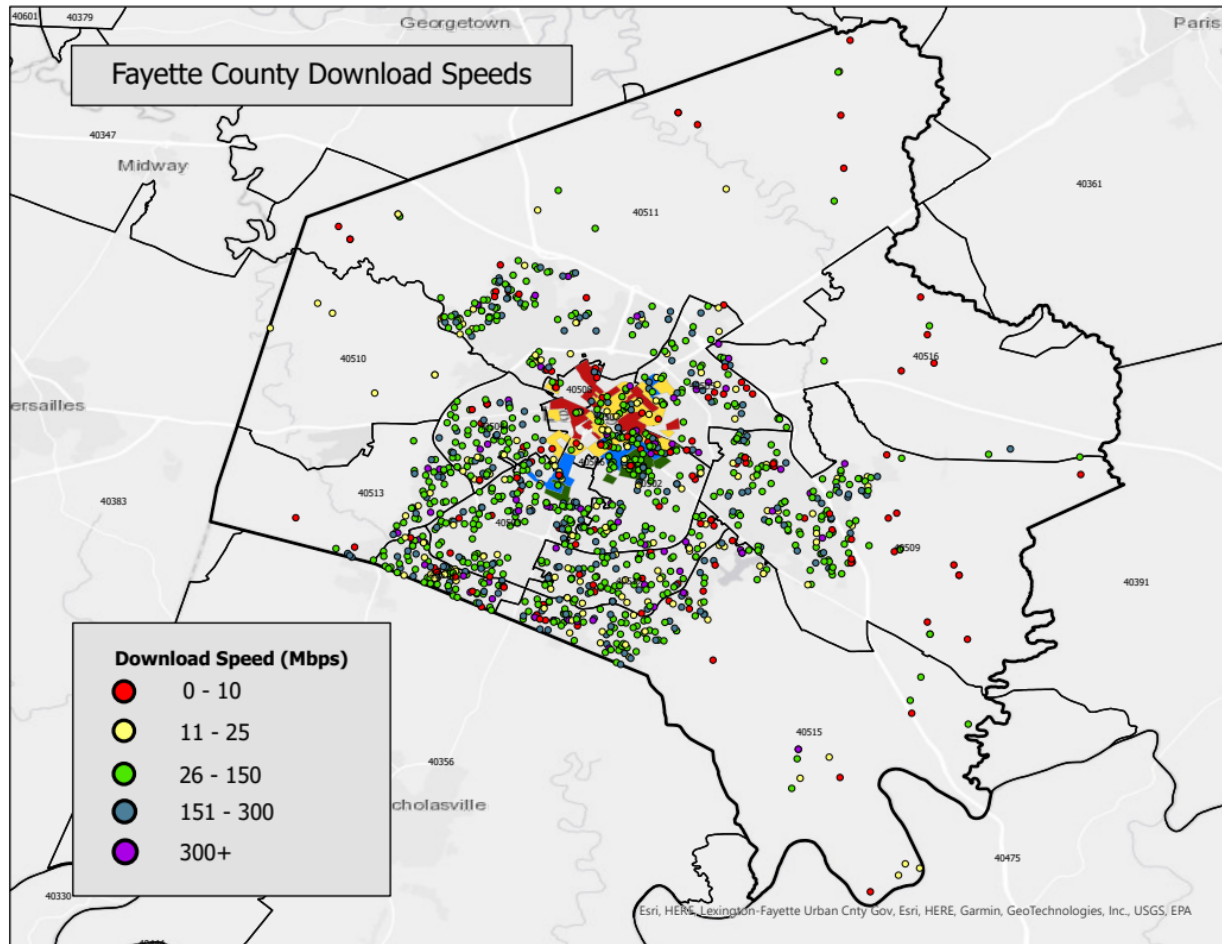
Lexington-Fayette Central CCD

- Zip Codes: 40502, 40503, 40504, 40505, 40507, 40508, 40511
- The Central CCD contains the areas that were originally redlined. These areas are representative of the core of Lexington. They include the original developments and much of the historic buildings of Lexington. This area also contains the University of Kentucky and Transylvania University, so it is home to a large population of internet users.
- The median income for this area is \$44,584.

Map Analysis



After mapping the LFUCG data, I have found that Lexington’s broadband access is equitable overall, with some areas of exception in the more rural parts of the county. After reviewing the data on the map and by way of average speeds and pricing, it is clear there are higher prices in areas with rural populations, but overall distribution of low priced internet is equally dispersed within the Urban Service Boundary.



This map also supports the well-known concept of urban-rural divide. As the second component of our definition of equity, overall speeds in Lexington are evenly dispersed among lower and higher income areas. The greatest determiners of speed are the proximity to the city center and the overall density of development in the area. Both factors support the theory that allowing the market to compete creates the most access for customers.

One of the greatest indicators of a relation to density is that there are few small clusters, most clusters are in subdivisions along major roadways and along the southern border of the county, which is where dense single-family housing is most prevalent. This leads to a large cluster along

the southernmost portion of the urban service boundary where the highest proportion of single home subdivisions are.

The proximity to the city center is less prevalent in the dataset given by LFUCG. There is more evidence of this in the heat map of Lexington, Kentucky given by the FCC, but there are still some indications that there is higher quality internet in the center of the city. Due to large concentrations of business development and housing, the city center was one of the areas served with the most broadband infrastructure during the expansion of Metronet. Subsequently, these areas have access to more providers with higher quality internet connection. Downtown is one of the only areas that has access to three groups: Metronet, Windstream, and Charter, that offer gigabit or near gigabit speeds in normal plans.

Findings

In understanding equity in Lexington, it is important to recognize there are many diverse neighborhoods within each of the Census divisions. LFUCG has done a good job serving as an intermediary with Metronet, whose large-scale fiber optic investment has caused a large decrease in overall prices and an increase in equitable service. Metronet can be in each of the CCD areas but is only within the Urban Service Boundary, making it an excellent competitor for the citizens within the boundary, but leaving the rural portions of the area without quality broadband.

There is reason to believe that the main determiner of internet usage within the Urban Service Boundary is income, as the lowest income brackets have the highest non-use of internet in their households. This is disproportionately so in the Northwestern CCD. There are many possible

factors leading to this phenomenon and upon breaking data down to the zip code level, we can see that the most likely factor is proximity to urban development. Leestown and its suburbs offer the type of dense single-home subdivisions that are most appealing to internet service providers. Even though these neighborhoods are disconnected from the dense downtown development, they are still very well served, even better served than some areas in wealthier portions of Lexington.

Upon analyzing by way of mapping and light data analysis, Lexington does fall into the average speed scores and is a little higher than cost averages, according to the Broadband Pricing Index report. LFUCG is well-connected and there is at least some service available throughout the county. There are many who would advocate for fiber to be placed throughout the county as well, but this would go against the basic truths that have been found in this paper. Broadband development relies heavily upon the profit motive of internet service providers.

According to the FCC, it is reported that Metronet offers 1 gigabit plans to much of the urban area in Fayette County. This is not very well represented in the 2021 data from LFUCG, which could indicate that low level plans or medium plans are more likely to be used than high speed plans. As was referenced in the Discussion of Issue, while it is reported that Lexington is a gigabit city, there seems to be a lack of uptake on actual gigabit plans.

Limitations

Much of LFUCG's data was incomplete. It was therefore removed from consideration.

The redlining data on ArcGIS was helpful in that it provided us with a reference point but with it being a static map layer, there were fewer ways to incorporate specific street names and census

tracts. When census tract mapping was added as a layer over the redlining data, it was very difficult to understand the points on the map.

There were not enough data points overall to make compelling narratives for the more rural areas of the county.

Future Research

A more detailed study of census tracts in relation to traditionally redlined areas with a larger data set for those areas. One of the issues that I ran into while writing this report, was that when breaking down into census tracts, each tract had only a few data points. Many had none. For future reference, if LFUCG decides to collect data again, it would be wise for them to get a large sample size and attempt to gain higher answering percentages for areas such as cost.

A study on rural areas is most certainly in order. Upon observing the outer areas of Fayette County, policy decisions must be made to enhance access for rural citizens. This could be an area of interest in future surveys and reports made to the FCC.

I would recommend that LFUCG seek a more qualitative element among residents of these specific neighborhoods that have high minority populations. To find if there is a racial disparity, there must be very large-scale efforts made by the local government officials to learn what is happening within specific neighborhoods.

If in the coming years, LFUCG can compile data from 2019 to 2022, this would give excellent time data to understand the impacts of Metronet's completion on the pricing and speed availability within the city.

Conclusion

Lexington is an excellent example of what a government can do to provide incentives to the market to get their residents better internet connection. Through this process of expanding their broadband presence, LFUCG has provided affordable and accessible internet to many areas affected by poverty. Because of the efforts to better the connectivity of Lexington as a whole, those in impoverished areas have been given the same access to broadband as those in wealthy and high-income neighborhoods. Even though this effort has largely been successful, there are still concerns that inequity exists outside of the Urban Services Boundary and could exist in areas throughout the city that were not totally represented by this data. A thorough study over the next several years would provide Lexington with the information necessary to combat issues of digital redlining and access inequity that can still befall a community at any time. Digital redlining is the act of changing prices in a dishonest fashion for specific areas of the city that are lower income, or in some cases, largely minority communities.

I have found that Lexington is a good example of using private investment to lower market rates, but being an Urban County Government, LFUCG should begin searching for solutions to support the connection of the thousands of residents outside of the service boundary.

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