

# Dane County Broadband Infrastructure Engineering Assessment

Current Assessment Progress Report

Dane County Wisconsin

Project reference: RFP#: 122044

November 18, 2022

**Prepared for:**

Dane County Wisconsin

**Prepared by:**

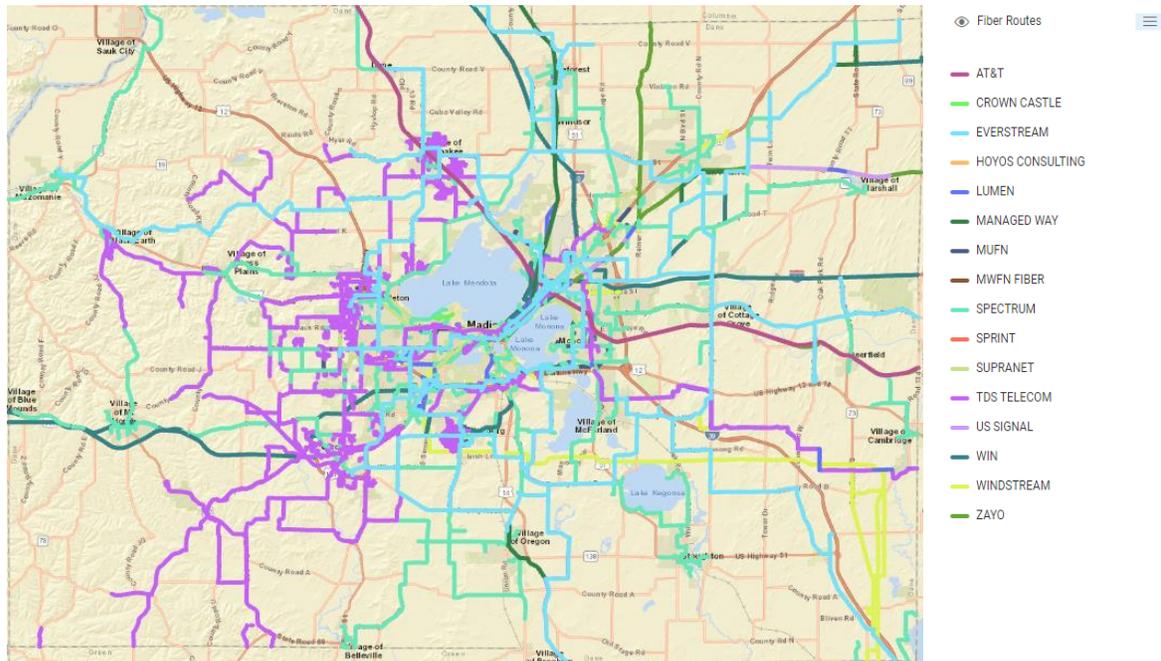
AECOM  
Technical Services Group  
aecom.com

Copyright © 2022 by AECOM

All rights reserved. No part of this copyrighted work may be reproduced, distributed, or transmitted in any form or by any means without the prior written permission of AECOM.



**Diagram 1: Fiber Routes**



While there is a varied presence of fiber networks in the county, not all network owners provide residential services to end users. ISP's such as Spectrum/Charter, TDS, AT&T Wisconsin, CenturyLink, Frontier, and others deliver directly to residences and businesses. Some of the networks are carrier-based service providers serving only businesses, governments entities, and community anchor institutes (CAI's). This would include networks and companies such as MUFN, Crown Castle Fiber, EarthLink Business, PAETEC Business Services, etc. While these fiber providers do not sell directly to residential users, they typically provide the opportunity for other companies to purchase internet service in bulk and resell it on their networks. The table below shows current fiber network owners and broadband providers offering services in Dane County.

**Table 1: Dane County Fiber Network Owners and Broadband Providers**

---

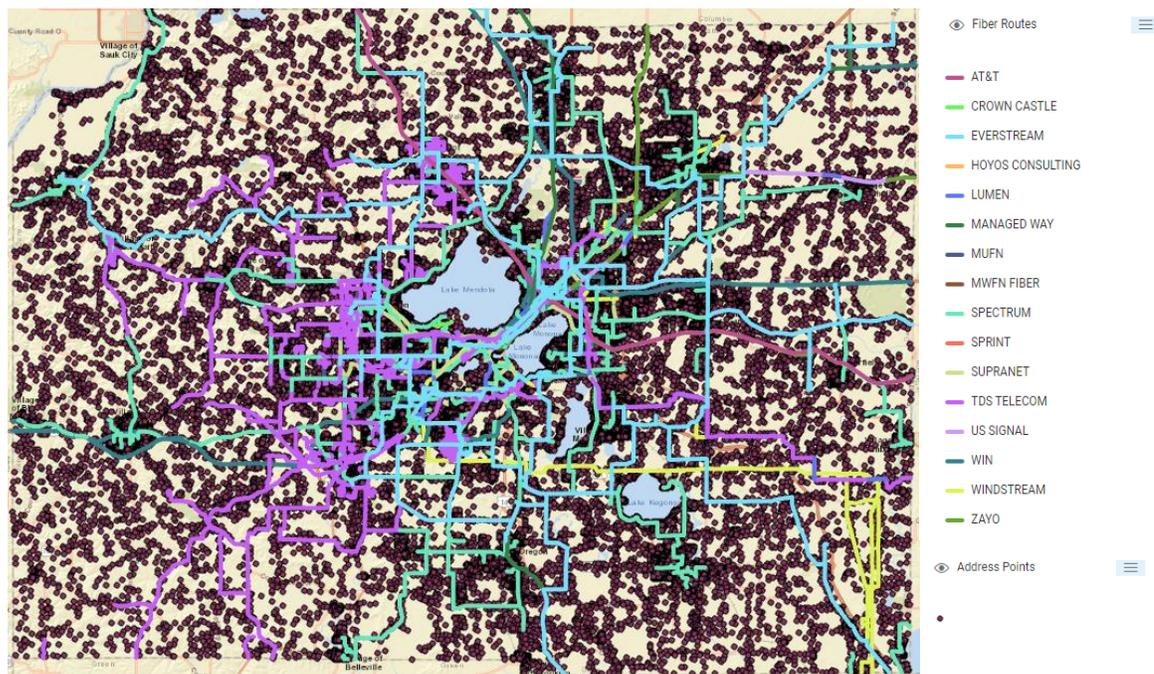
Spectrum/Charter Communications
TDS Telecom/metrocom
AT&T Wisconsin
CenturyLink/Lumen
Viasat
Upnetwi
Frontier Communications
LiteWire
HughesNet
Mt Horeb Telephone Company
BugTusselWireless
Netwurx LLC
US Cellular
VSAT Systems
Call One, Inc.
CBTS Technology Solutions, LLC
Compudyne
Consolidated Communications
Crown Castle Fiber
EarthLink Business, LLC
Fusion Cloud Services, Inc.
GCI Communication Corp.
Logix Communications
MCI
McLeod USA Telecommunications Services, LLC
MUFN
PATEC Business Services
Tailwind Voice and Data
TPx Communications

US Signal Company

Voyant Communications

The fiber map above also contains additional layers detailing the existing CAI's, cell towers, and all the address points within the county. Each of these layers can be individually overlayed on the fiber network and broadband provider layer to view where the fiber networks traverse with relation to each of the data points. As can be seen in the map below, when the address points are viewed with the existing fiber networks the most apparent issue is the lack of fiber infrastructure to residential users. Fiber optic networks cost money to deploy and maintain, and ISP's weigh build costs against their return on investment (ROI). It is often cheaper to utilize existing, inferior network infrastructure to provide service than to overbuild an entire network with a new fiber optic cable. It is also not cost effective for providers to build fiber into rural areas where the population density lacks the sufficient business case to support build costs. The result is less fiber available to the overall population, perpetuating the lack of connectivity issues to unserved and underserved areas of Dane County's communities.

**Diagram 2: Fiber Routes and Address Points**

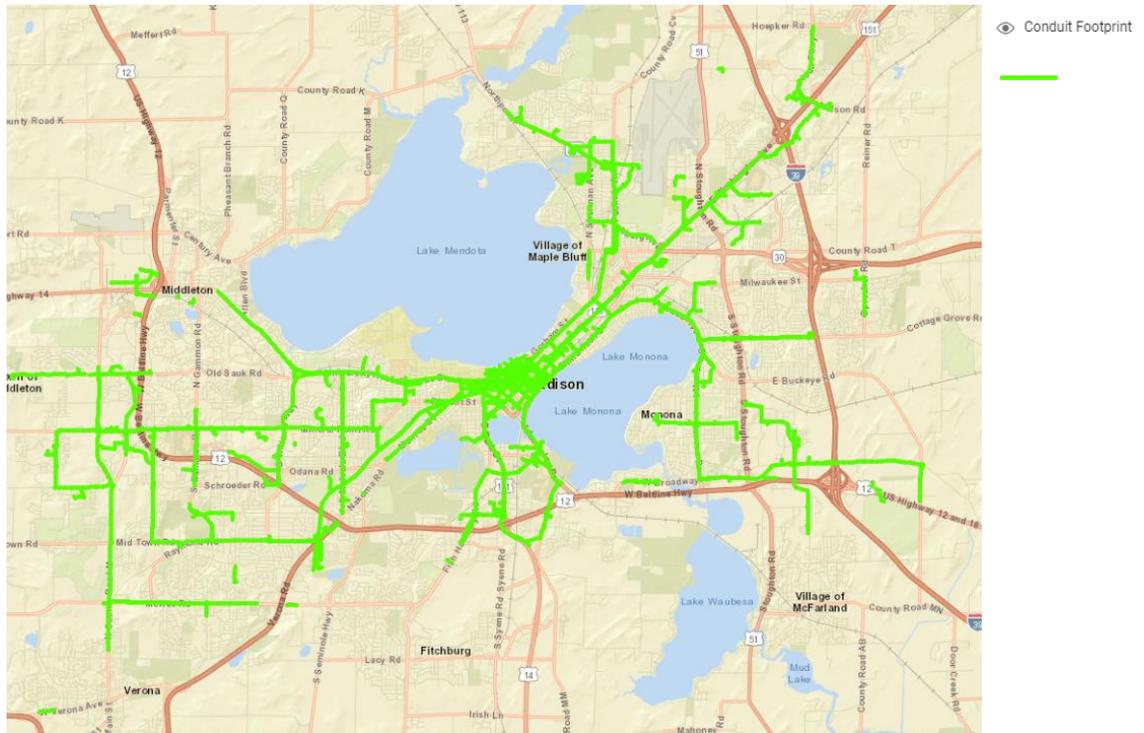


The UW River Falls report surveyed county residents regarding how they gained access to the internet at their homes. Approximately 68% of the respondents either accessed the internet through a cable modem or a landline/DSL subscription. Cable modem internet can be provided over fiber or coaxial cable. Only 11.5% responded that they are served via fiber optic cable. Landline/DSL services are exclusively provided over legacy, copper networks. As Diagram 2 shows, the density of fiber in the county is not proportionate with the number of address points and supports the results of the survey. The facilities-based providers overcome gaps in the fiber network by deploying coaxial or copper cables to the end user. Copper networks provide an inferior and lower bandwidth access option compared to fiber optic cable. Fiber optic is future proof and scalable to support new technology and increased demands in speeds. Fiber cables provide greater speed as they carry data via light waves while coax and copper are limited to transmitting data electrically. Coax and copper are susceptible to interference making them less reliable, while fiber optic cable can transmit services over greater distances, with higher bandwidth and with lower latency and less signal loss.

## MUFN

Diagram 3 below provides a view of an existing, middle mile metro network known as the Metropolitan Unified Fiber Network (MUFN) that serves the Madison, Middleton, and Monona areas. The network was built with a Broadband Technologies Opportunities Program (BTOP) grant under the American Recovery and Reinvestment Act of 2009 (ARRA). The MUFN conduit and cable assets are owned and maintained by two entities, the City of Madison with approximately 90% ownership and the University of Wisconsin (UW) who owns the remaining 10%. MUFN's network is a consortium of 19 Madison area entities consisting of 15 non-profit groups and 2 commercial partners. The current MUFN affiliates are shown below in Table 2. MUFN does own and operate its own network over the backbone, but MUFN is not a broadband provider. The consortium works directly with non-profits and commercial clients. Non-profit organizations can join MUFN as a member or work with either of the two commercial entities to determine how the network can be best utilized for their needs. Agreements to use the MUFN fiber are written as Memorandum's of Understanding (MOU's) between the organizations. MOU's are agreements between parties defining the mutually agreed upon nature and terms of the parties relationship. Organizations who are for-profit can work directly with MUFN's commercial partners to determine what they can do to support the for-profit entity. MUFN's network serves all members with services or fiber that can be used for public and private networks. Connections to the MUFN Fiber network can be accomplished by MUFN extending into an end user location or the affiliate building to connect to the existing fiber. The fiber network currently connects many of the Community Anchor Institutes (CAI's) in its footprint. CAI's are defined as schools, libraries, medical and healthcare providers, community colleges and other institutions of higher education, and other community support organizations and entities such as police and fire stations. MUFN also connects to commercial and residential buildings for broadband services that are delivered by the commercial partners. MUFN is currently not interested in extending beyond Dane County, but they have expressed that supporting high-speed, affordable broadband throughout the county is a top priority. Dane County and MUFN have already had conversations, and MUFN wishes to continue working with the county and taskforce.

**Diagram 3: MUFN Conduit Footprint**



**Table 2: MUFN Affiliates 2022**

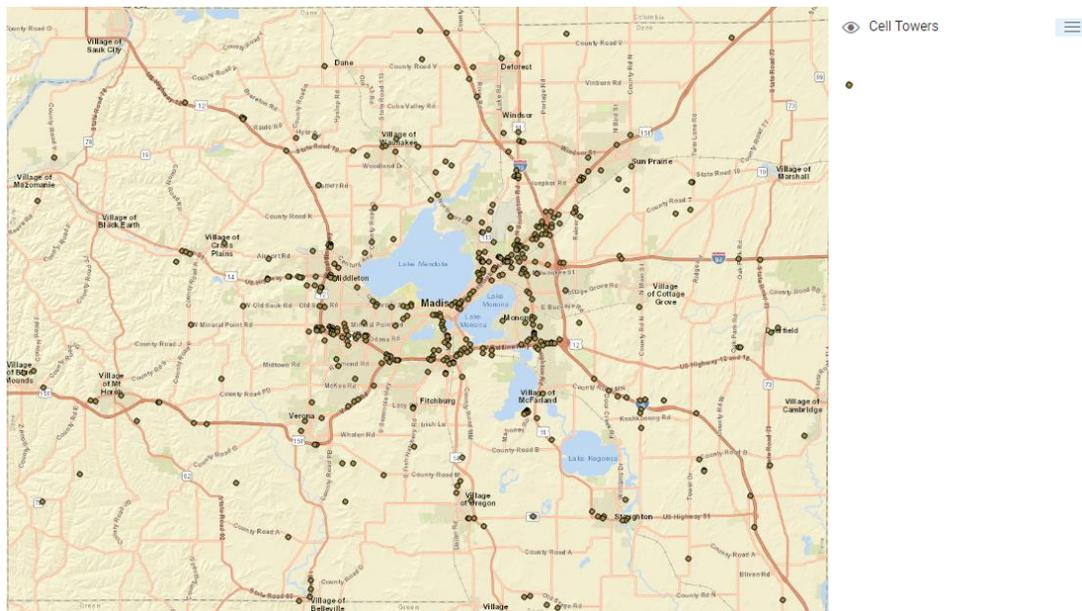
Non-Profit Affiliates
City of Madison
City of Middleton
City of Monona
Dane County
DaneNet
Madison College
Madison Metropolitan School District
Middleton-Cross Plains School District
Monona Grove School District
South Central Library System
UnityPoint Health – Meriter
University of Wisconsin – Madison
UW Health
Wisconsin Department of Public Instruction
Wisconsin Geological and Natural History Survey
Wisconsin Independent Network
Wisconsin State Lab of Hygiene
Broadband Technologies Opportunity Program
Commercial Affiliates
SupraNet Communications
Wisconsin Independent Networks (WIN)

## Wireless Broadband

Wireless broadband delivery is another option used for providing broadband services. The UW River Falls Survey found that 18% of the respondents use some form of wireless broadband internet access. The use of fixed wireless access accounted for 7% of wireless broadband access. Fixed wireless technology delivers internet over signals that are delivered from a fixed point that could be miles away to a fixed point in the home such as an antenna or modem that remains in a fixed location. Cellular internet also deliver broadband over signals transmitted through the air, but there is a difference from fixed wireless service. Cellular service also generates the signal from a fixed location, but the receiving device is a mobile phone or hotspot device that is not in a fixed location. Survey respondents reported that 6% of the participating households use cellular or hotspot internet access for their broadband needs. The remaining 5% of respondents use satellite services for broadband access. Satellite broadband is delivered by communication satellites to the consumer. Wireless broadband deployment does have some advantages

over fiber optic networks. Fiber networks deployment is typically a time consuming and lengthy process where most wireless applications can be deployed very quickly. Fiber optic is also more costly than wireless deployment in regard to the materials and equipment used. These advantages are why wireless is often deployed to more rural areas where fiber networks do not exist today. However, fiber optic networks deliver a superior broadband experience in many ways. Fiber optics uses light to transmit data as opposed to signals propagated through the air for wireless broadband. The light waves are not susceptible to interference like wireless signals and give a less interrupted experience. Fiber networks can carry a higher maximum speed and continue to provide a consistent speed when the network becomes congested with users. Wireless in theory can do the same, but the user speeds typically decrease as the network congestion increases. Distance is a limiting factor for both fiber and wireless, but fiber can carry the signal, with less signal degrade, much further than wireless. While fiber is considered superior, wireless does have an application and technology continues to improve. Diagram 4 shows the existing cell tower infrastructure in Dane County. Cell towers are the most common fixed point for generating wireless broadband signals. The area in Dane County that is most densely populated with cell towers is in and around the more urban areas. This area is already populated with various fiber optic network options. The rural areas could benefit with wireless access as an option, but those parts of the county are sparsely populated with towers.

**Diagram 4: Cell Towers**

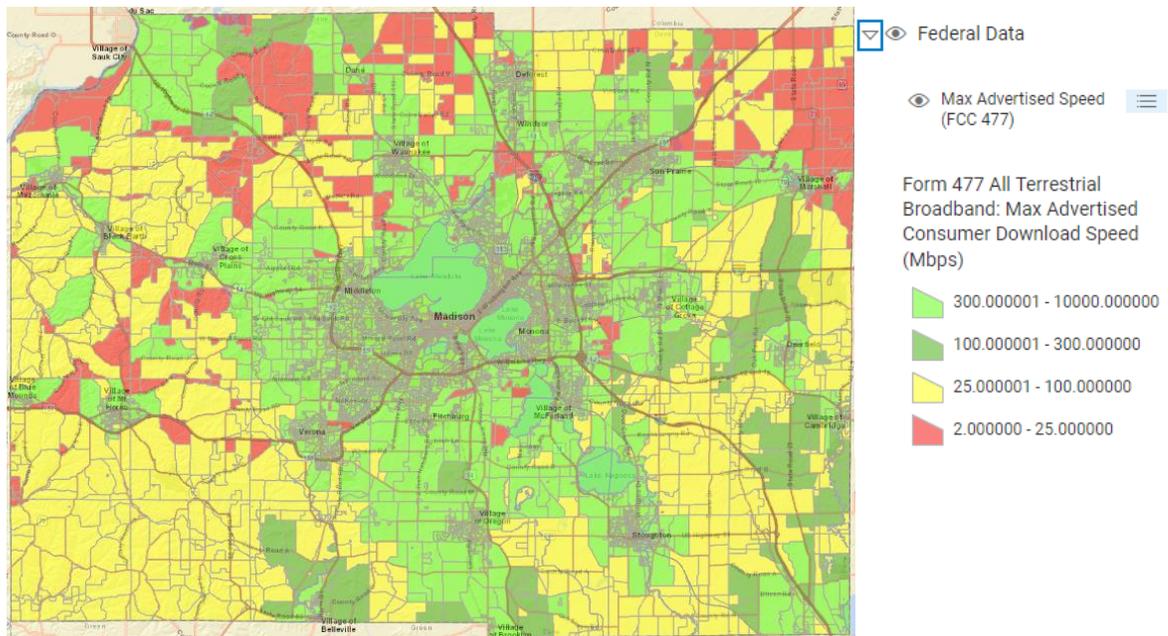


## Broadband Service Max Advertised Download Speeds

This assessment also reviewed internet quality experienced by users who currently subscribe to services. The majority residents outside of the greater Madison area are considered underserved or unserved by NTIA guidelines. Underserved broadband users are defined as having a download speed of less than 100Mbps and 20Mbps upload speed. Unserved users have an average download speed of less than 25Mbps and less than 3Mbps upload speed. Neither classification is considered to be reliable broadband. The need for reliable broadband has been increasing for years and became immediately apparent during the pandemic. Post-pandemic need for broadband continues to grow as the world has shifted to more automated and application driven services, remote education options, telecommuting for work and telehealth services. The UW survey asked respondents to define their most popular uses for internet. The most popular use for the internet was for entertainment such as streaming services. 71% of the respondents said they frequently use internet for entertainment purposes. The next most popular household uses are

telecommuting for work (48% of respondents) and as a primary way to access medical information or services (41%). Remote education accounted for almost a third (32%) of the respondent's frequent usage. The survey also asked respondents about how better internet would change aspects of their lives related to business, telecommuting, and agricultural businesses. While the majority of respondents (74%) were unsure or unlikely to start, move, or grow a business, 26% said they were somewhat likely or very likely to start, move, or grow a business with better internet. Improved internet access would also impact telecommuting opportunity for 46% of the respondents with 32% saying they would be very likely to telecommute and 11% being somewhat likely to consider the option. Agricultural businesses expressed that they view internet as valuable (32%) or very valuable (38%). All the responses point to the need for better internet access for all aspects of Dane County's residents' lives. Residents of the county could potentially expand options for employment and improve their quality of life. There is also an economic impact that could be had as businesses would potentially be created or grow, and agricultural businesses could modernize and scale efficiencies to increase production and bottom-line growth.

**Diagram 5: Max Advertised Download Speeds (FCC Form 477)**



### Average Max Download Speeds vs. Max Advertised

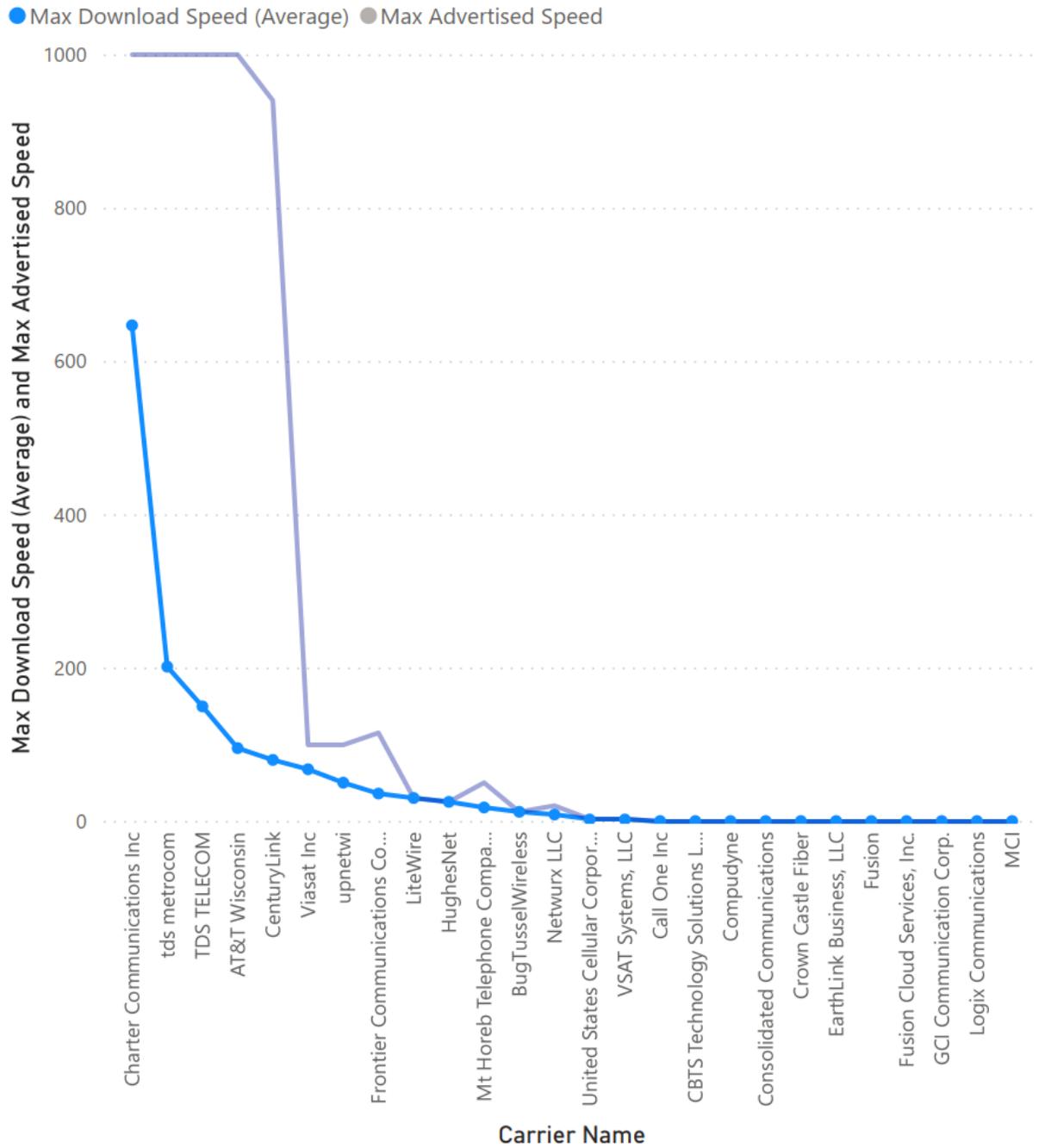
The initial assessment of broadband services consisted of mapping the maximum advertised speeds throughout the county. Below is a map showing the maximum advertised download speeds across Dane County from the FCC Form 477 data. Bright green indicates maximum advertised download speeds between 300Mbps and 1Gbps, dark green represents advertised download speeds 100Mbps to 300Mbps, yellow shaded areas are advertised download speeds between 25Mbps and 100Mbps, and red shading shows areas that have advertised download speeds of 2Mbps to 25Mbps. The map shows the two predominant advertised maximum download speeds fall in the 300Mbps-1Gbps range and 25Mbps-100Mbps. The map shows large parts of the county with access to advertised speeds between 100Mbps and 1Gbps. Speed test data compared to maximum advertised download speeds provides a clearer picture of the internet quality available to Dane County residents. The below map is a view of speed test results showing that actual services are well below advertised maximums. Bright green indicates speed test results within advertised speeds and red indicates speed test results that are below advertised speeds. When compared to the map showing the maximum advertised speeds, the majority of the county is receiving much less speed than advertised. UW River Falls study also queried respondents about their download and upload speeds. Download speeds were broken into six different categories. The highest download speed category was 100.1Mbps or faster which is above the download speed threshold for classifying service as underserved. 30% of the polled people said that their broadband download speeds fell into this category. The remaining five categories for download speeds, with response percentages, were 100Mbps-20.1Mbps (31%), 20Mbps-10.1Mbps (12%), 10Mbps-5.1Mbps (10%), 5Mbps-1.1Mbps (12%), Under 1Mbps (6%). The responses show that 70% of the respondents download speed is at or below the underserved threshold and of the 70% that are underserved, approximately 18% are considered underserved. Upload speeds were also collected as part of the study and show similar results. The study broke the upload speeds into six categories as well. The two categories that were above the underserved threshold were 100.1Mbps or faster and 100Mbps-20.1Mbps. Responses showed that 10% of the people have upload speeds at or greater than 100.1Mbps and 11% fell into the 100Mbps-20.1Mbps range. The remaining four upload speed categories, and their associated percentages, were 20Mbps-10.1Mbps (20%), 10Mbps-5.1Mbps (19%), 5Mbps-1.1Mbps (21%), and Under 1 (19%). Upload speeds show similar results with the majority of the respondents (79%) at or below the upload speed threshold for underserved and approximately 40% would fall into the unserved classification. The collected data supports the results shown in the map that show much slower user speeds than advertised.

**Diagram 6: Speed Test Below Advertised**



**Diagram 7: Average Max Download Speed vs. Max Advertised**

**Max Download Speed (Average) and Max Advertised Speed by Carrier Name**



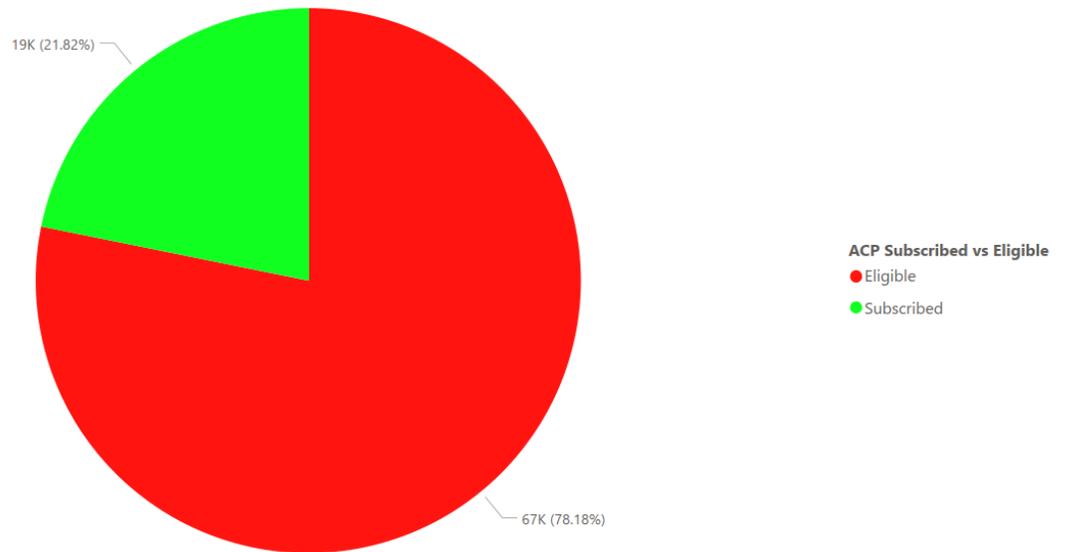
## Broadband Satisfaction

Broadband user satisfaction correlates directly to the quality of the service they are receiving. Customers pay for their connections and expect to receive the corresponding service levels. The quality of the connection is also important for the subscribers intended broadband use. Connections that are too slow, intermittent, or unavailable cannot support the higher bandwidth needs to transmit data engaging in more popular activities like streaming services, gaming and on-line applications for telecommuting, remote learning, or remote healthcare. Responses to the UW River Falls survey show that only 19% of those reporting are very satisfied. The remaining 81% fall into four categories of somewhat satisfied (30%), neutral (17%), somewhat dissatisfied (19%) and very dissatisfied (15%). 51% of the respondents are not satisfied with their service. The reason respondents are dissatisfied with their service fell into four main categories. The highest percentage of responses (39%) said the services are too expensive. This also correlates with another part of the survey where 34% of the responses state they had no internet at home currently because it is too expensive. The remaining 61% of respondents were not satisfied with their service because it was too slow (32%), unreliable (27%), or they received poor customer service (11%). The data shows that 89% of the respondents are dissatisfied because of poor quality.

## Affordable Connectivity Program

Dane County population in 2020 was 542,459 residents. The poverty rate was 11% which puts 59,670 people at or below the poverty line. The Affordable Connectivity Program (ACP) is a federally funded program that aims to provide affordable, high-speed internet to low-income households. The current ACP provides a discount of up to \$30.00 per month for eligible households and up to \$75.00 per month for Tribal lands. Eligible households are also able to receive a one-time discount of up to \$100.00 to purchase a laptop, desktop computer, or tablet from a participating provider. There are 67,000 Dane County residents who are eligible to participate in ACP, but only approximately 19,000 of the eligible households are enrolled. This shows that 78.2% of the eligible households are not enrolled in the program (see Diagram 6). With a discount of \$130.00 per household (includes the \$100.00 purchase discount), and only 21.8% of those eligible participating, the amount of federal funding not being used by eligible households is approximately \$8,710,000.00. Lack of ACP participation in the program can be attributed to residents not knowing about the program or not knowing how to apply. The FCC recognizes the need to bring awareness to the program and opened a Affordable Connectivity Outreach Grant program on November 10, 2022. The purpose of the grant program is to facilitate the promotion of the ACP and increase awareness and participation in the ACP. There is a total of \$70,000,000.00 available for this program and it is split across two different grants. The National Competitive Outreach Program (NCOP) is allocated \$60,000,000.00. Of the \$60,000,000.00, \$27,000,000.00 will be reserved for each state to receive a minimum of \$500,000.00 for ACP outreach initiatives. The Tribal Community Outreach Program (TCOP) receives the remaining \$10,000,000.00 to be used for ACP outreach activities specific to tribal communities. Applications must be submitted by 11:59pm EST January 9, 2023, with monies to be awarded on or before March 10, 2023. Additional information on the program and the application link can be found at the following URL: <https://www.fcc.gov/acp-grants>.

**Diagram 8: ACP Eligible Households vs. Subscribed Households**



### Closing Remarks

The current infrastructure assessment has set a solid foundation for the AECOM team to move forward with Technology Options. The Technology Options segment of the Infrastructure Engineering Assessment will include an assessment of all available technologies to provide service to end users including Fiber-to-the-Premise (FTTP) and wireless technologies when applicable. AECOM will determine a conceptual design for deploying future infrastructure, along with a Bill of Materials (BOM), equipment requirements, and rough order of magnitude (ROM) costs to implement a broadband solution. AECOM will provide a comprehensive progress report detailing the above deliverables and a map will be provided in GIS format that outlines all aspects of the study noted above.

---