

BROADBAND



Part One:

DISCUSSING the **TECHNOLOGY**

July 2020



The Delaware Valley Regional Planning Commission is the federally designated Metropolitan Planning Organization for a diverse nine-county region in two states: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey.



DVRPC's vision for the Greater Philadelphia Region is a prosperous, innovative, equitable, resilient, and sustainable region that increases mobility choices by investing in a safe and modern transportation system; that protects and preserves our natural resources while creating healthy communities; and that fosters greater opportunities for all.

DVRPC's mission is to achieve this vision by convening the widest array of partners to inform and facilitate data-driven decision-making. We are engaged across the region, and strive to be leaders and innovators, exploring new ideas and creating best practices.

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EXECUTIVE SUMMARY

Introduction

As was true with waterways, highways, railways, and electricity in prior decades, broadband is a crucial driver of job creation and economic growth. Internet applications reliant on high-speed broadband are increasingly critical for innovations in health care, education, transportation, business, and communications. The American Recovery and Reinvestment Act of 2009 allocated \$7.2 billion to expand broadband services, create jobs, and stimulate economic growth. To build upon prior efforts, investments are still needed at every level (federal, state, and local) to enable all citizens to capitalize upon this technology.

Over the course of the Coronavirus Disease 2019 (COVID-19) pandemic, broadband has proven to be a vital utility. It enabled the requisite social distancing to occur while also facilitating emergency response efforts and continuity of public, private, and personal operations. The pandemic also further underscored the region's digital divide.

Therefore, the Delaware Valley Regional Planning Commission's (DVRPC's) analysis

of broadband and the digital divide in Greater Philadelphia will be published as a three-part Broadband series. This enables DVRPC to fully analyze the socioeconomic impacts of the digital divide as understood prior to and highlighted during the pandemic, and to formulate more relevant and timely recommendations for bridging the divide.

Part One: Discussing the Technology

This report is Part One in the Broadband series. It maintains a narrow focus outlining the basics of how broadband works, and ascertains the coverage areas for specific technologies and Internet Service Providers (ISPs) active within the region.

How Broadband Works

The National Telecommunications and Information Administration (NTIA) defines broadband as an advanced communications system capable of providing high-speed (a minimum of 768 kilobits per second [Kbps] download and 200 Kbps upload) transmission of information over the Internet and other networks.

768

kilobits per second is the minimum download speed required in order to be defined as high-speed internet transmission

Broadband can be delivered via fixed broadband or wirelessly. Both types are provided extensively throughout the Greater Philadelphia area.

Technologies and Providers

Fixed technologies include Digital Subscriber Lines (DSL), Cable Modem, Fiber Optics, Leased Lines (T1), Broadband over Powerline (BPL), and Satellite, while wireless technologies include cellular mobile wireless (3G, 4G, LTE, 5G, WiMax), Wi-Fi, and Wireless Internet Service Providers (WISP).

Satellite is the dominant type of fixed broadband technology, covering 100 percent of the region, and ViaSat, Inc. (ViaSat) is the dominant ISP as it provides coverage for the entire region. However, it is important to note that data available from the Federal Communications Commission (FCC) is self-reported by the ISPs at the census block level, and an entire block can be considered served by an ISP even if there is only one customer served within that area.

Part Two: Understanding the Digital Divide

In Part One of the series, DVRPC identified a digital divide with regards to speeds and consumer choice among ISPs. The divide exists between New Jersey and Pennsylvania, as well as between residential and business consumers.

Part Two of the series, "Understanding the Digital Divide," will look to answer the question:

To what extent does a digital divide exist at the neighborhood level, and what were the ramifications of such a divide during the COVID-19 pandemic?

Part Three: Bridging the Digital Divide

The third and final part in the Broadband series will synthesize and build upon Parts One and Two, and formulate policy recommendations aimed at bridging the region's digital divide.

INTRODUCTION TO BROADBAND

How Broadband Works

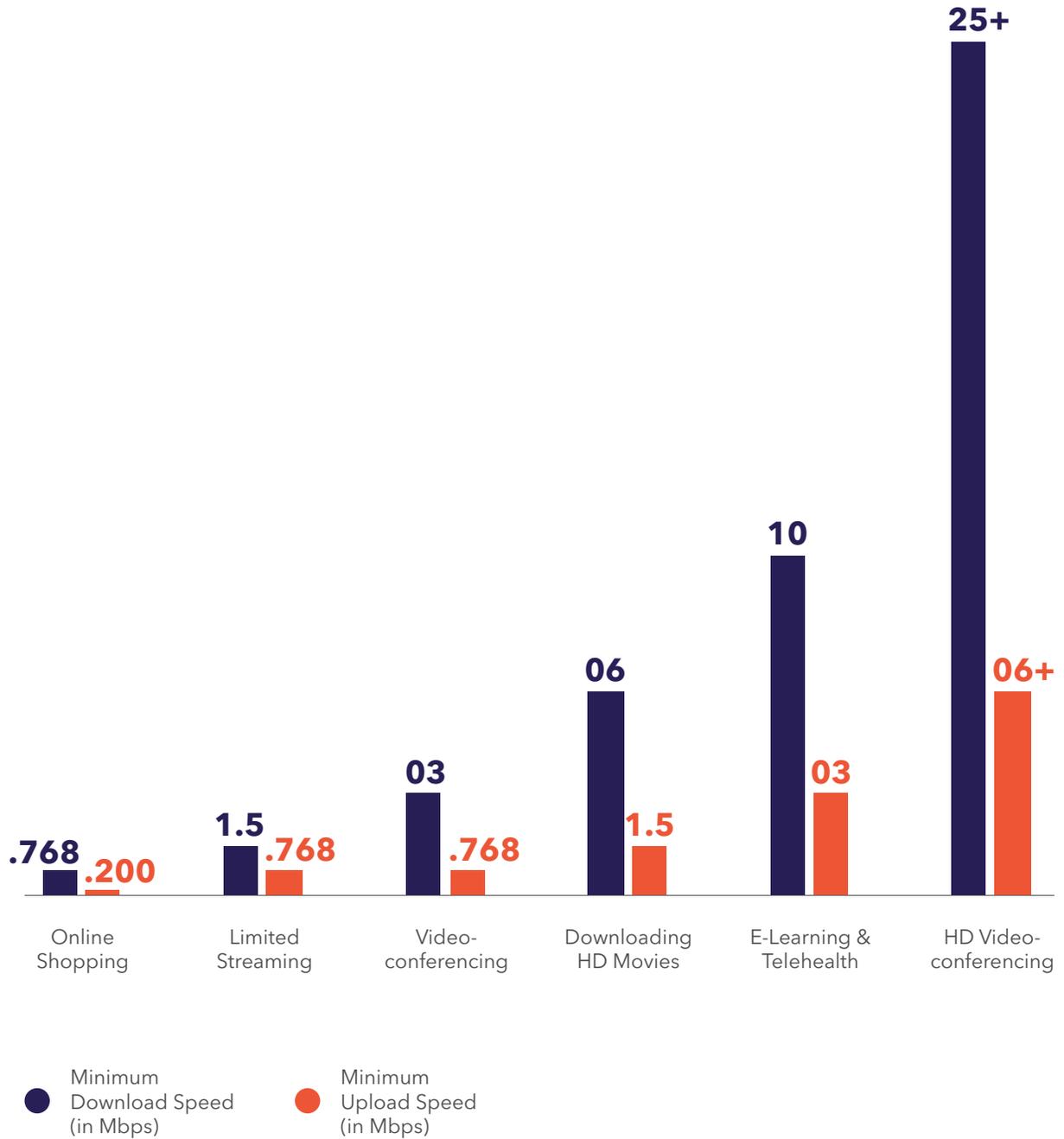
Theoretically, broadband has three layers and can be compared to the national highway system of interstate roads, state roads, and local roads. The highest level of the Internet, the “backbone,” is hosted by commercial, government, academic, and other high-capacity network centers. The “middle mile” refers to the segment linking the operator’s “core” network to the local network. The “last mile” then transports the Internet to homes and businesses. Community anchors, emergency services, hospitals and schools, municipal offices, and large businesses have the means and capacity to access broadband-based services. The majority of home and small business users rely on last-mile hosts and ISPs to obtain broadband.

Broadband is defined by how fast the user’s computer can download and upload information from the Internet. Download is the speed at which a computer receives data from the Internet, and upload is the speed to send data. The speed at which information can be transmitted depends on the bandwidth.

Bandwidth is the transmission capacity of an electronic pathway. That capacity can be described in terms of how much data, measured in bits, can be transmitted per second and is reported in Kbps, megabits (Mbps), and gigabits. The NTIA defines broadband as providing a minimum of 768 Kbps download and 200 Kbps upload. Most broadband technologies have different download and upload speeds, with upload speed typically more limited. Table 1 on the next page provides examples of the broadband speeds required to execute various activities over the Internet.

As evidenced in Figures 1 through 4 on the following pages, broadband speeds in Greater Philadelphia vary between Pennsylvania and New Jersey, rural and developed areas, and business and residential consumers. Furthermore, residential speeds are only advertised speeds, and not necessarily the speeds that are actually realized by individual consumers. This differs from business speeds, which are based on the speeds contracted with business consumers.

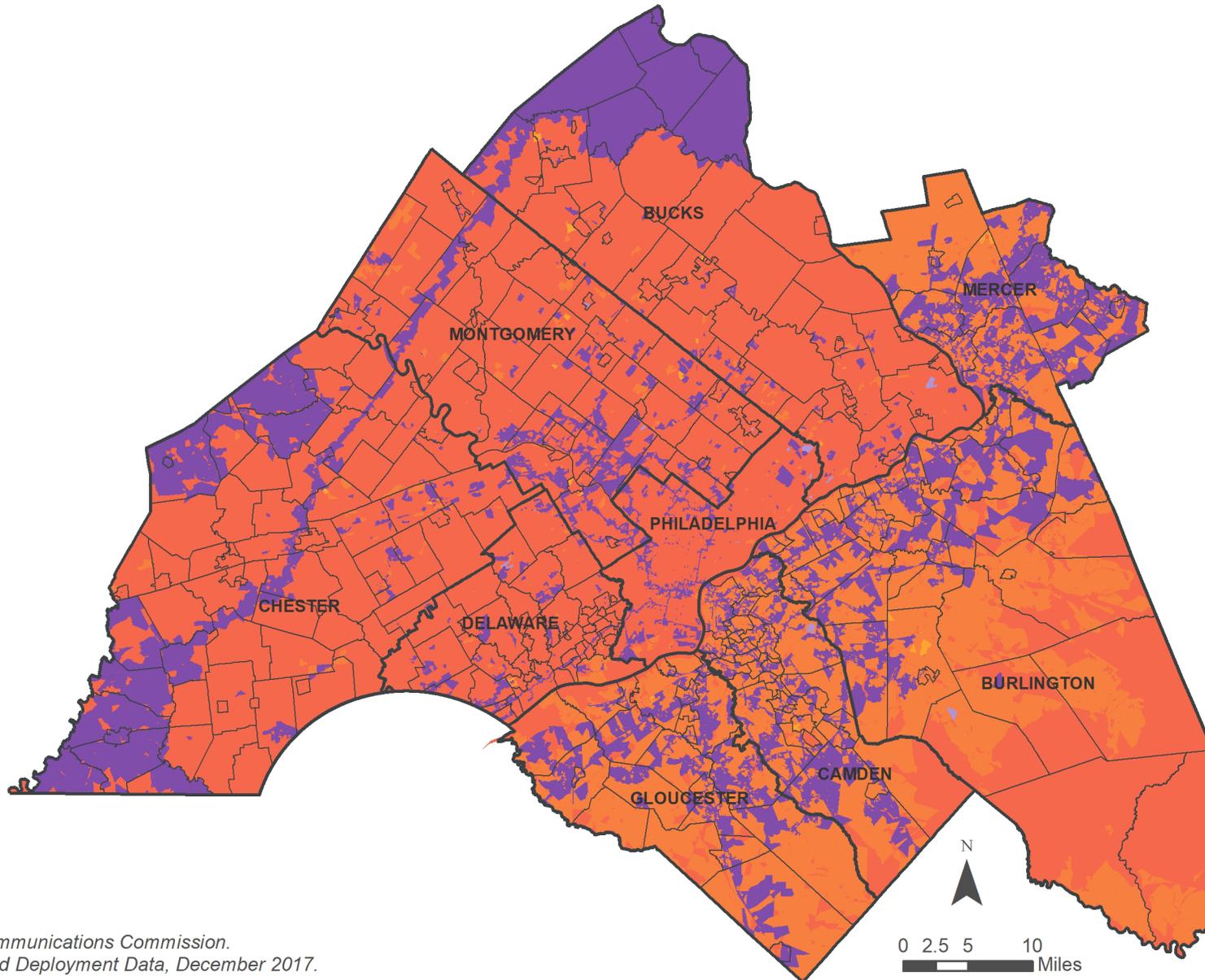
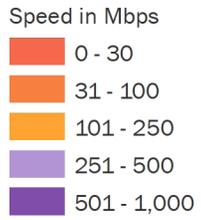
TABLE 1: Required Broadband Speeds



Source: Broadband Speed Guide, Federal Communications Commission, 2019.

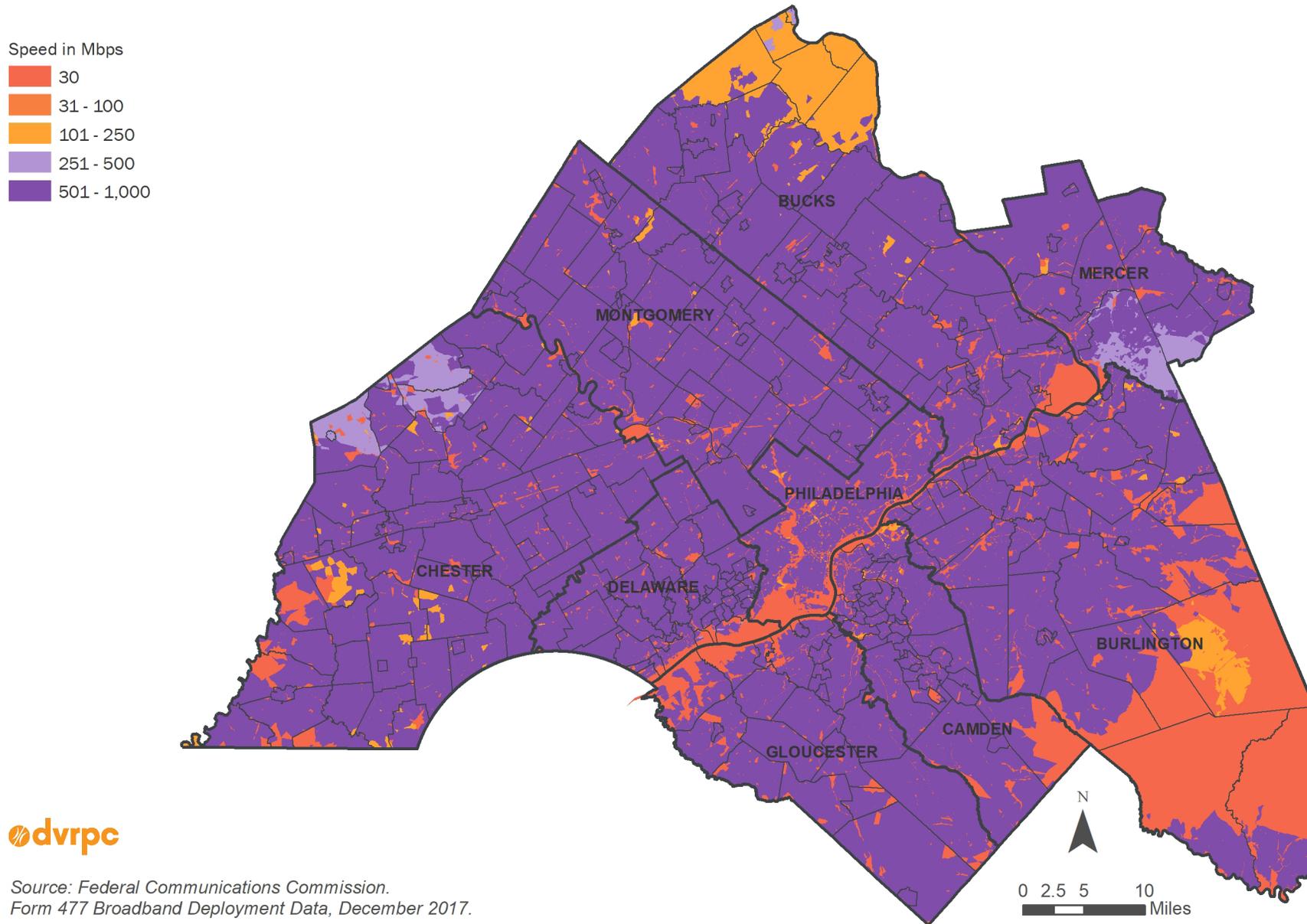


FIGURE 1: Highest Contracted Business Download Speeds



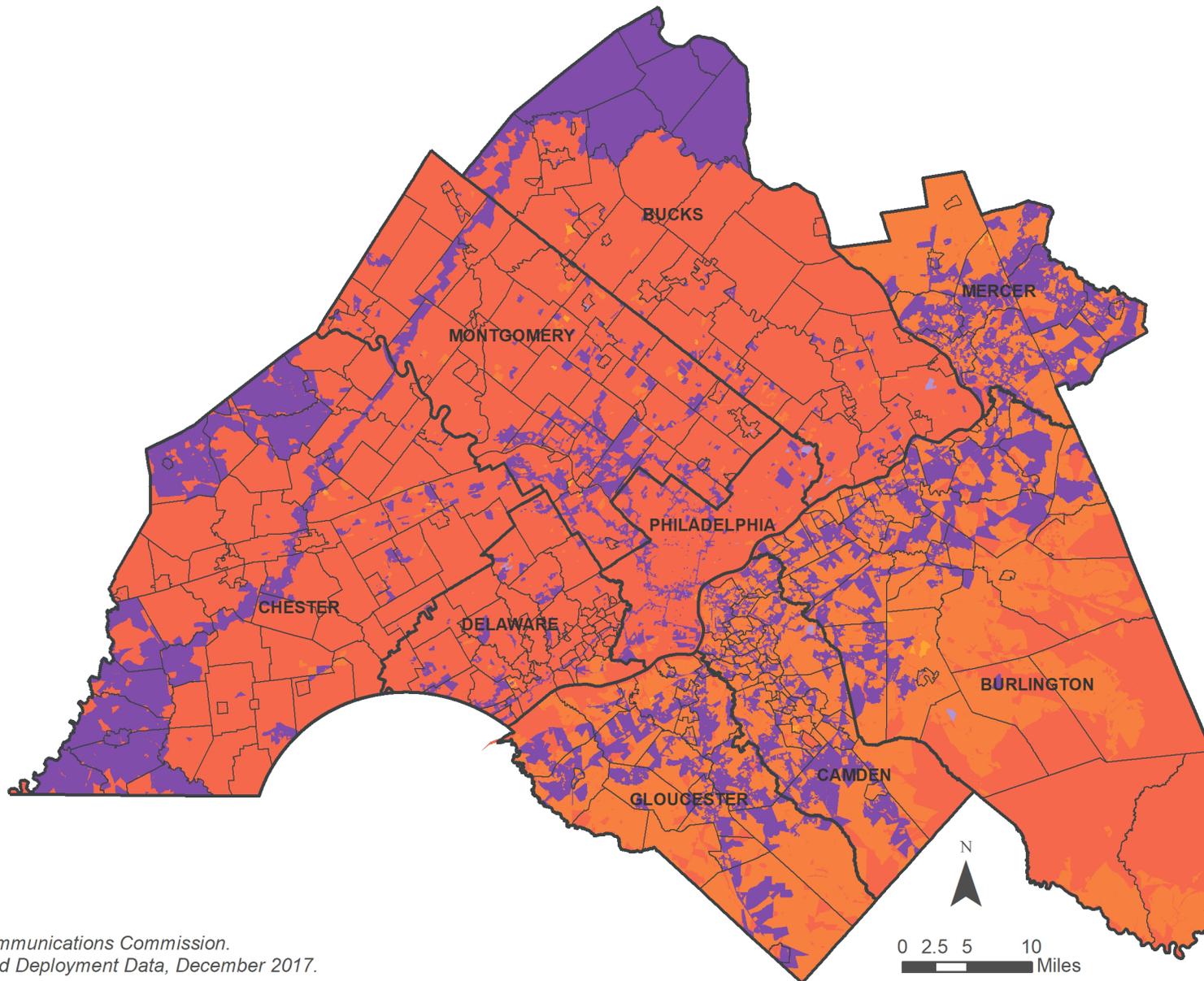
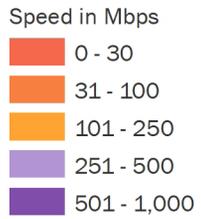
Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

FIGURE 2: Highest Advertised Residential Download Speeds



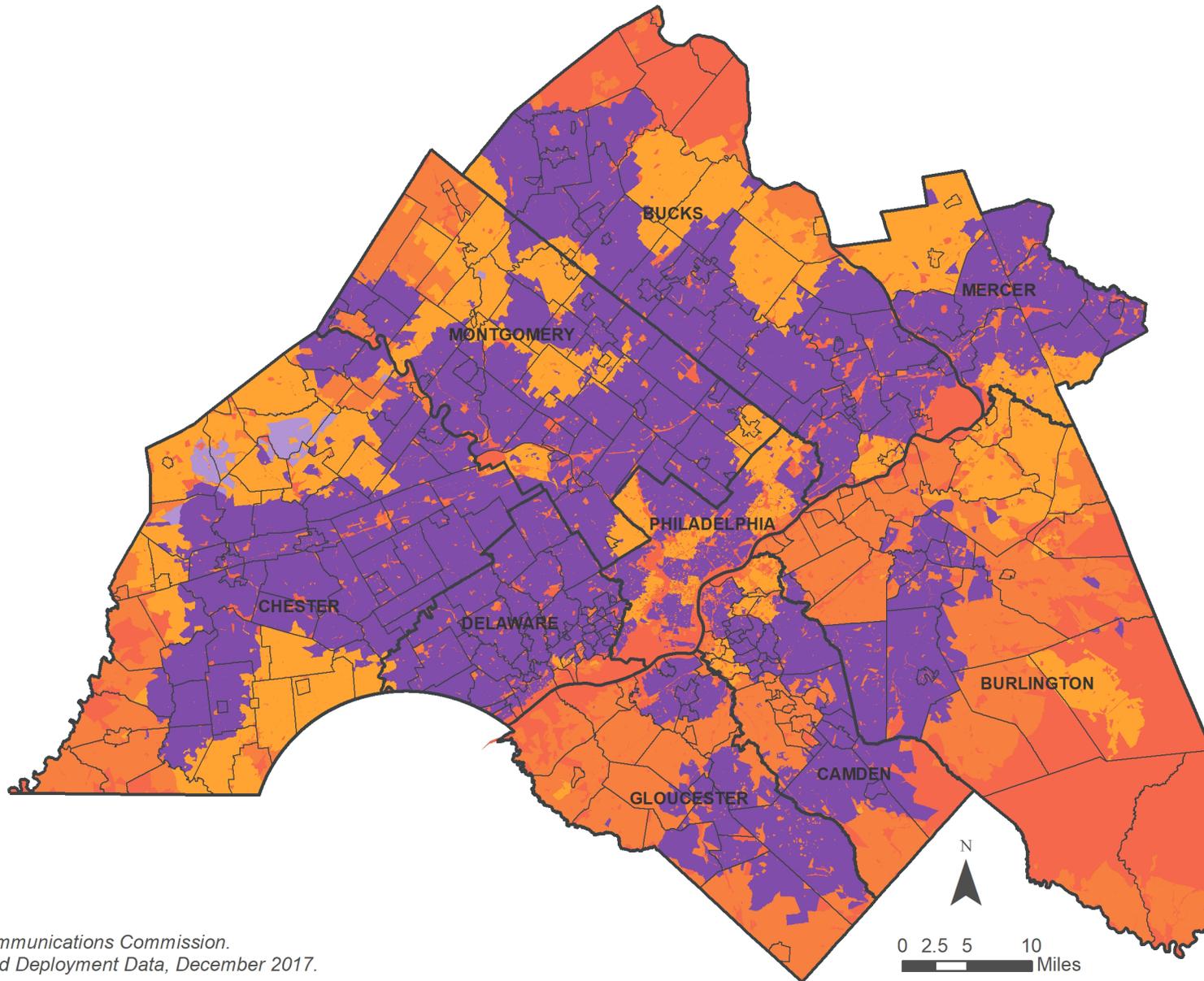
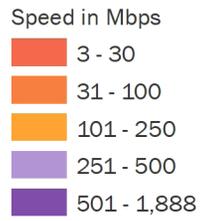
Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

FIGURE 3: Highest Contracted Business Upload Speeds



Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

FIGURE 4: Highest Advertised Residential Upload Speeds



Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

BROADBAND TECHNOLOGIES AND PROVIDERS

Technologies

There are two categories of broadband technologies: fixed and wireless. Both of which cover the Greater Philadelphia area extensively.

Fixed Broadband

Fixed broadband technologies bring a wire connection to the home or business, and a Wi-Fi router can then be used by the subscriber to share the Internet connection internally among several devices. Fixed technologies include DSL, Cable Modem, Fiber Optics, Satellite, Leased Lines (T1), and BPL.

DSL

DSL is the existing landline-wired technology used by residential and small business users. DSL uses copper phone lines to deliver direct connections to the Internet, allowing users to not share bandwidth with neighbors. Users must be located within 18,000 feet (3.4 miles) of a phone company's central office (this is an issue in many rural areas). DSL connections are asymmetric, meaning the networks offer more bandwidth and faster speeds for download compared to upload.

Symmetric types of DSL provide equal bandwidth for upload and download and are marketed as Business DSL. There are 14 DSL ISPs in the region, of which Verizon Communications, Inc. (Verizon) is the dominant provider.

Cable Modem

Cable-based Internet services use the cable television network to deliver broadband. This is typically faster than an asymmetric DSL connection. Cable networks are a shared connection, so speeds can slow during peak usage times. Of the 13 cable providers, Comcast Corporation (Comcast) is the dominant ISP throughout the region.

Fiber Optic

Fiber Optic systems use lasers across very thin strands of glass, creating a more resilient technology that has high capacity for speeds and data transmission. The cost of laying out the fiber network is high, but once in place the system can be easily upgraded and maintained, resulting in lower operating costs than DSL, cable, or wireless networks. Building out the fiber network is the most effective means to provide high capacity broadband Internet.

54

Fixed broadband providers in Greater Philadelphia

With a total of 31 ISPs, Fiber Optics offer the greatest range of options.

Satellite Internet

It may seem counter intuitive, but in 2018, the FCC concluded that Satellite should be categorized as a fixed broadband technology. Satellite users send and receive information via small dishes installed on the premises to a satellite in space, which transmits the signal to a network operation center that is connected to the Internet. Satellite-based Internet connection can be interrupted by objects and weather, and broadband upload speeds are typically slower than other networks (fixed and wireless). There are four satellite ISPs in the region.

Wireless

Wireless technologies use radio frequencies through transmitters and receivers to deliver broadband.

The most recent advancement in wireless technology was released in early 2019 and is known as the fifth generation or 5G. Because this generation is faster and has a much greater transmission capacity, it is expected to significantly advance

the capacity for the Internet of Things (IoT) and revolutionize the way in which we utilize the Internet. However, unlike prior generations, 5G requires a much shorter distance between the user and the antenna: meters instead of miles. Additionally, variables such as weather and obstructions will impact the functionality of 5G. Given these limitations, there is some question as to whether deployment of 5G will be viable in rural areas. Wireless technologies include cellular mobile wireless (3G, 4G, LTE), Wi-Fi, and WISPs.

Cellular Broadband

Cellular broadband is available in a variety of technologies. Cell phones and other mobile devices use mobile wireless technologies, such as 3G, 4G, 5G, LTE, WiMax, and other networks.

Wi-Fi

Wi-Fi or Hotspots are designed to broadcast the Internet for several hundred feet. They are used by public and private networks, including businesses for their employees or retailers for customers, who connect to the Internet by using Wi-Fi-enabled mobile devices (laptops, tablets, or phones).

"G" Networks

Wireless began in the 1980s with the first generation (1G) of networks with voice-only, analog service. The top speed of data transmission on a 1G network reached around 2.4 kbps. In 1991, the second-generation network (2G) began allowing cell phones to move into the digital realm. 2G allowed for call and text encryption, as well as Short Message Service, picture messaging, and Multimedia Message Service. The maximum speed for 2G was 50 kbps. By 1998, the 3G network was in practice, allowing for more data, video calling, and mobile Internet. This was the height of mobile technology and by today's standards, considered "slow." The current cellular network is 4G and is 500 times faster than 3G. It can support high-definition mobile TV; video conferencing with a top speed can be 10s of Mbps (when the device is moving); and when the device is stationary, it can be 100s of Mbps. The 20 megahertz bandwidth sector has peak capacity of 400 Mbps. However, since users are sharing available sector capacity among others, observable speed experiences by users are typically in 10s-100s of Mbps. As more people get access to mobile devices and the IOT expands, as many as 24 billion devices are expected to need cellular network support by 2024. The next generation (5G) will provide increased data transfer between devices more quickly than ever before, so high-density areas like airports and urban areas should experience fast speeds. Thanks to reduced latency and wider bandwidth, 5G will provide the necessary speed and efficiency.

WISP

WISPs are designed to cover large areas using point-to-multipoint networks to broadcast wireless data up to 20 miles. A signal is broadcast and received by a fixed wireless antenna. A combination of a Wi-Fi hot-spot and a WISP can enable a Neighborhood Internet Service Provider or a Wi-Fi hot-zone. A Wi-Fi hot-zone can cover areas such as a neighborhood, shopping mall, or campground. WISPs can provide "last-mile" availability.

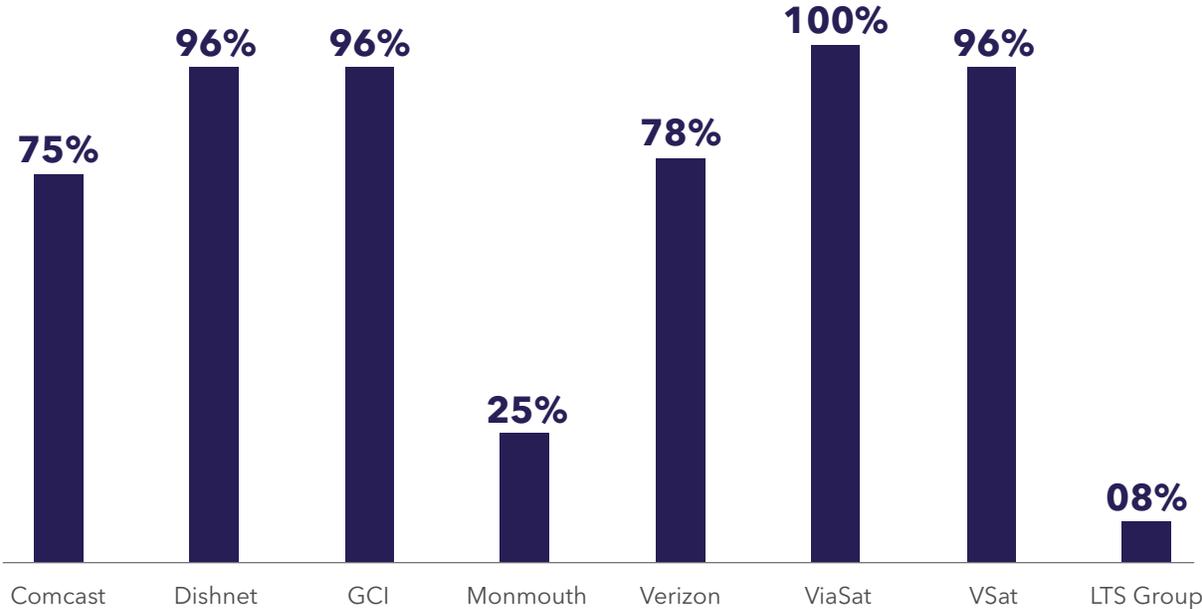
Providers

According to the FCC, within the region there are 54 unique fixed broadband providers and four wireless providers.

Fixed Broadband

The region's greatest coverage area is provided by ViaSat, which provides broadband via Satellite. Although, all four of the region's Satellite ISPs provide coverage of 96 percent or more.

TABLE 2: Fixed Broadband Providers with Greatest Regional Coverage



Source: Federal Communications Commission, 2017.



Verizon is the dominant non-Satellite ISP, with a coverage area of 78 percent. As demonstrated in Table 2, of the 54 total ISPs within the region, only six provide coverage greater than 25 percent. Figures 5 and 6 on the following pages demonstrate the number of fixed broadband providers by census block.

New Jersey versus Pennsylvania

Generally speaking, residential consumers in Pennsylvania have access to slightly faster advertised speeds compared to New Jersey.

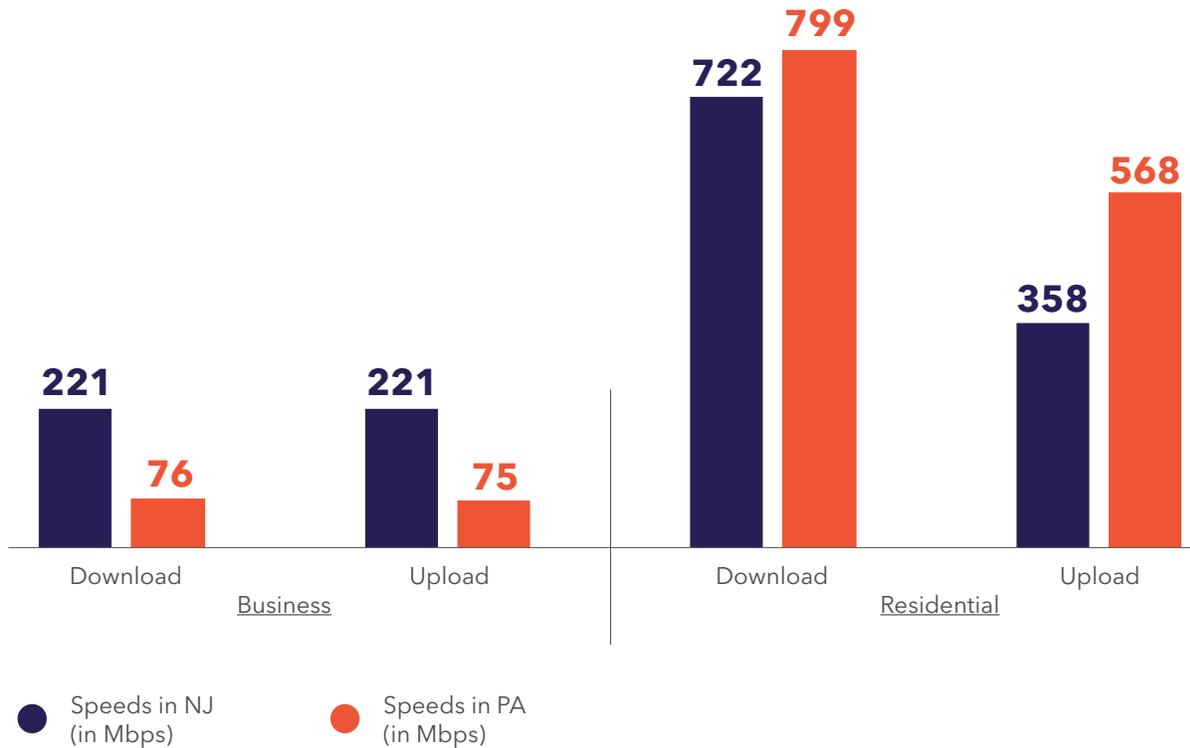
This is particularly evident in the rural parts of Burlington County.

With regards to choice of ISP, there are 35 ISPs operating in New Jersey, of which only 10 are residential ISPs. However, in Pennsylvania there are 45 ISPs, of which 17 provide Internet to residential customers.

Business versus Residential

As advertised by the ISPs, residential consumers in Pennsylvania have access to slightly faster broadband compared to their counterparts in New Jersey, while the

TABLE 3: Average High Fixed Speed by Consumer Type and State



Source: Federal Communications Commission, 2017.



inverse is true for business consumers as shown in Table 3.

Additionally, although there are 54 fixed broadband providers in the region, only 20 provide residential service whereas 50 provide service to businesses.

Wireless Broadband

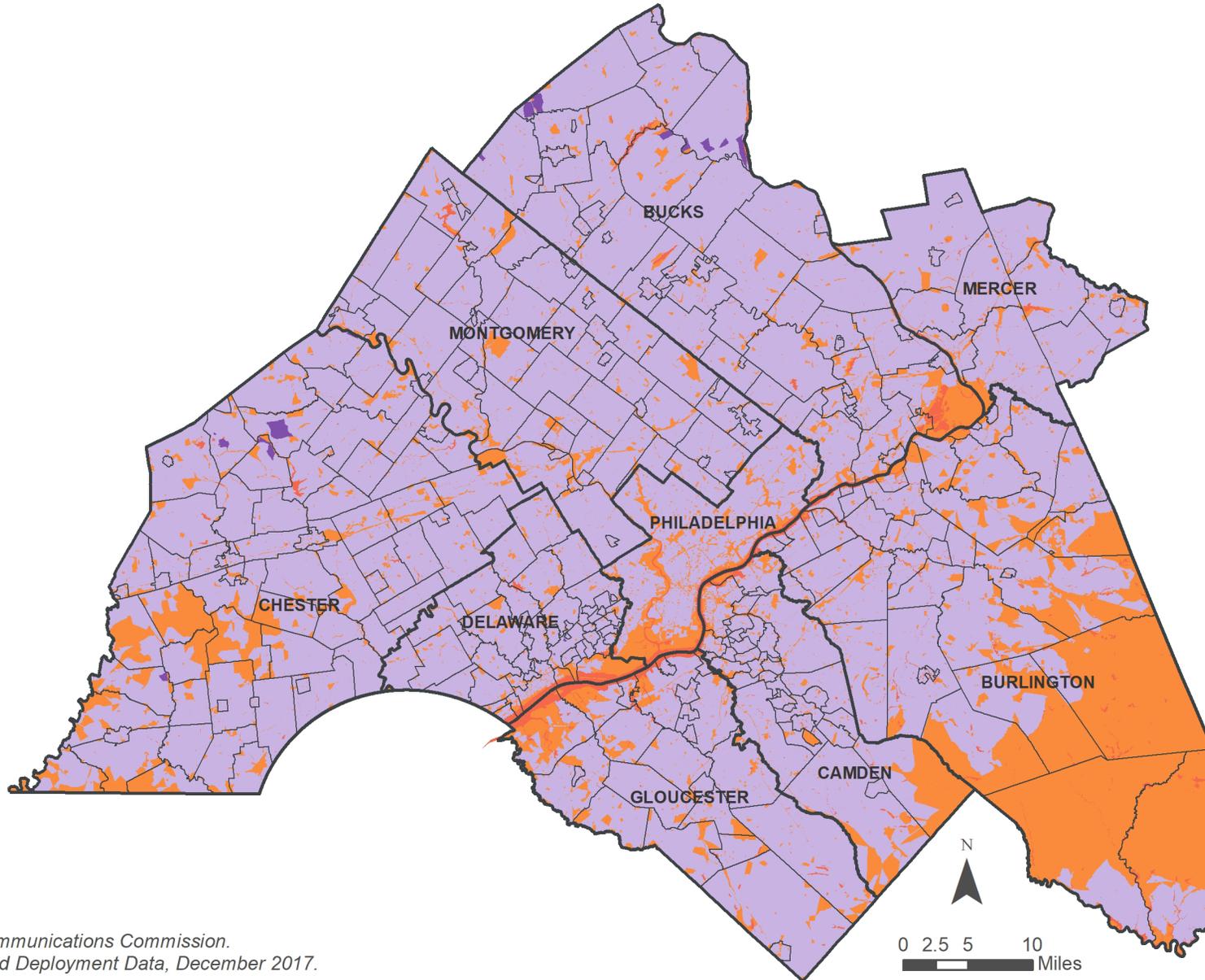
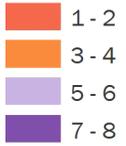
As defined by the FCC, there are only four wireless broadband providers in Greater Philadelphia: AT&T Mobility, Sprint, T-Mobile, and Verizon Wireless. As depicted in Figure 7, most of the region is covered by all four providers except for a portion of Burlington County, which is where the Pine Barrens are located.

Summary of Findings

Of the 54 fixed broadband providers, 47 only provide coverage for 8 percent or less of the region. Additionally, there is some degree of a digital divide between residential and business consumers, as well as between consumers in New Jersey and Pennsylvania. Part Two of the Broadband series will look to understand the digital divide at the neighborhood level and explore its impacts during the COVID-19 pandemic. Part Three will provide recommendations for bridging the digital divide.

FIGURE 5: Number of Fixed Residential Providers

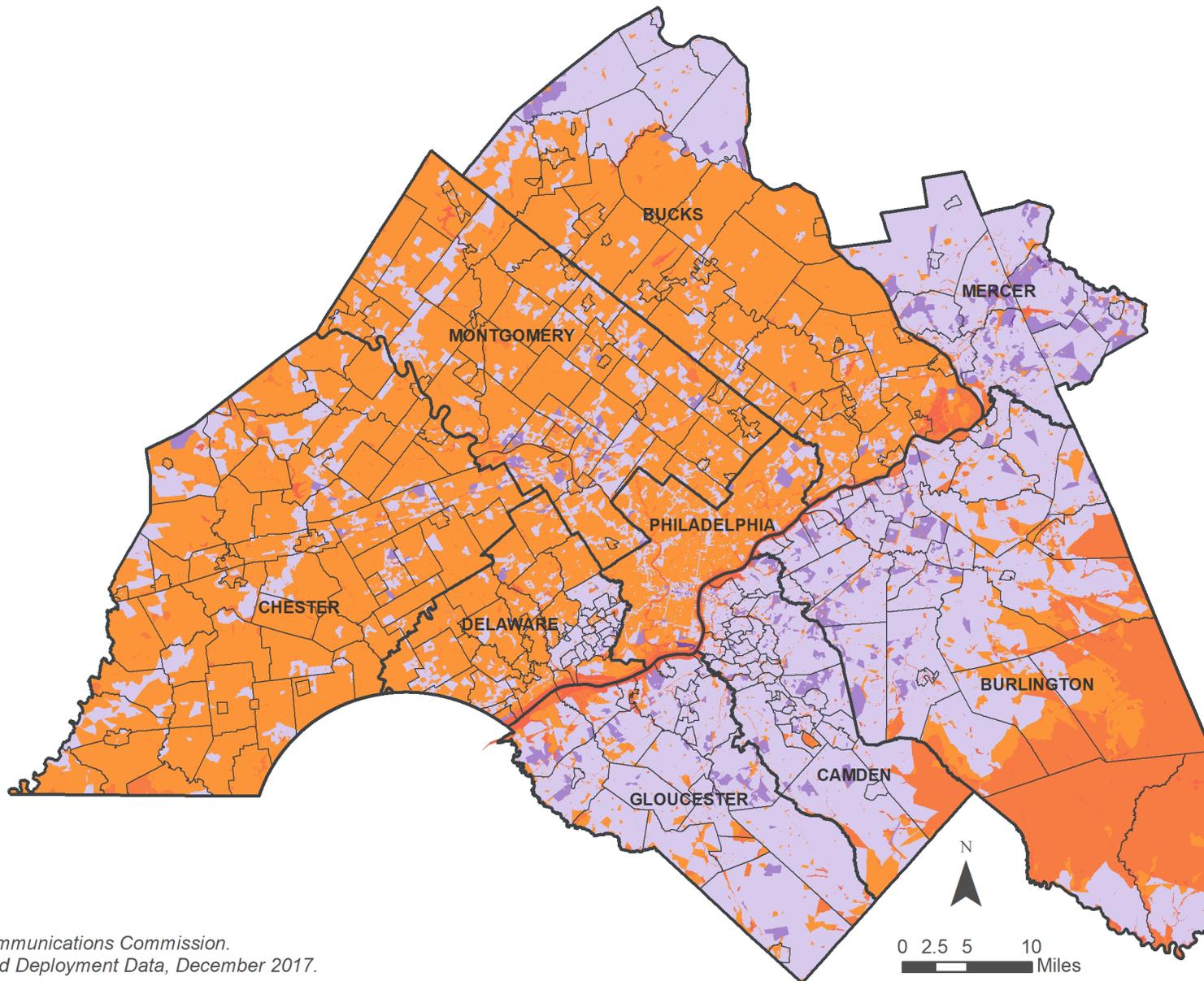
Total Providers



Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

FIGURE 6: Number of Fixed Business Providers

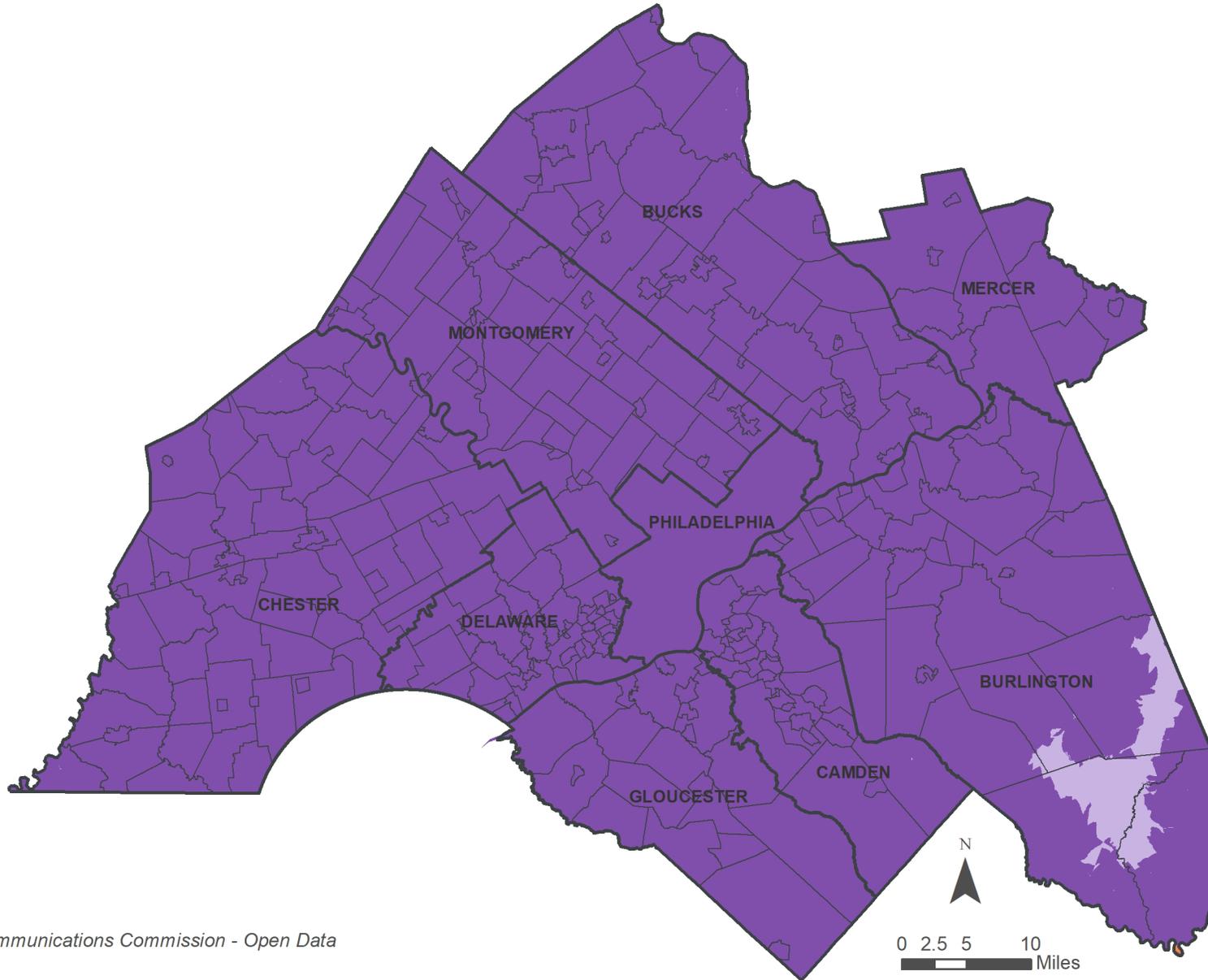
Total Providers



Source: Federal Communications Commission.
Form 477 Broadband Deployment Data, December 2017.

FIGURE 7: Number of Wireless Providers

Number of Providers



Source: Federal Communications Commission - Open Data
December 2017

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