NOBLE COUNTY, OHIO

MOBILE & FIXED BROADBAND ANALYSIS

April 1, 2020

CONNECTED NATION™

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A | EXECUTIVE SUMMARY

The vision of Commissioner Brad Peoples and the Noble County broadband taskforce is to ensure that citizens have access to an improved broadband infrastructure and that no citizen in Noble County be left offline. This vision can only be realized by understanding the existing broadband landscape in the county. Ultimately, the development of, and access to, ubiquitous broadband infrastructure - that being fixed or mobile high-speed internet service at speeds of at least 25 Mbps downstream and 3 Mbps upstream - is the desired outcome, but this may require incremental steps over time to achieve this goal. Ideally, internet with download speeds of a gigabit or more will begin to permeate the county.

Today, technology plays a pivotal role in how businesses operate, how institutions provide services, and where consumers choose to live, work, and play. The success of a community has become dependent on how broadly and deeply the community adopts technology resources, which includes access to reliable high-speed networks, the digital literacy of residents, and the use of online resources locally for businesses, government, and leisure.

Broadband availability is becoming an increasingly significant and essential part of the "infrastructure" for twenty-first century communities. Broadband enables us to utilize social media, stream entertainment services like Hulu, and allows us to send and receive email, but its impact can also be felt in healthcare, education, business, and government services. It has become critical for families, students, businesses, and institutions to participate in the digital economy. Communities, particularly those in rural areas like Noble County, struggle with economic recession, attrition, disinvestment, apathy, and overall community decline. To combat these factors, the county must retain leadership, stem youth and family outmigration, increase civic engagement, increase community and economic development activity, and support local human capital development. Robust broadband access, and its meaningful adoption and use, can significantly impact these underlying aspirations.

This broadband study was developed for Noble County, Ohio following a streamlined wireline and wireless infrastructure assessment performed by Connected Nation (CN) and a detailed mobile broadband testing protocol subsidized by the Ohio Department of Transportation (ODOT) through funds made available under a TIGER VII grant. Additional guidance was from County Commissioner Brad Peoples and the volunteers that comprise the local broadband team.

From December 16-20, 2019, CN's Director of Engineering & Technical Services worked on the ground to conduct a targeted outside plant audit to identify commercial transport fiber optic lines (not mapped as part of CN's residential mapping engagement with the State of Ohio). For example, neither Horizon nor American Electric Power report

residential broadband service in Noble County, yet both have a network of fiber optic cable across the county. This was not intended to be an all-encompassing inventory of infrastructure assets or routes, but rather was focused on identifying assets that should be introduced into the broadband discussion. Other discussion items include the recent broadband study completed by the Buckeye Hills Regional Council.

Simultaneously, surveys were collected through December 15, 2019 to determine how Noble County residents are using the internet and how best to increase broadband usage in the county.

The purpose of this document is to summarize the results of a county-wide survey and limited infrastructure assessment and to provide recommendations for addressing deficiencies or highlighting opportunities for improving the local technology ecosystem.

CN also developed an interactive, online map, for use by the Noble County taskforce. In addition to being able to visualize the broadband infrastructure routes, the map allows the user to toggle on/off a number of other data layers key to the future decision making process. These include:

- Townships: boundaries of each township within Noble County
- Assets/Infrastructure Locations: shows the assets identified (fiber markers, towers, water tanks, etc.) from December 16-20, 2019 and those identified from January 13-14, 2020 and may include photo documentation
- Infrastructure Routes: shows the infrastructure routes (fiber, fiber transport) for AEP and Horizon identified during the dates referenced above and may include photo documentation
- Community Anchor Institutions: schools, libraries, health care facilities, etc.
- FCC Antenna Registration: the locations and information for towers registered with the Federal Communications Commission within and adjacent to Noble County
- FCC Built-Out Locations: areas where broadband was expanded or improved under federal funding known as the Connect America Fund (CAF) for Frontier Communications and Windstream Holdings, Inc.
- CAF Phase 2 Eligible Areas: areas where an incumbent local exchange carrier (ILEC) or other company has or will receive federal subsidies to continue deploying DSL at speeds of 10 Mbps x 1 Mbps
- CAF Phase 2 – Auction Eligible Areas: locations outside of the ILCE's federally subsidized area that were available for auction
- ACCESS – 100 Mbps Download/10 Mbps Upload: the areas where broadband services may be available according to recent state data collection; see full description following list
- ACCESS – 50 Mbps Download/5 Mbps Upload: the areas where broadband services may be available according to recent state data collection; see full description following list
- ACCESS – 25 Mbps Download/3 Mbps Upload: the areas where broadband services may be available according to recent state data collection; see full description following list
- ACCESS – 10 Mbps Download/1 Mbps Upload: the areas where broadband services may be available according to recent state data collection; see full description following list
- Broadband Survey Questions
  - Current Internet Service Type?
  - Interest in Additional Internet Choices?
  - Have a Home Broadband Connection?
  - Are You Satisfied with Connection?

The broadband access data displayed on the map are developed from a combination of direct provider outreach and data collection, FCC Form 477 broadband deployment filings, and independent research conducted by CN Ohio. If a broadband provider was unwilling or unable to supply granular data and a detailed service area could not be developed, the provider's service availability is represented by FCC Form 477 data, a format which tends to be overstated. This broadband data for Ohio was developed in November 2019.

According CN's residential broadband mapping data, Noble County was the least-connected county in Ohio, with 76.83% of households able to access internet service at 10 Mbps x 1 Mbps connection rates. This percentage dipped to 58.38% of households that can access broadband service at speeds of 25 Mbps x 3 Mbps, and 37.35% that can access broadband at speeds of 50 Mbps x 5 Mbps as well as 100 Mbps x 10 Mbps broadband service.

The interactive map can be found at https://connectednation.org/ohio/noble/interactivemap.

B | CONTEXT & BACKGROUND

Broadband access refers to the infrastructure that enables a high-speed internet connection. Broadband is essential infrastructure for twenty-first century communities. Broadband empowers a community to access applications ranging from healthcare and education to business and government services. Unfortunately, many communities suffer from inequities of access on several fronts: between income levels; between urban and rural areas; between traditional business areas and nontraditional ones; and differing levels of service due to geography or infrastructure limitations.

Access to affordable broadband will also be a key issue in this area. The unemployment rate in Noble County was 7.2% in December 2019 (the most recent data from the United States Federal Reserve). By comparison, the unemployment rate across Ohio for this time period was 4.2%. Historically, unemployment rates in Noble County reached a record high of 20.6% in December 2010 and are consistently above the national average.

The U.S. Census Bureau's 2018 American Community Survey estimates that Noble County has a population of 14,443 and 6,144 housing units (4,967 of which are occupied households), indicating a population density of 35.7 persons per square mile across an area of 405 square miles of land. The U.S. Census Bureau's American Community Survey five-year estimate (2014-2018) also shows that 80.8% of the occupied housing units are owner-occupied and those households have a median value of $98,400. These figures are both below the averages for the state of Ohio, where 89.7% of households are owner-occupied with a statewide median household value of $140,000. Additionally, Noble County experienced a poverty rate of 15.4% of the population, compared to the statewide average of just 14.5% of Ohio residents.

The U.S. Census Bureau's American Community Survey five-year estimate (2014-2018) indicates that 72.7% of all Noble County homes own a computer (compared to a statewide average of 87.4% of households) and 65.1% of all Noble County homes have an internet subscription, which includes speeds lower than broadband definitions (far below the statewide average of 80.2% of households with an internet connection).

The Appalachian Regional Commission designates Noble County as "At Risk" and, according to their "County Economic Status In Appalachia, Fiscal Year 2020" data, the following information may also shed light on whether there is a broadband chasm or whether the issue may be related to affordability, perception of necessity, etc.:
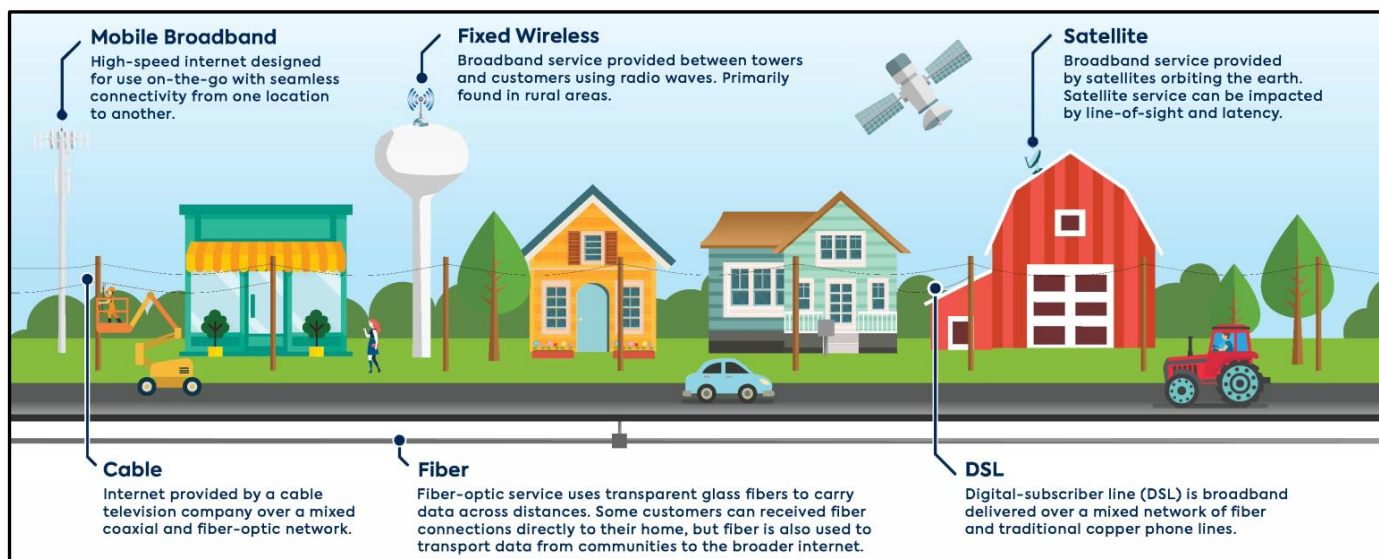
- Three year average unemployment rate: 7.7%
- Per capita income: $18,125
- Poverty rate: 12.9%

C | BROADBAND INTERNET PROVIDERS

Broadband access refers to the infrastructure that enables a high-speed internet connection. There are two primary types of broadband connections: fixed and mobile.

Fixed broadband is delivered to a user via several technology platforms including cable, digital subscriber line (DSL) over a phone line, fiber optics, and fixed wireless. Fixed broadband is designed for stationary use at a fixed location such as a home, business, or institution (see examples in Appendix III: Infrastructure).

Mobile broadband is a wireless technology used to connect portable devices to the internet. These networks are designed to provide seamless connectivity as the user moves from one location to the next while accessing the web from a portable device.

Mobile Broadband
High-speed internet designed for use on-the-go with seamless connectivity from one location to another.

Fixed Wireless
Broadband service provided between towers and customers using radio waves. Primarily found in rural areas.

Satellite
Broadband service provided by satellites orbiting the earth. Satellite service can be impacted by line-of-sight and latency.

Cable
Internet provided by a cable television company over a mixed coaxial and fiber-optic network.

Fiber
Fiber-optic service uses transparent glass fibers to carry data across distances. Some customers can received fiber connections directly to their home, but fiber is also used to transport data from communities to the broader internet.

DSL
Digital-subscriber line (DSL) is broadband delivered over a mixed network of fiber and traditional copper phone lines.

Charter Communications (doing business as Spectrum) and Suddenlink Communications provide a broadband technology platform known as Data Over Cable Service Interface Specification (DOCSIS). The DOCSIS providers compete directly with the incumbent local exchange carriers (ILEC), who deliver a technology platform known as Digital Subscriber Line (DSL) over an aging copper network. The ILECs include CenturyLink, Inc., Frontier Communications, and Windstream Western Reserve; their copper telephone lines may be more than 50 years old and do not perform as well as when they were new. Fixed wireless internet service (WISP) is offered in Noble County by Agile Network Builders, Rowe Wireless Internet, and WVHotSpot.net.

Local broadband providers have depleted their "greenfield" opportunities (a location where they could construct a network for the first time to serve new homes or businesses). Overbuild activities ("brownfield," constructing broadband networks at locations where two or more other providers are already there) have been less active as each potential pocket of homes is scrutinized by providers to determine if a reasonable return-on-investment (ROI) is achievable. The use of the term "overbuild" and "brownfield" exclude fixed wireless service and are relegated to wireline competition only. Fixed wireless deployments are often less expensive, do not typically require pole attachment agreements, easements, rights-of-way, trenching, etc. and, due to the lower costs of deployment, can more efficiently compete.

Brownfield opportunities are also typically affected by the speed and pricing of the competitor, the number of competitors, and the demographic composition of the neighborhood.

There may be an unsustainable ROI model which could dissuade a private company from making such an investment. No one wants to be the third or fourth provider in a neighborhood, competing against an entrenched incumbent and attempting to "take" someone else's customer base. There is a common adage in the telecom industry that is summarized as "…if there is a return-on-investment to be made, the private sector would already be doing so."

| Internet Service Provider	Technology	Website
Agile Network Builders	Fixed Wireless	www.agilenetworkbuilders.com
CenturyLink, Inc.	DSL	www.centurylink.com
Charter Communications	Cable	www.spectrum.com/
Frontier Communications Corporation	DSL	www.frontier.com
Rowe Wireless Networks LLC	Fixed Wireless	www.rowenetworks.com
Serenity Wireless	Fixed Wireless	www.serenitywirelessllc.com
Suddenlink Communications	Cable	www.suddenlink.com
Windstream Western Reserve Inc.	DSL	www.windstream.com
WVHotSpot.net	Fixed Wireless	www.wvhotspot.net

D | MOBILE DRIVE TESTING RESULTS

From January 13-24, 2020, CN conducted extensive mobile drive testing under the direction of the Ohio Department of Transportation (ODOT), driving all roads in Noble County and collecting test data on the four major mobile carriers (AT&T, Sprint, T-Mobile, and Verizon). This included the use of unlimited and unthrottled mobile data plans on mobile handsets capable of transmitting and receiving fourth generation (4G) services with the use of nPerf testing software.

Test Process: As tests are completed, the results are captured on each handset (see sample at right). Each test is quick and simple, taking approximately 15-20 seconds to complete.

Configuration:

How the nPerf testing software works:

- Bitrate testing (download and upload speeds) relies on downloading binary files with multiple simultaneous requests (between 4-16 threads) in order to saturate the network for a few brief seconds. nPerf measures both the peak rate (24.27 Mbps download in illustration at right) and the average rate of the download and upload test samples.

- The latency test is performed 10 times and the minimum (30 milliseconds in illustration at right) and average latency values (62 ms) are calculated from the same number payload threads. A latency value of less than 300 ms round trip is sufficient for 4G mobile service.

- Data is then sent from the Android mobile phone to a nearby server on the internet (hosted by nPerf).

Diagram of Test Equipment Setup Configuration
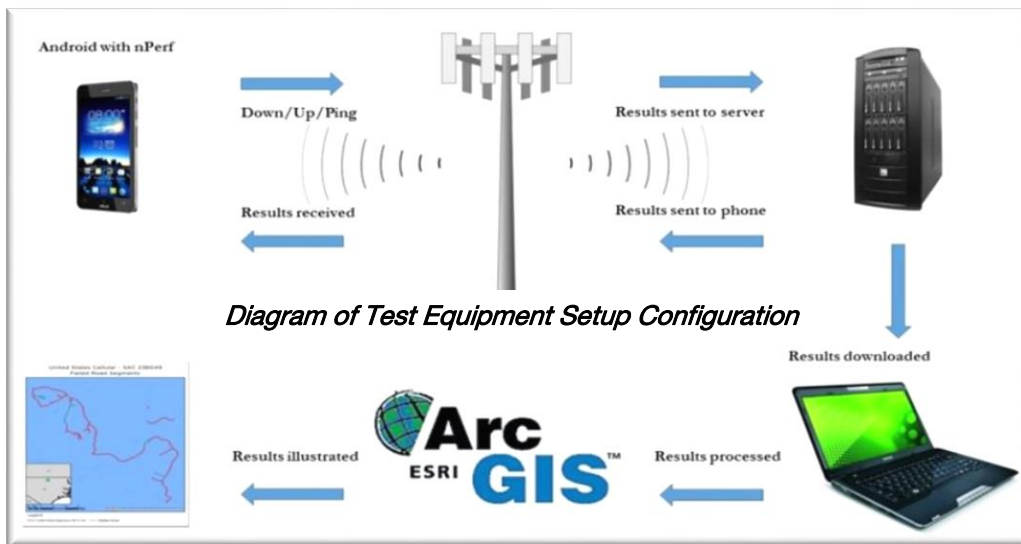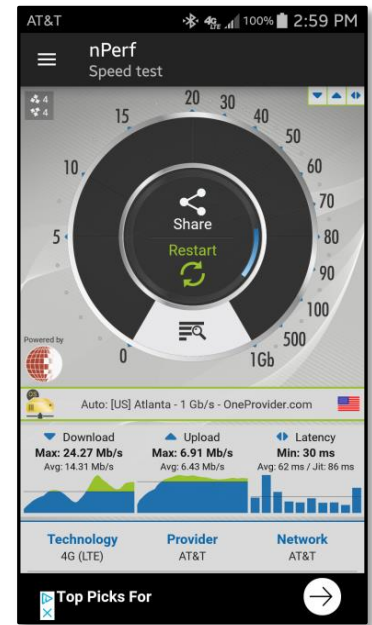
The eventual deployment of fifth generation, or 5G, wireless services will likely have little impact in Noble County and, if available, such networks will be designed to push immense amounts of data across the mobile network in highly populated areas. 5G will not be a band-aid or cure-all and will be subject to its own set of inherent problems. For example, a 5G network is reliant upon access to robust fiber connection in order to accommodate the short range, dense mobile network.

In their article titled "What is 5G?" PCMag.com opines on the initial launch of 5G networks stating "…we think this will be 'millimeter wave' 5G, which requires dense networks of cells that don't reach very far (say, about 1000 feet each), but deliver extremely high speeds."

As evidenced by the maps in Appendix II, Noble County has mobile coverage gaps in many of the same areas where there are broadband gaps. This is due, in part, to the combination of terrain and foliage that make it difficult for a wireless signal to penetrate and therefore to deliver service to nearby households.

E | SURVEY RESULTS

The following provides an overview of results from the broadband survey conducted in Noble County between August and December 2019. Altogether, 88 surveys were received from households across the county, and respondents provided insights into their internet connectivity, or lack thereof. Data from Noble County is compared to data from across dozens of other rural communities across Michigan, Ohio, Texas, and Pennsylvania that have participated in the Connected Communities program (referred to as "Connected Communities") to benchmark and identify areas for improvement.
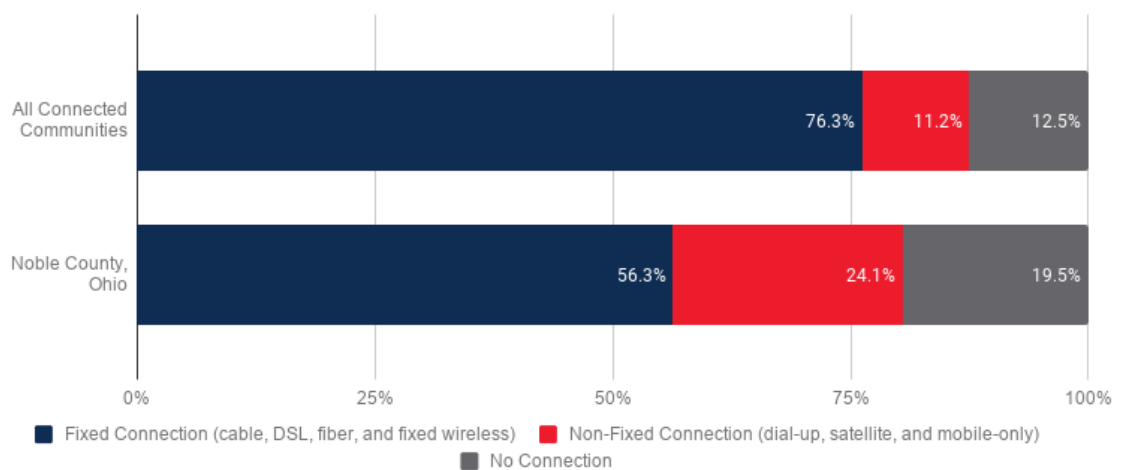
ADOPTION

Approximately 76% of households in Noble County that took the survey adopt (subscribe to) fixed broadband service. Fixed service is delivered via cable, DSL, fiber, or fixed wireless technology. Slightly more than 11% of respondents indicate they have internet service, but it is delivered via dial-up, satellite, or a mobile wireless service. This leaves 12.5% of households without internet access at home. When applied to the county as a whole, that represents an estimated 1,177 households in the county with no fixed broadband service.
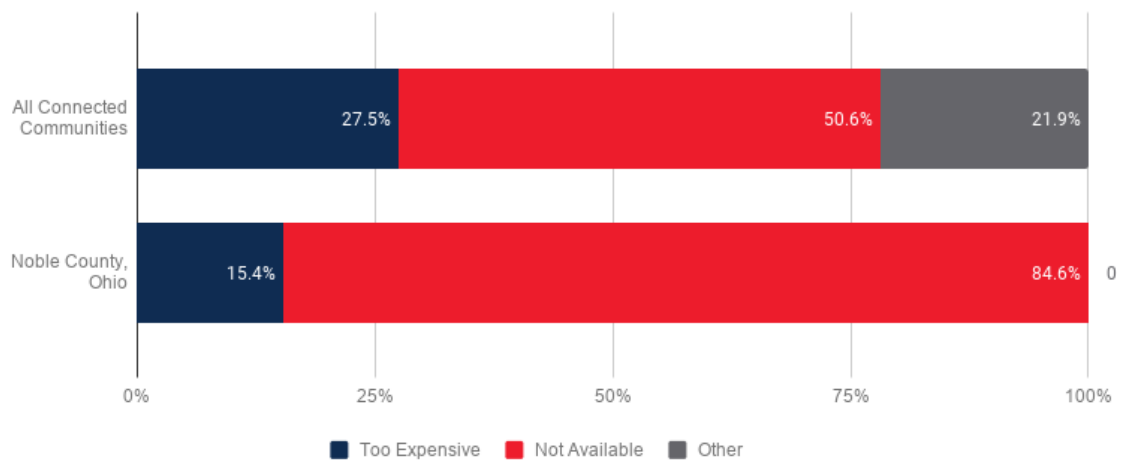
Among those without a home internet connection, the vast majority (nearly 85%) say broadband is not available where they live. The balance

Home Broadband Adoption

All Connected Communities: Fixed Connection 76.3%, Non-Fixed Connection 11.2%, No Connection 12.5%

Noble County, Ohio: Fixed Connection 56.3%, Non-Fixed Connection 24.1%, No Connection 19.5%

Legend:
- Fixed Connection (cable, DSL, fiber, and fixed wireless)
- Non-Fixed Connection (dial-up, satellite, and mobile-only)
- No Connection

Primary Barrier to Home Broadband Adoption

All Connected Communities: Too Expensive 27.5%, Not Available 50.6%, Other 21.9%

Noble County, Ohio: Too Expensive 15.4%, Not Available 84.6%, Other 0

Legend:
- Too Expensive
- Not Available
- Other

(15.4%) indicates the monthly cost of service is too expensive. Cost and availability are the two primary barriers to home broadband adoption in many communities, however, Noble County has a higher rate of those indicating availability as their primary barrier to subscribing.

CONNECTION DETAILS

Two percent of monthly income is a recognized standard for measuring the affordability of a home internet connection. Respondents indicate that, on average, their internet connection costs nearly $58 per month. This is just 12 cents higher than the average monthly costs in other communities. Two percent of the median household income in Noble County is $79.09 per month. These results show the average cost of service is well below the 2% threshold.

Average Monthly Cost of Home Internet Service

$57.56

$57.68

$0.00 $20.00 $40.00

■ All Connected Communities   ■ Noble County, Ohio
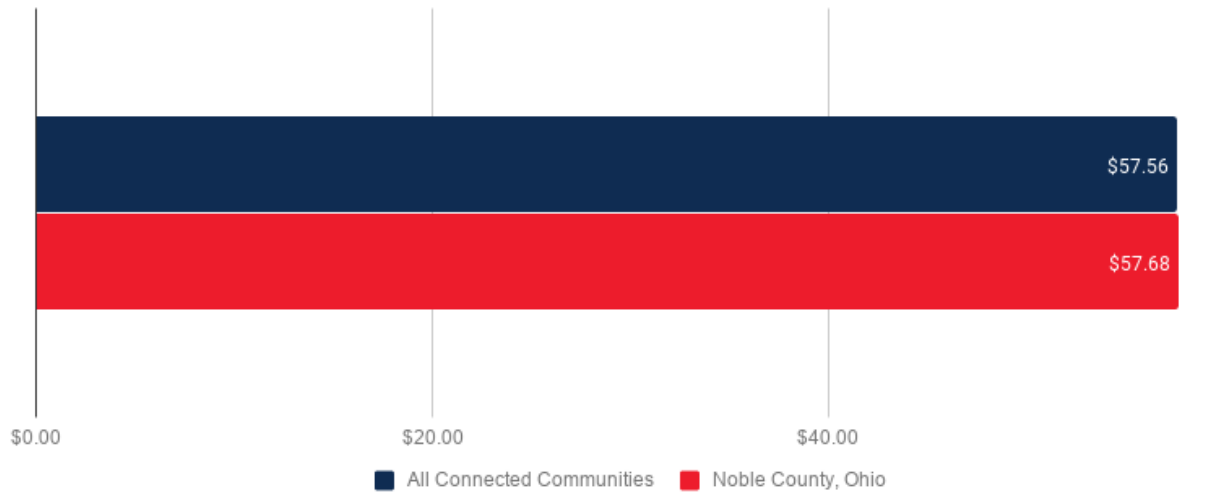
The FCC currently defines broadband as an internet connection with a download speed of at least 25 Mbps and upload speed of at least 3 Mbps. On average, respondents indicate their connection download speed is 12.6 Mbps, which is significantly lower than household connections in other communities. More than six out of seven Noble County households that know their download speeds report having a speed less than the FCC defined speed.

Average Subscribed to Download Speed (Mbps)

38.3

12.6

0.0   10.0   20.0   30.0   40.0

■ All Connected Communities   ■ Noble County, Ohio
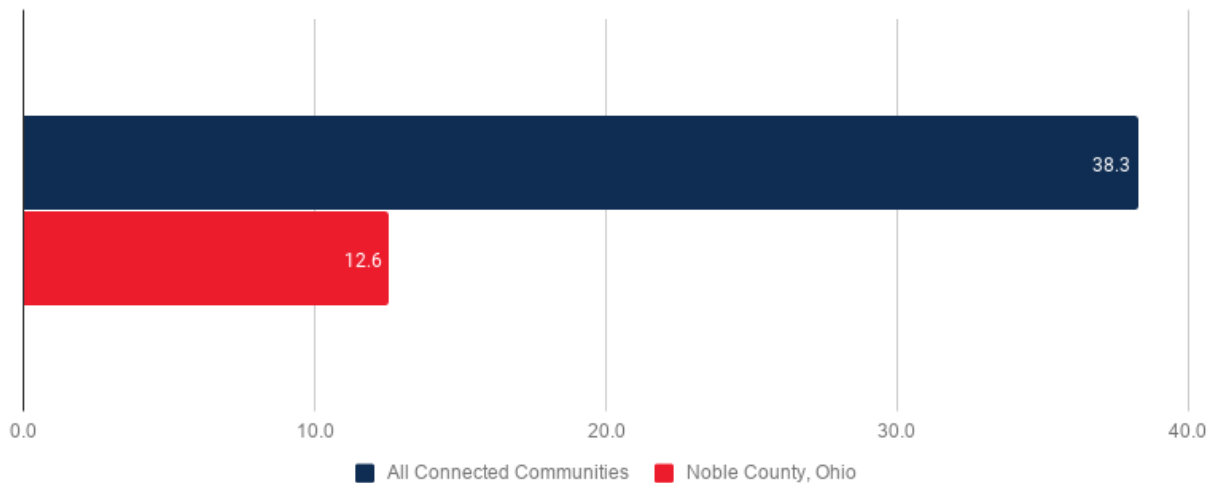
Competition provides residents with choices for service, allowing them the ability to switch providers if their current service does not meet their needs. Nearly 60% of respondents in Noble County indicate their internet connection does not meet their needs. This is a higher rate of dissatisfaction than among households in other communities.

Does Your Internet Connection Meet Your Current Needs?
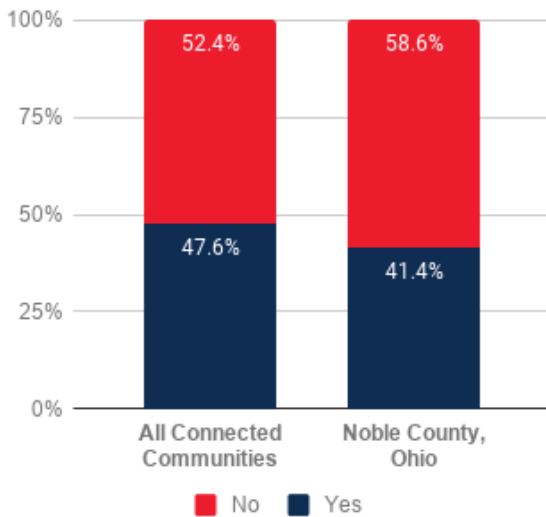

Why Does Your Connection Not Meet Your Needs?
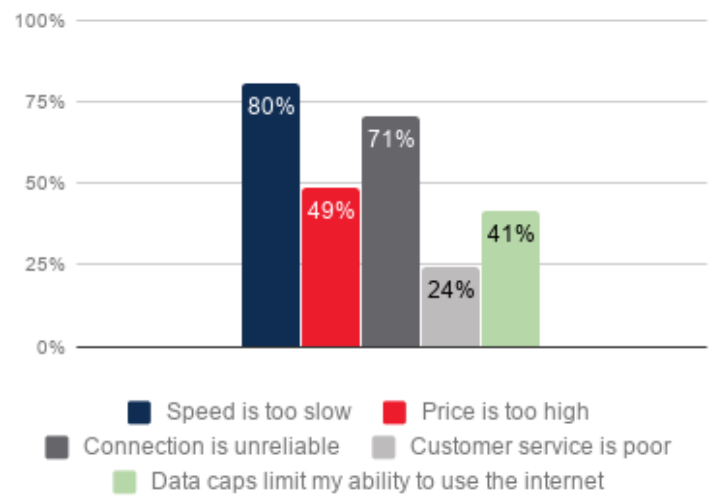
When asked why their connection does not meet their needs, four out of five households (80%) indicate that the speed is too slow. Nearly one-half (49%) say the cost is too high. More than seven out of ten (71%) say they are dissatisfied with their home internet service due to reliability issues. Nearly one in four (24%) cite poor customer service, while 41% say they are dissatisfied with their home broadband service because data caps limit their ability to use the internet to the extent that they would like.[1]

The issue on which nearly every internet subscriber agrees is the need for competition. The overwhelming majority of respondents (96%) say they are interested in additional internet choices for their home.
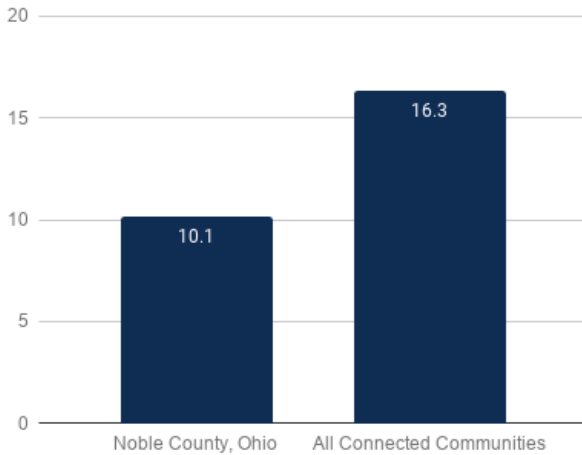
Are You Interested In Additional Internet Choices at Home?

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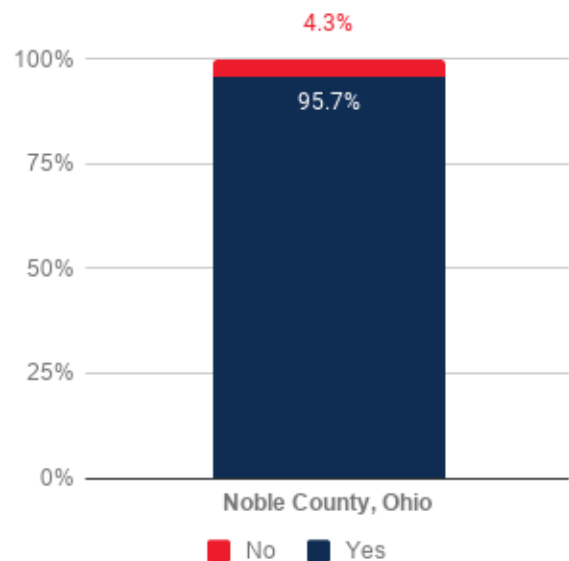
[1] Respondents could provide more than one answer to this question; as such, percentages will not total 100%.

DEVICES IN THE HOME

Average Number of Devices in the Home

In the early days of the internet, when dial-up access was the only available option, a desktop computer was the primary, and virtually the only, way of connecting to the internet. However, with the rise of Wi-Fi, mobile broadband, Bluetooth, and many other revolutionary technologies, residents have multiple ways through which they can access the internet. While a wide variety of devices are available to connect to the internet, sometimes the lack of an internet-enabled device is cited as a barrier to home broadband adoption. Households in Noble County, on average, report having fewer internet-connected devices than households in other communities.

Noble County residents reported owning an average of 2.4 smartphones per household, as well as more than one laptop computer, tablet computer, and internet-connected television on average. They reported owning fewer desktop computers, internet-connected gaming devices, Smart Home devices, and other internet-connected gear on average.

Average Number of Each Device in the Home
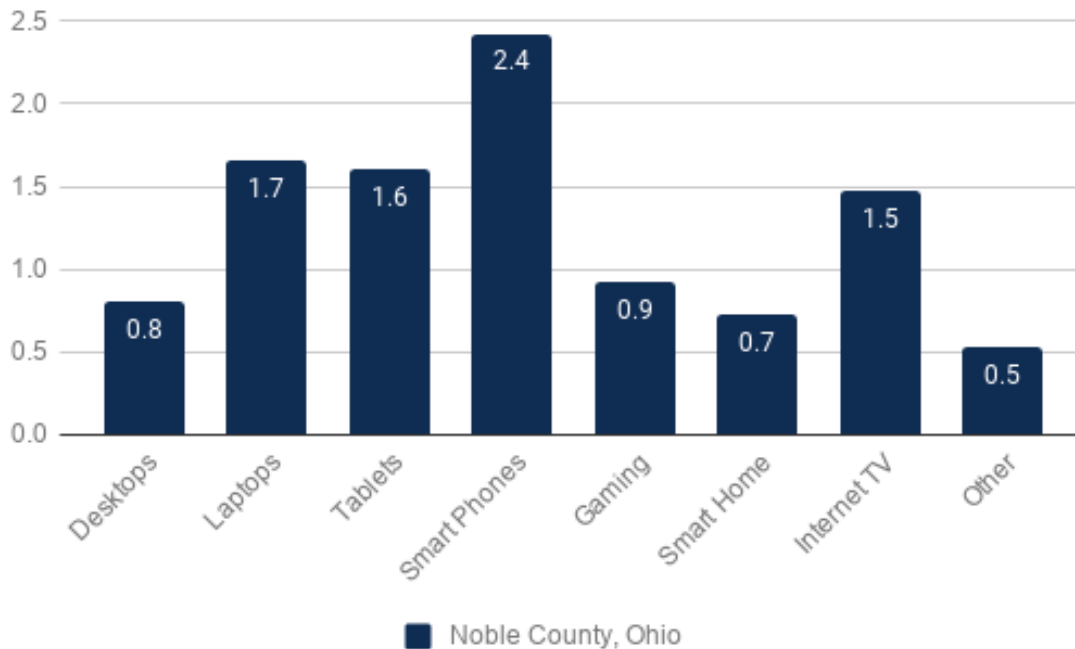
MOBILE SERVICE

Mobile broadband is the technology that connects mobile, or cellular, phones to the internet. Mobile technology is designed to operate seamlessly as a user travels about. It is considered distinct from fixed broadband connectivity because while mobile broadband connections may be useful (or preferable) under some circumstances, it has limitations such as speed and reliability when compared to fixed broadband connections.

Despite these limitations, mobile broadband is increasingly important to local economies, government services, public safety and utility organizations, as well as local residents. Robust mobile broadband service can be vital to the development of infrastructure upgrades, such as smart grid and other utility efficiencies, unlocks opportunities for business development, and provides support for educational, healthcare, and government services.

Across Noble County, just less than three out of four respondents (74.7%) said they subscribe to mobile internet service at home. This is slightly lower than the average of 79% reported by all participants of all Connected Communities residential surveys.

Households Subscribing to Mobile Service

	All Connected Communities	Noble County, Ohio
No	20.6%	25.3%
Yes	79.4%	74.7%
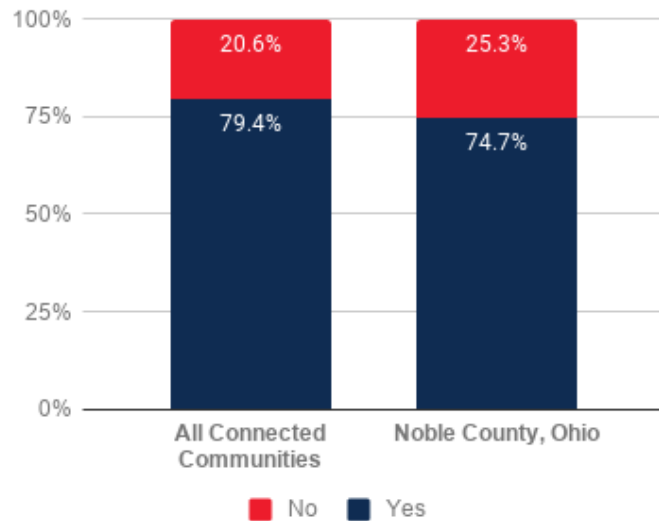
BROADBAND AND THE WORKPLACE

Broadband affects every aspect of life, changing the way we spend time at home, how we travel, how we learn, as well as how we work. Broadband's impact on business practices cannot be overstated, as employers and workers alike now rely on high-speed internet connectivity to communicate with customers, increase efficiency, and give workers new flexibility to work from anywhere.

In Noble County, technology impacts hundreds of jobs. More than nine out of ten employed Noble County residents (91.5%) responded that they use a computer as part of their job, while a slightly higher percentage (91.7%) said they use the internet for their work.

Do You Use a Computer for Work?

	Yes	No
All Connected Communities	96.7%	3.3%
Noble County, Ohio	91.5%	8.5%
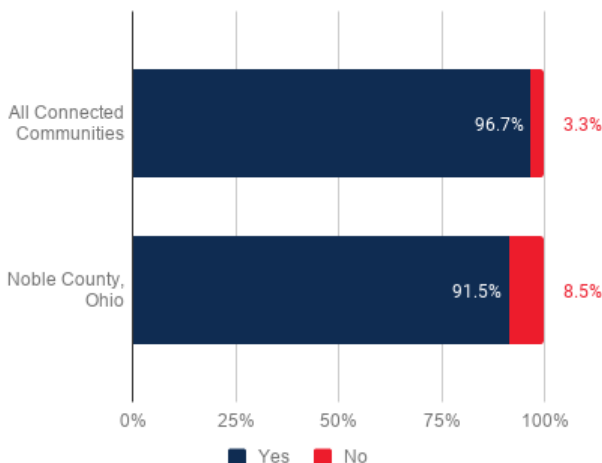
Do You Use the Internet for Work?

	Yes	No
All Connected Communities	97.2%	2.8%
Noble County, Ohio	91.7%	8.3%
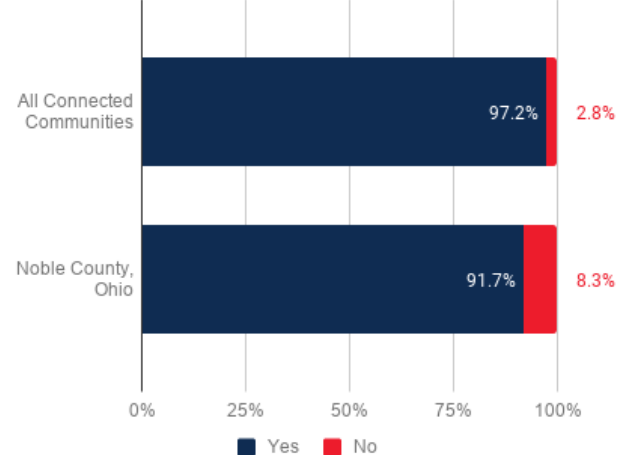
Technology also plays a role in the workplace as a growing number of employees are now teleworking. Teleworking, or telecommuting, refers to working outside of a conventional workplace and communicating with it by way of telecommunications or computer-based technology during normal working hours. Further, telework is a form of organizing and/or performing work remotely that could also be carried out at the employer's premises. Teleworking is a spatially flexible work style that typically also involves greater flexibility in one's daily routine. Teleworkers typically have higher incomes and higher rates of advanced degree attainment. While traditional teleworkers are often thought of as those in management occupations or professional service industries, recently, technology has enabled new opportunities for teleworkers across the occupational and industry sector spectrum.

In Noble County, 43% of respondents said they telework at least occasionally. Over one-half said they did not, while another 5% said they were retired, they owned their own business, or had some other current employment experience. This share of adult residents who report teleworking in Noble County is slightly higher than the average of 35% who telework in all Connected communities.

Do You Currently Telework for Your Job?
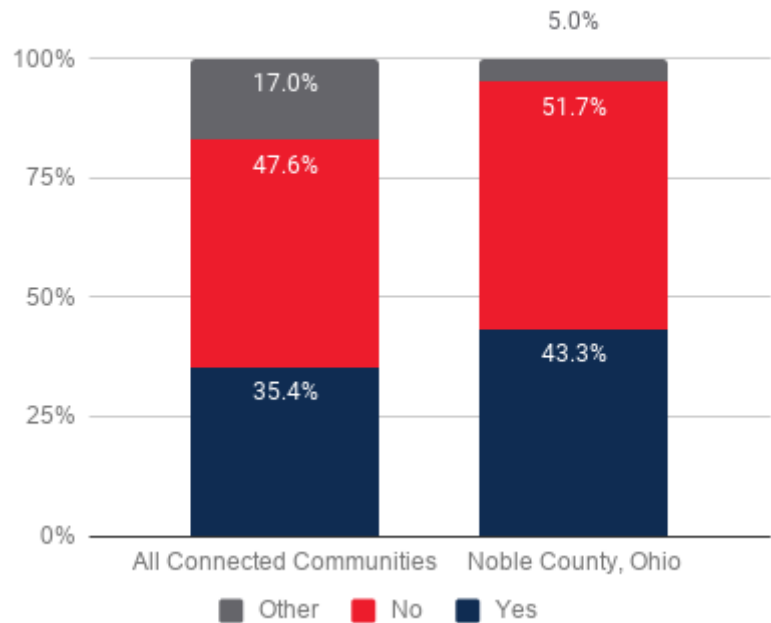
Broadband also affects local businesses through customers' online shopping habits. By selling goods and services online, businesses are able to reach a global customer base and make it easier for potential buyers to find them. Even local buyers often search for and buy from nearby stores via the internet.

Average Online Purchases from Local and Non-Local Businesses in the Last 12 Months
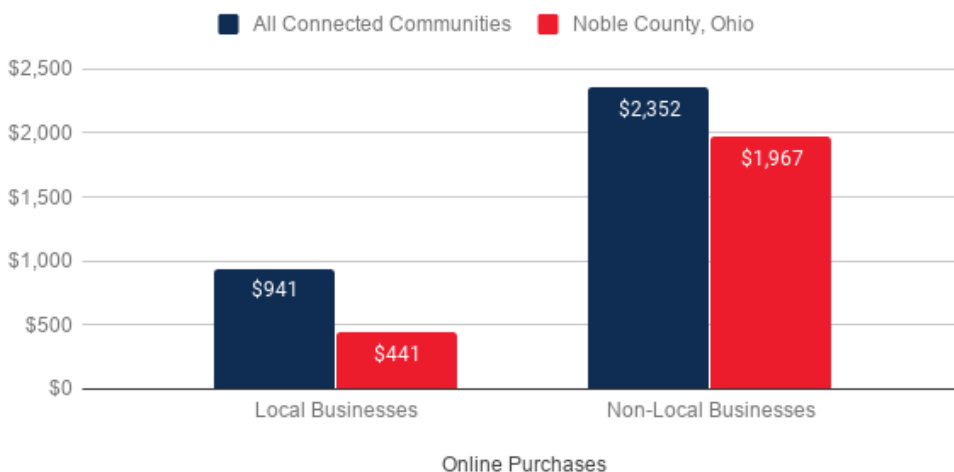
In Noble County, respondents reported that they spent an average of $441 in online purchases from local businesses (those within 50 miles of their home) in the past 12 months. In addition, they report spending $1,967 on purchases from businesses that are located more than 50 miles away from their home during this same time period. Both of these estimates are below the average amount reported in Connected communities; in particular, the average amount spent at local businesses in Noble County is less than one-half the average.

F | PATH FORWARD

The following recommendations are presented to assist Noble County in expanding broadband access and adoption throughout the community.

The FCC's Form 477 broadband data continues to draw criticism for its inaccuracies and the recent announcement of $20.4 billion in funding for the Rural Digital Opportunity Fund (RDOF) (https://www.fcc.gov/rural-digital-opportunity-fund) underscores the problems faced by counties, like Noble County, when attempting to improve broadband coverage.

The maps created by CN (in Appendix I below) display a higher level of accuracy regarding internet network infrastructure than the overstated coverage of the FCC Form 477 data. By way of example, let's assume that everyone in Summerfield lived within one defined Census Block. According to the FCC, if only one person in Summerfield had access to broadband, then the entire population of Summerfield is represented as having access to broadband.

CN believes the following recommendations to Noble County are essential to addressing the challenges and objectives necessary to stimulate broadband expansion, adoption and use.

DEVELOP PUBLIC-PRIVATE PARTNERSHIPS

Due to the rural nature of Noble County, it would appear the best course of action is to develop public-private partnerships (P3) with the local broadband providers, other government entities, nonprofit organizations, etc.
This option mitigates risk to the county but allows it to express some control over the areas served while passing the majority of the financial burden on to a private partner. Noble County can access certain funds available through the Appalachian Regional Commission, United States Department of Agriculture, and other funds such as Community Development Block Grants, which broadband providers cannot generally access. In addition, other funds include:

Rural Digital Opportunity Fund: https://www.fcc.gov/rural-digital-opportunity-fund.
USDA Loan and Grant Programs: https://www.usda.gov/reconnect/program-overview.

Windstream filed Chapter 11 bankruptcy on February 25, 2019. The bankruptcy courts have allowed Windstream to access "up to $400 million of its $1 billion in debtor-in-possession financing" so it can continue "business as usual." Windstream received federal subsidies under the FCC's Connect America Fund (CAF) to expand and/or improve their network(s) to ensure more homes had access to internet at speeds of 10 Mbps x 1 Mbps. This included network improvement in portions of the Noble County area. At present, Windstream may be legally unable to enter into a P3.

ANALYZE THE RISK/REWARD SCENARIO

Ideally, fiber-to-the-home (FTTH) deployments represent the most likely "future-proof" technology platform. However, due to the limited number of unserved homes per square mile, FTTH deployments are an unlikely near-term solution. Instead, a series of fixed wireless deployments may offer the ability to reach some (but not all) of the unserved households in Noble County. Such deployments can be accomplished with significantly lower capital investments and the ROI model for such deployment presents the opportunity to mitigate financial risk. This includes the use of potential vertical assets already in place throughout the county (see sample in Appendix III: Infrastructure). While the broadband surveys suggested an interest in broadband options, there is no guarantee that consumers will find service prices points palatable.

CONSUMER EDUCATION

From the onset, Noble County should undertake an exercise to discover the intricacies related to federal telecommunications and broadband regulations, identify low-cost service offerings (such as Lifeline) that may appeal to consumers in the area allowing them to access some form of internet connectivity that may have been otherwise unknown or unadvertised in Noble County.

G | APPENDIX I: RESIDENTIAL BROADBAND SERVICE BY SPEED TIERS

Broadband Service with Speeds of at Least
25 Mbps Download/
3 Mbps Upload

NOBLE COUNTY

OHIO

Household Availability
58.38% *
* Preliminary Estimate

— Local Road
County Boundary
Municipal Boundary
Federal/State Land
Water

Fixed, Terrestrial Non-Mobile Broadband Service

Detailed Service Areas
FCC Service Availability

CONNECTED NATION™ Ohio
INNOVATE Ohio

Published November 4, 2019

Broadband data displayed on this map are developed from a combination of direct provider outreach and data collection, FCC Form 477 broadband deployment filings, and independent research conducted by Connected Nation Ohio. If a broadband provider was unwilling or unable to supply granular data and a detailed service area could not be developed, the provider's service availability is represented by FCC Form 477 data, a format which tends to be overstated. This map is not a guarantee of Internet service availability. Mobile and satellite services may also be available.

The current FCC definition of broadband is a minimum speed of 25 Mbps (Megabits per second) download and 3 Mbps upload.

Updates to this map will occur in March 2020; submit feedback on the map to help make it more accurate: https://connectednation.org/ohio/feedback

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Broadband Service with Speeds of at Least 50 Mbps Download/ 5 Mbps Upload

NOBLE COUNTY

OHIO

Household Availability
37.35%*
* Preliminary Estimate

— Local Road
County Boundary
Municipal Boundary
Federal/State Land
Water

Fixed, Terrestrial Non-Mobile Broadband Service

Detailed Service Areas
FCC Service Availability

CONNECTED NATION™ Ohio
INNOVATEOhio

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Broadband Service with Speeds of at Least
100 Mbps Download/
10 Mbps Upload

NOBLE COUNTY
OHIO

Household Availability
37.35%*
* Preliminary Estimate

— Local Road
▢ County Boundary
⬡ Municipal Boundary
Federal/State Land
Water

Fixed, Terrestrial Non-Mobile Broadband Service
▨ Detailed Service Areas
▨ FCC Service Availability

CONNECTED NATION™
Ohio
INNOVATE**Ohio**

Published November 4, 2019

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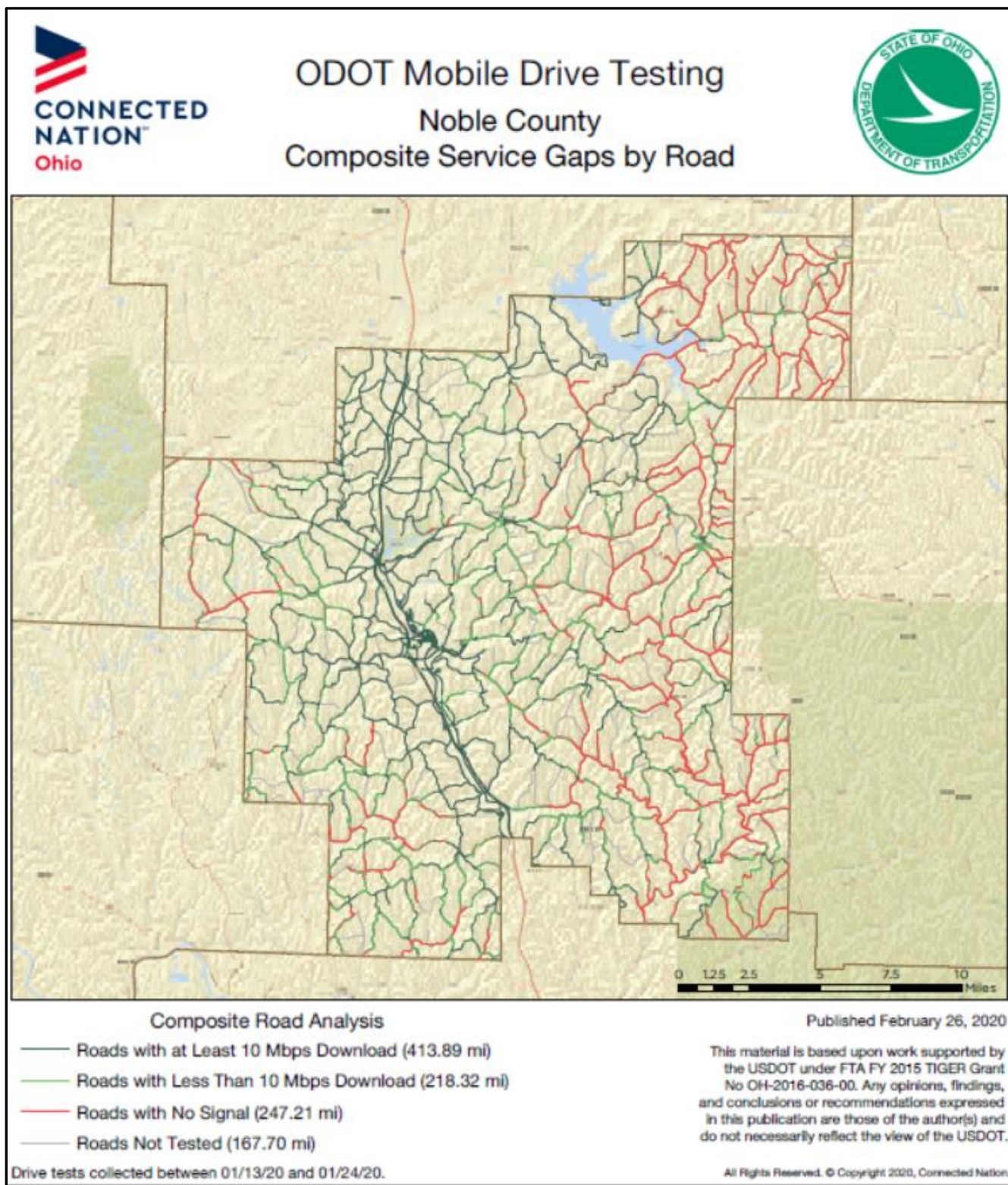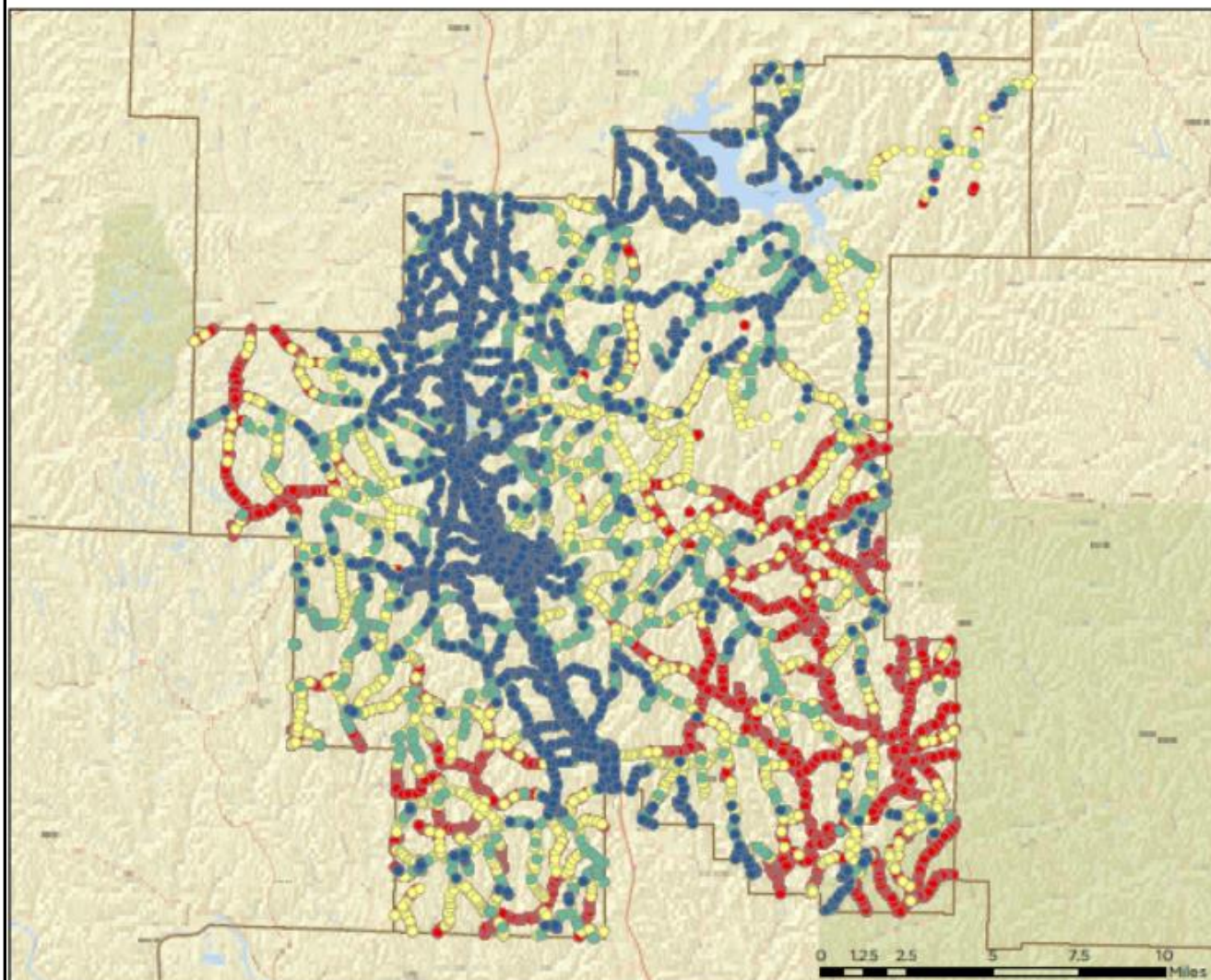## H | APPENDIX II: MOBILE BROADBAND TEST RESULTS AND ANALYSIS MAPS

ODOT Mobile Drive Testing
Noble County
Composite Service Gaps by Road

Composite Road Analysis

— Roads with at Least 10 Mbps Download (413.89 mi)
— Roads with Less Than 10 Mbps Download (218.32 mi)
— Roads with No Signal (247.21 mi)
— Roads Not Tested (167.70 mi)

Drive tests collected between 01/13/20 and 01/24/20.

Published February 26, 2020

This material is based upon work supported by the USDOT under FTA FY 2015 TIGER Grant No OH-2016-036-00. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the USDOT.

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CONNECTED
NATION

ODOT Mobile Drive Testing
Noble County
Composite Drive Test Results

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

Published February 26, 2020

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Download Speed

- 25 Mbps+
- 10 - 24.99 Mbps
- 0.01 - 9.99 Mbps
- Test Failed

Drive tests collected between 01/13/20 and 01/24/20.

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I | APPENDIX III: INFRASTRUCTURE SAMPLE

J | APPENDIX IV: POTENTIAL FIXED WIRELESS SOLUTION

Agile Networks' presence in the county is de minimis and is currently limited to TV White Space (TVWS) coverage from the MARCS Lewisville tower in nearby Monroe County.

WVHotSpot's nearest tower site is located approximately in Malaga (also Monroe County) and coverage is limited to the northeast corner of the area with possible service on the ridge-tops near Batesville.

Rowe Wireless is currently operating on towers in Caldwell and Sarahsville.

The combined fixed wireless coverage touches the north central area of the county well, but the southern part is lacking fixed wireless coverage.

There are at least two additional sites that could be used to increase fixed wireless broadband coverage; the elevated water tank at Crooked Tree and the SBA tower near Dexter City (see sample illustration below for discussion). These sites, combined with possible additional use of TVWS spectrum may dramatically increase broadband coverage.
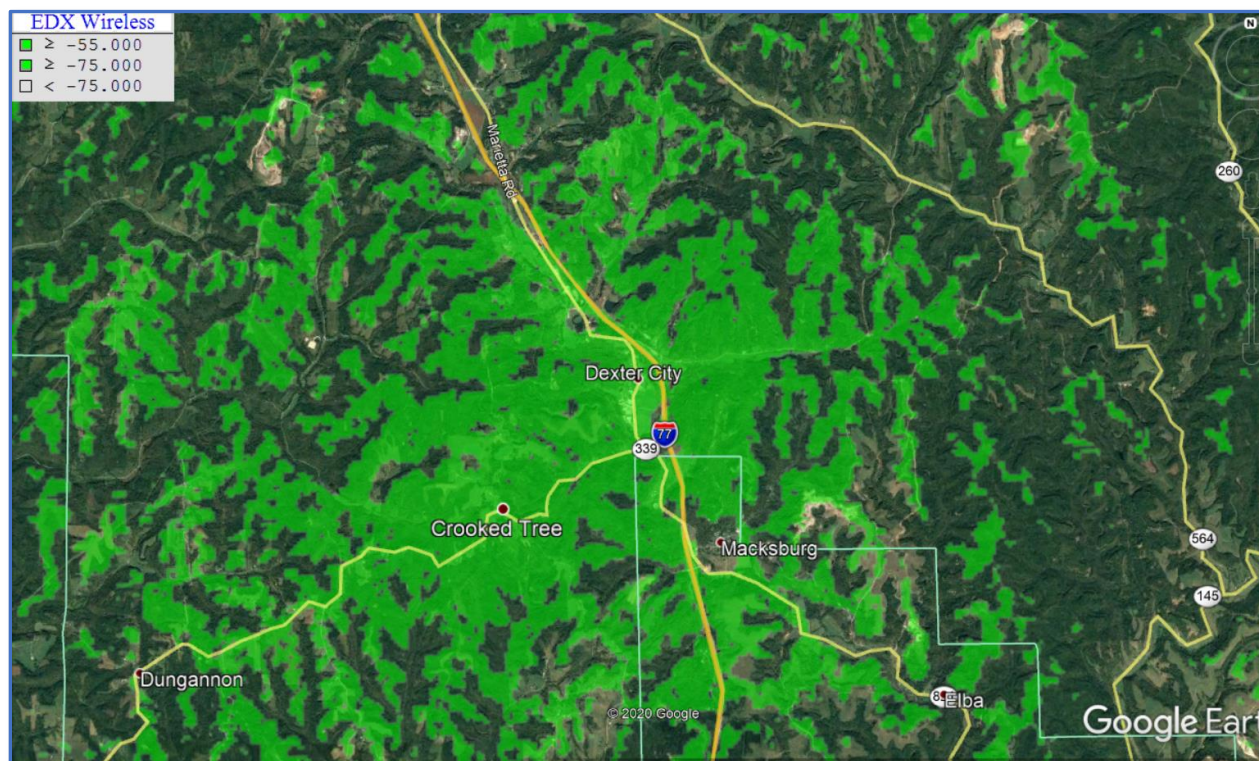
K | APPENDIX V: BROADBAND GLOSSARY AND TABLE OF UNITS

The following is reproduced, in part, from a resource provided by the National Telecommunications and Information Administration (NTIA)

Numbers

3G: The term for the 3rd generation wireless telecommunications standards usually with network speeds of less than 1 Mbps.

4G: The term for 4th generation wireless telecommunications standards usually with network speeds greater than 1 Mbps.

5G: The term for emerging 5th generation wireless telecommunications standards usually associated with network speeds of up to 1 Gbps or more.

A

ADSL (Asymmetrical Digital Subscriber Line): A form of internet service communications technology that delivers constantly accessible data transmissions over copper telephone lines. ADSL is a common version of DSL and has download speeds between 2 and 6 Mbps and upload speeds reaching 512 Kbps.

Asymmetrical Bandwidth: A connection in which the maximum transfer rate is different for download and upload speeds.

ATM (Asynchronous Transfer Mode): A transmission method where information is re-structured into packets. It is asynchronous due to the fact that the recurrence of packets from an individual user is not necessarily periodic.

B

Backbone: A major high-speed transmission line that strategically links smaller high-speed internet networks across the globe.

Backhaul: The portion of a broadband network in which the local access or end user point is linked to the main internet network.

Bandwidth: The capability of telecommunications and internet networks to transmit data and signals.

Bit: The base unit of information in computing. For our purposes, also the base unit of measuring network speeds. A single piece of information is equal to 1 bit. Network speeds tend to be measured by bits per second—using kilo (1,000), mega (1,000,000), and giga (1,000,000,000). A bit is a part of byte; they are not synonyms. Bit is generally abbreviated with a lower case b.

Broadband: The term broadband commonly refers to high-speed internet access that is always on and faster than traditional dial-up access. Broadband includes several high-speed transmission technologies, such as fiber, wireless,

satellite, digital subscriber line, and cable. For the Federal Communications Commission (FCC), broadband capability requires consumers to have access to actual download speeds of at least 25 Mbps and actual upload speeds of at least 3 Mbps.

Broadband Adoption: The use of broadband in places where it is available, measured as the percentage of households that use broadband in such areas.

BTOP: Broadband Technology Opportunities Program, established by the 2009 stimulus legislation, a program to disburse $4.7 billion to improve broadband access and literacy throughout the country.

Burstable: Authorizes a connection to exceed its specified speed, normally up to a set maximum capacity for a period of time.

Burst Speed: A method which momentarily allots additional bandwidth to consumer's services for short periods of time.

C

Cable Modem System: Cable television companies have offered internet access via their cable system for more than a decade. The network architecture uses a loop that connects each subscriber in a given neighborhood, meaning they all share one big connection to the internet.

Central Office: A telecommunication company's building where consumers' phone lines are attached to equipment that connects a consumer to other consumers in that central office or other central offices across the globe.

Community Anchor Institutions: Schools, libraries, medical and health care providers, public safety entities, institutes of higher education and other community support organizations that provide outreach, access, equipment, and support services to facilitate greater use of broadband service by the entire population and local governments.

Conduit: A reinforced tube through which cabling runs. Conduit is useful both to protect fiber-optic cables in the ground and because one can place the conduit underground when convenient and later "pull" the fiber cabling through the conduit.

D

Dark Fiber: Fiber that is in place but not being used for broadband services. ("non-lit" fiber, also see "Lit Fiber").

Digital Divide: The gap between those of a populace that have access to the internet and other communications technologies and those that have limited or no access.

Digital Equity: Recognizes that digital access and skills are now required for full participation in many aspects of society and the economy. Digital Equity links Digital Inclusion to social justice and highlights that a lack of access and/or skills can further isolate individuals and communities from a broad range of opportunities.

Digital Inclusion: Implies that individuals and communities have access to robust broadband connections; internet-enabled devices that meet their needs; and the skills to explore, create, and collaborate in the digital world.

Digital Literacy: The ability to leverage current technologies, such as smartphones and laptops, and internet access to perform research, create content, and interact with the world.

Digital Skills: Any skills related to operating digital devices or taking advantage of digital resources.

DOCSIS (Data Over Cable System Interface Specification): The international telecommunications standard for cable signaling data and spectrum sharing. DOCSIS standards evolve over time. DOCSIS Standard 3.1 is the most recent version.

DSL (Digital Subscriber Line): A form of technology that utilizes a two-wire copper telephone line to allow users to simultaneously connect to and operate the internet and the telephone network without disrupting either connection.

E

EDGE: Enhanced Data Rates for GSM Evolution: An upgraded 2G mobile standard offering faster data transfer speeds. Connections may fall back on this if 3G or 4G aren't available—on smartphones it will usually be indicated by an 'E' next to the signal meter.

E-Government Services: The government's use of web-based and information technology resources to connect with citizens and provide online services and resources.

F

Fiber (Also referred to as Fiber Strand): A flexible hair-thin glass or plastic strand that is capable of transmitting large amounts of data at high transfer rates as pulses or waves of light.

FTTH or FTTP (Fiber to the Home or Fiber to the Premise): The delivery and connection of fiber optics directly to a home or building.

Fixed Broadband: High-speed data transmission to homes and businesses using technologies such as T1, cable, DSL, fiber, and fixed wireless. Excludes mobile broadband and non-terrestrial services.

Fixed Wireless Broadband Access: The use of wireless devices/systems in connecting two fixed locations, such as offices or homes. The connections occur through the air, rather than through fiber, resulting in a less expensive alternative to a fiber connection.

I

Internet Service Provider (ISP): A company that provides users (individuals or businesses) with access (a connection) to the internet and related services.

Interconnection: The linking of numerous telecommunications networks to exchange user traffic.

L

Last Mile: The technology and process of connecting the end customer's home or business to the local network provider.

Lit Fiber: An active fiber optic cable capable of transmitting data.

LMDS (Local Multipoint Distribution Service): A wireless broadband service that uses microwave signals to render communications service—voice, data, internet—to customers within the last mile.

Loan: The giving of money or property in exchange for payment of the principal amount plus interest.

Local Area Network (LAN): A group of connected network devices that are on a high-speed connection and typically within the same building or location.

LTE (Long Term Evolution): A 4G wireless broadband technology that provides speeds up to 100 Mbps download and 30 Mbps upload.

M

Middle Mile: The connection between a local network, also called a "last mile" connection, and the backbone internet network.

Mobile broadband: A type of internet connection designed for use "on-the-go" with seamless connectivity from one geographic location to the next.

N

Network Infrastructure: The hardware and software components of a network that provide network connectivity and allow the network to function.

O

Open Access Network: Networks that offer wholesale access to network infrastructure or services provided on fair and reasonable terms with some degree of transparency and nondiscrimination.

P

Point of Presence: The particular place or facility where local internet service providers connect to other networks. Distance from the Point of Presence can affect service availability and pricing.

Public Computer Center (PCC): A facility that is open to the public and provides broadband access, education, support, and training relevant to community needs. PCC locations include, but are not limited to, community colleges, libraries, schools, youth centers, employment service centers, and centers in public housing developments, among many others, that provide broadband access to the general public or specific vulnerable populations, such as low-income, unemployed, older adults, children, minorities and people with disabilities.

R

Rights-of-Way (ROW): ROW are legal rights to pass through property owned by another. ROW are frequently used to secure access to land for digging trenches, deploying fiber, constructing towers and deploying equipment on existing towers and utility poles.

S

Service Area: The entire area within which a service provider either offers or intends to offer broadband service.

SDSL (Symmetrical DSL): A technology that permits the symmetrical transfer of data over copper telephone lines. The transmission bandwidth for uploads and downloads is equal.

SONET (Synchronous Optical Network): An American National Standards Institute standard for the simultaneous transmission of data over optical fiber.

Spectrum: A conceptual tool used to organize and map the physical phenomena of electromagnetic waves. These waves propagate through space at different radio frequencies, and the set of all possible frequencies is called the electromagnetic spectrum.

T

Tier 1 Internet Network: A network of internet providers that form a superhighway that allows users access to every other network on the internet.

Tier 2 Internet Network: A network of smaller internet providers that allow users to reach some portion of the internet but that still purchase IP transit.

Transportation Investment Generating Economic Recovery (TIGER): A supplementary discretionary grant program administered by the U.S. Department of Transportation, included in the American Recovery and Reinvestment Act of 2009; now referred to as Better Utilizing Investments to Leverage Development (BUILD).

Telecommunication Services or Services: Includes regulated and unregulated services offered to customers for the transmission of 2-way interactive communication and associated usage. A telecommunication service is not a public utility service (from the Michigan Telecommunications Act).

Telemedicine: The use of high-speed, high-capacity internet to support long-distance health care services, patient and provider education, and enhanced health care administration.

V

VoIP (Voice over Internet Protocol): A technology that allows users to send and receive voice calls using an internet connection instead of a phone line.

W

Wi-Fi (Wireless Fidelity): A technology that uses radio transmissions to enable electronic devices to connect to a wireless local area network (LAN).

WiMAX: A wireless technology through which wireless internet access is provided with a significantly larger range than regular Wi-Fi. WiMAX can provide broadband service up to 30 miles.

WISP: An ISP that provides service through a wireless network.

Table of Units

Units Associated With Broadband	
Bit	Smallest unit of digital information
Byte	Equal to 8 bits
Bps	Bits per second
Kbps	Kilobits per second (1000 bits per second)
Mbps	Megabits per second (1 million bits per second)
Gbps	Gigabits per second (1 billion bits per second)
Tbps	Terabits per second (1 trillion bits per second)