Pennsylvania Cellular Data: An Analysis of Ookla Speed Tests, 2021-2022

March 2023

Key Findings

- In both rural and urban Pennsylvania, cellular speeds increased significantly from 2021 to 2022. The rate in rural Pennsylvania increased 59 percent and the urban rate increased 35 percent.
- Average cellular speed rates in urban Pennsylvania were more than twice as fast as rates in rural Pennsylvania. In 2022, the average rural rate was 86 megabits per second (Mbps) and the average urban rate was 199 Mbps.
- Cellular speed rates in rural Pennsylvania are comparable to those in other rural parts of the United States. In 2022, the rural Pennsylvania rate was 86 Mbps and the rural U.S. rate was 85 Mbps.
- Cellular speed rates in urban Pennsylvania are higher than those in other urban parts of the U.S. In 2022, the urban Pennsylvania rate was 199 Mbps and the urban U.S. rate was 173 Mbps.

Introduction

According to the U.S. Census Bureau, almost three-quarters of rural Pennsylvania households rely on smartphones for daily tasks. The speed at which these users connect to the network is critically important. The higher the speed, the faster the user can connect to the internet and communicate with others.

The Center for Rural Pennsylvania used data from Ookla's open-source database to measure cellular coverage and speeds in rural and urban Pennsylvania counties. Ookla is a web service that provides analyses of internet and cellular access performance metrics. In 2022, Ookla captured more than 87,180 cellular speed tests in rural Pennsylvania from more than 28,970 sites. In urban Pennsylvania, Ookla captured more than 224,880 cellular speed tests from 56,757 sites. The focus period of the analysis was 2021 through 2022. (More information about the data and how they were analyzed is on Page 6.)

Cellular Penetration Rates

According to 2021 Census data, 73 percent of rural households and 80 percent of urban households have a smartphone with a cellular data plan. Both rural and urban households with smartphones and cellular plans generally have higher incomes and their householders are younger than those without these plans.

Characteristics of Rural and Urban PA Households with and without Smartphone and Cellular Data Plans, 2021

	Rural Households		Urban Households	
	With Smartphone and Cellular Data Plan	Without Smartphone and Cellular Data Plan	With Smartphone and Cellular Data Plan	Without Smartphone and Cellular Data Plan
Median Household Income	$72,095	$34,400	$83,743	$36,069
Avg. Age of Householder	51.6	65.9	49.9	65.3
% Householders Who are Employed	65%	31%	70%	35%
% Households with Children Under 18 Years Old	30%	10%	32%	11%

Data source: 2021, 1-years Average, American Community Survey, Public Use Microdata Sample, U.S. Census Bureau.
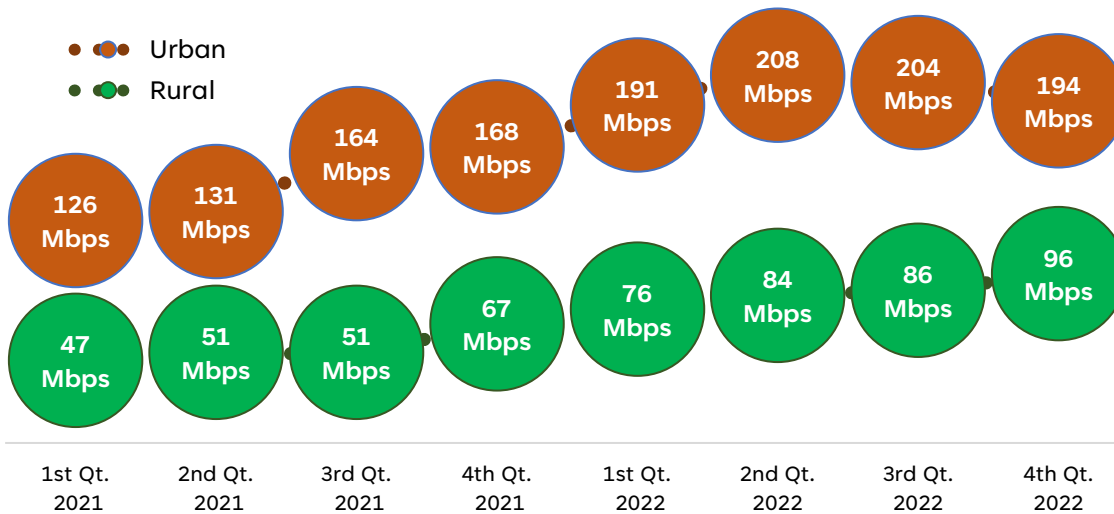
Change in Download Speeds

According to Ookla speed test data, both rural and urban Pennsylvania counties saw sizable increases in average download speeds from 2021 to 2022. During this period, the average rural download speed went from 54 Mbps to 86 Mbps, an increase of 59 percent. In urban counties, the average speed went from 147 Mbps to 199 Mbps, an increase of 35 percent.

The number of Pennsylvania counties with an average download speed of 100 Mbps went from nine in 2021 to 24 in 2022.

Despite these sizable increases, urban download speeds remain twice as fast as rural download speeds.

**Average Cellular Download Speeds in Rural and Urban Pennsylvania by Quarters, 2021 to 2022**

Note: The decrease in urban cellular speeds in the third and fourth quarters of 2022 may relate to a decrease in the number of urban Ookla speed tests during those quarters. In the first and second quarters of 2022, urban Pennsylvania counties had 116,189 speed tests. In the third and fourth quarters of 2022, there were 108,700, or a decrease of 7,459 or -6 percent. During this period, the number of rural speed tests increased by 4,841 or 12 percent. *Data source: Ookla.*

Rural and Urban Download Speeds

According to Ookla data, in 2022, the average cellular download speed in rural Pennsylvania was 86 Mbps and the average download speed in urban Pennsylvania was more than twice as fast at 199 Mbps.

In Pennsylvania, the three counties with the fastest average download speeds, in descending order, were Philadelphia, Allegheny, and Bucks. Each had average speeds of more than 200 Mbps. The three counties with the lowest average speeds, in descending order, were Tioga, Pike, and Forest. Each had average speeds of under 40 Mbps.

Average Download Speeds by County, 2022
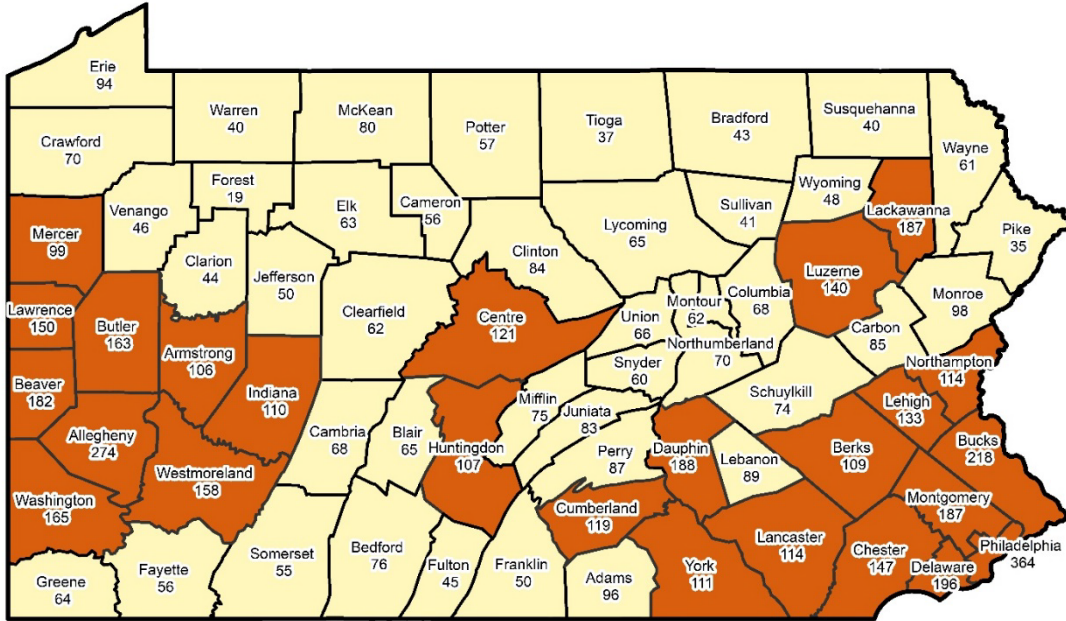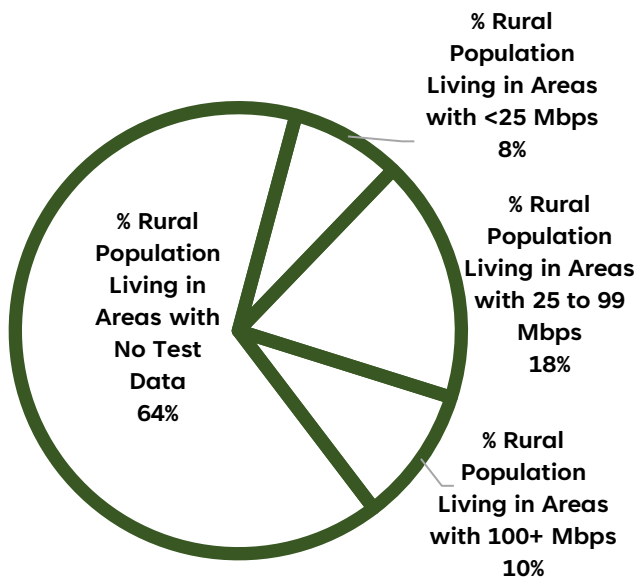

Statewide Rate = 168 Mbps

- Below 100 Mbps
- At or Above 100 Mbps

Data source: Ookla.

Approximately 8 percent of Pennsylvania's 3.38 million rural residents live in areas with slower average cellular speed (less than 25 Mbps) and 10 percent live in areas with higher average speeds (100 or more Mbps). In comparison, 7 percent of Pennsylvania's 9.62 million urban residents live in areas with slower speeds and 39 percent live in areas with higher speeds. Sixty-four percent of rural residents and 33 percent of urban residents lived in Census Blocks with no test data.
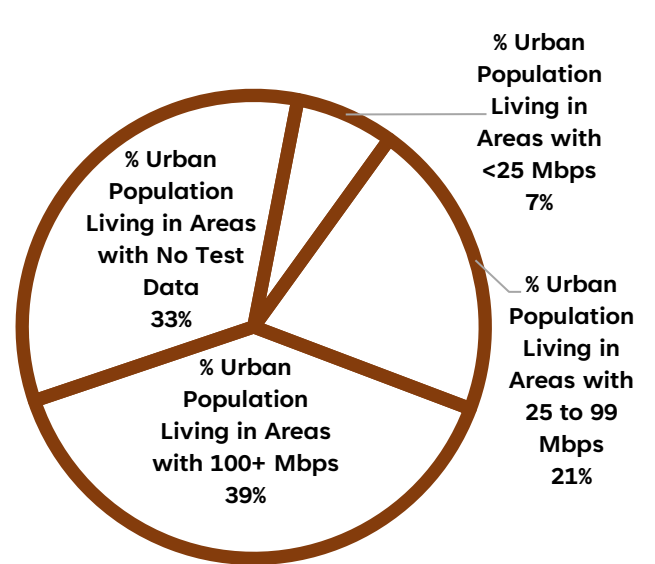

% Rural Population by Cellular Speed
(n=3.38 Millon)

- % Rural Population Living in Areas with <25 Mbps 8%
- % Rural Population Living in Areas with 25 to 99 Mbps 18%
- % Rural Population Living in Areas with 100+ Mbps 10%
- % Rural Population Living in Areas with No Test Data 64%

% Urban Population by Cellular Speed
(n=9.62 Million)

- % Urban Population Living in Areas with <25 Mbps 7%
- % Urban Population Living in Areas with 25 to 99 Mbps 21%
- % Urban Population Living in Areas with 100+ Mbps 39%
- % Urban Population Living in Areas with No Test Data 33%

Data source: Ookla and the 2020 Census, U.S. Census Bureau.

National Comparison

In 2022, the average cellular download speed across the U.S. was 152 Mbps. This speed was a 43 percent increase from 2021.

The three states with the highest download speeds were, in descending order, Rhode Island, Illinois, and Massachusetts, each with an average download speed of more than 190 Mbps. Pennsylvania had the nation's 11th highest download speed with 168 Mbps, on average. The three states with the lowest speeds, in descending order, were West Virginia, Alaska, and Vermont, each with download speeds of less than 56 Mbps.

Notably, the average download speed in rural Pennsylvania is roughly comparable to the average across the rural U.S. (86 Mbps and 85 Mbps, respectively). However, between 2021 and 2022, the download rate in rural Pennsylvania increased faster (by 59 percent) than the download rate in other rural parts of the U.S., which increased by 44 percent.
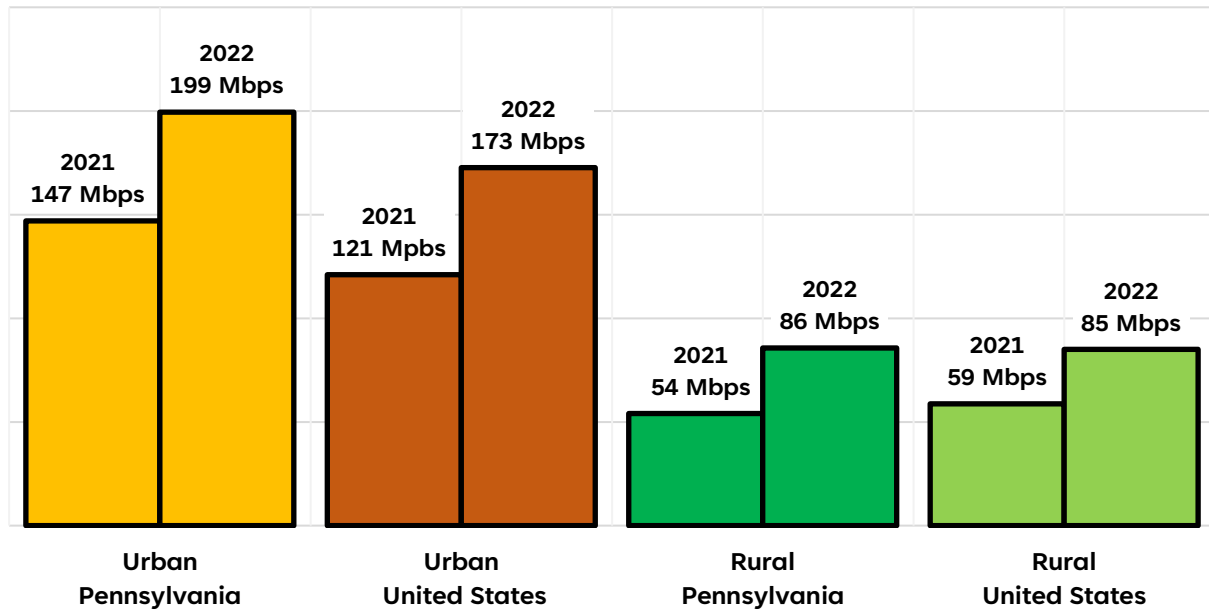
The average download speed in urban Pennsylvania (199 Mbps) is faster than average speeds in other urban U.S. counties (173 Mbps). However, the download rate in urban Pennsylvania increased slower (by 35 percent) than it did in other urban parts of the U.S., which increased by 43 percent, between 2021 and 2022.

Average Cellular Download Speeds by State, 2022
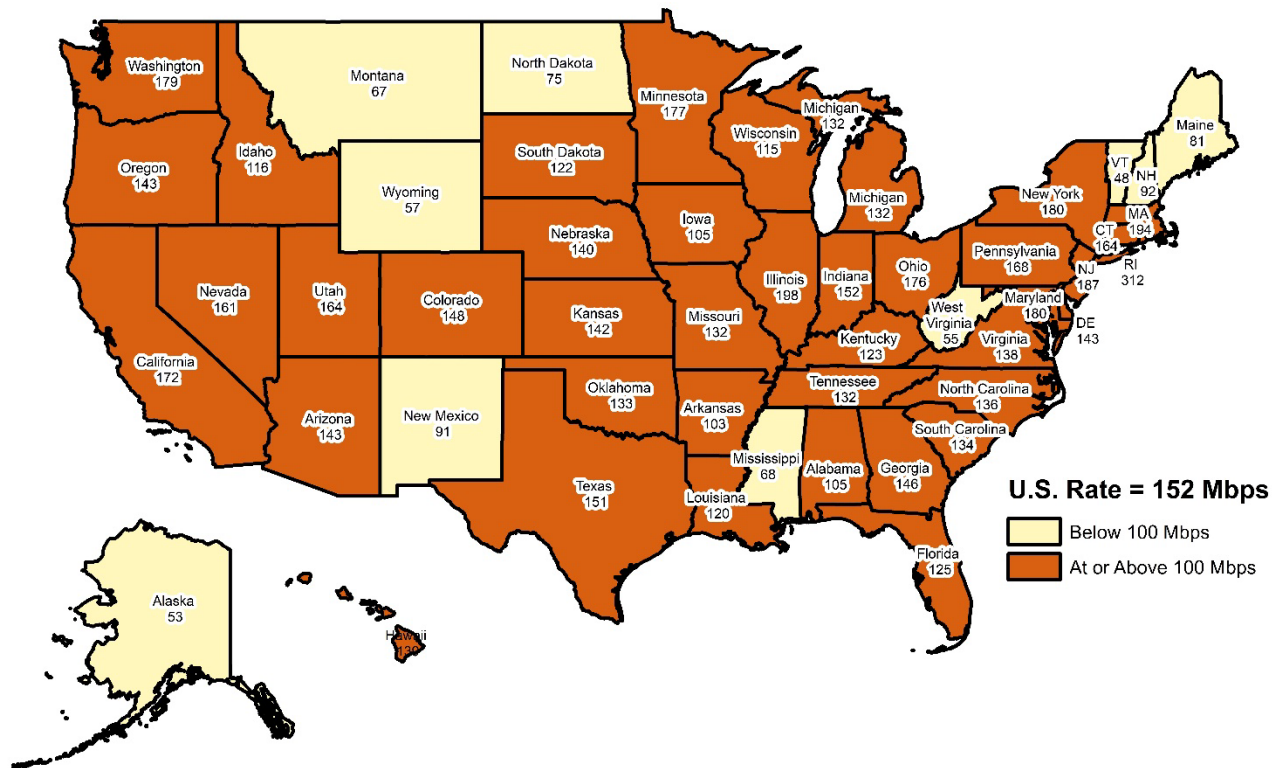
Data source: Ookla.

Average Cellular Download Speeds in Rural and Urban Pennsylvania and United States, 2021 and 2022

2021
147 Mbps

2022
199 Mbps

2021
121 Mpbs

2022
173 Mbps

2021
54 Mbps

2022
86 Mbps

2021
59 Mbps

2022
85 Mbps

Urban
Pennsylvania

Urban
United States

Rural
Pennsylvania

Rural
United States

Data source: Ookla.

Conclusion

For rural Pennsylvania, as well as other rural parts of the U.S., cellular speeds increased significantly between 2021 and 2022; however, a sizeable speed gap still exists between rural and urban areas, at both the state and national levels.

Because of the importance of cellular service and the speed at which it can be accessed, the Center for Rural Pennsylvania will periodically update these analyses as new data become available.

Methods

Data on cellular speeds came from Ookla, a for-profit company that specializes in collecting and analyzing speed tests from both internet and cellular users. The company collects its data from crowdsources and applies scientific controlled testing tools. Because data are crowdsourced, they do not constitute a random sample. Therefore, caution should be used when interpreting data collected in a non-random fashion. The data can be accessed from this website: https://github.com/teamookla/ookla-open-data.

Ookla provides free access to its summary level GIS data by calendar quarter. The data are available in GIS polygons that are approximately 54 acres in size. A polygon is a spatial area containing information about that area. In 2022, there were 85,727 polygons reported in Pennsylvania.

Each polygon represents one or more speed tests. The data reported within each polygon include the average download and upload speeds, the number of tests, the average latency, and the number of different devices used to take the test.

The Center for Rural Pennsylvania calculated the geographic center of each polygon and then overlayed them with Pennsylvania's rural and urban counties. The Center used its definition of a rural county: a county is rural if its population density is below the statewide rate of 291 people per square land mile. All other counties are considered urban. The same method was applied to identify rural and urban counties across the U.S. If a county's population density was below the statewide density, it was defined as rural. All other counties were classified as urban.

Speed rates were converted from kilobits per second to megabits per second. The speed data was then multiplied by the number of tests for each location. To determine average speeds, the data were summed to the county or rural and urban levels and divided by the number of tests.

To simplify the information for readers, the Center focused on the average download speeds as a single measure. This level of speed correlates with rate data, which look at the transfer from internet to a smartphone.

It is important to note that speeds can vary based on many factors, including, but not limited to:

- Age of the smartphone device;
- Data package purchased by the consumer;
- Distance of the device from the cellular site;
- Whether the device is in a building or a moving vehicle;
- Terrain surrounding the device's location; and
- Weather/seasonal conditions.

Despite these limitations, the data allow for a comparative analysis between rural and urban areas.

In 2022, the Ookla data showed that there were 85,727 speed test polygons in Pennsylvania. These speed test polygons had an approximate land area of 7,137 square miles, or 16 percent of Pennsylvania's total land area of 44,742 square miles. In addition, the speed test polygons touch 233,119 Census blocks. According to the 2020 Census, these blocks had a total population of 11.1 million, or 85 percent of Pennsylvania's total population of about 13.0 million.

Data Limitations

The data presented here could show bias to areas with 5G service. According to the Federal Communications Commission, 5G stands for the 5th generation of mobile communications. This next generation of technology promises consumers faster data rates with lower latency, or delays, in transmitting data. It also promises more capacity for a more efficient network. This technology is expected to support speeds of up to 300 Mbps or greater. Currently the 5G technology is being deployed throughout the country and is not universally available.

It is important to note that the absence of a speed test polygon does mean a lack of cellular service or insufficient speeds.

Number of Rural and Urban Speed Test Polygons, 2022

	Rural Speed Test Polygons	Urban Speed Test Polygons	Total Speed Test Polygons
Polygon with 1 Test	16,345 (56%)	26,384 (46%)	42,729 (50%)
Polygon with 2 to 4 Tests	8,683 (30%)	19,262 (34%)	27,945 (33%)
Polygon with 5+ Tests	3,942 (14%)	11,111 (20%)	15,053 (17%)
Total # Polygons	28,970 (100%)	56,757 (100%)	85,727 (100%)

Data source: Ookla.

Ookla Cellular Test Polygons and Number of Tests Within Each Polygon, 2022
Note: Total number of speed tests in 2022 = 312,078
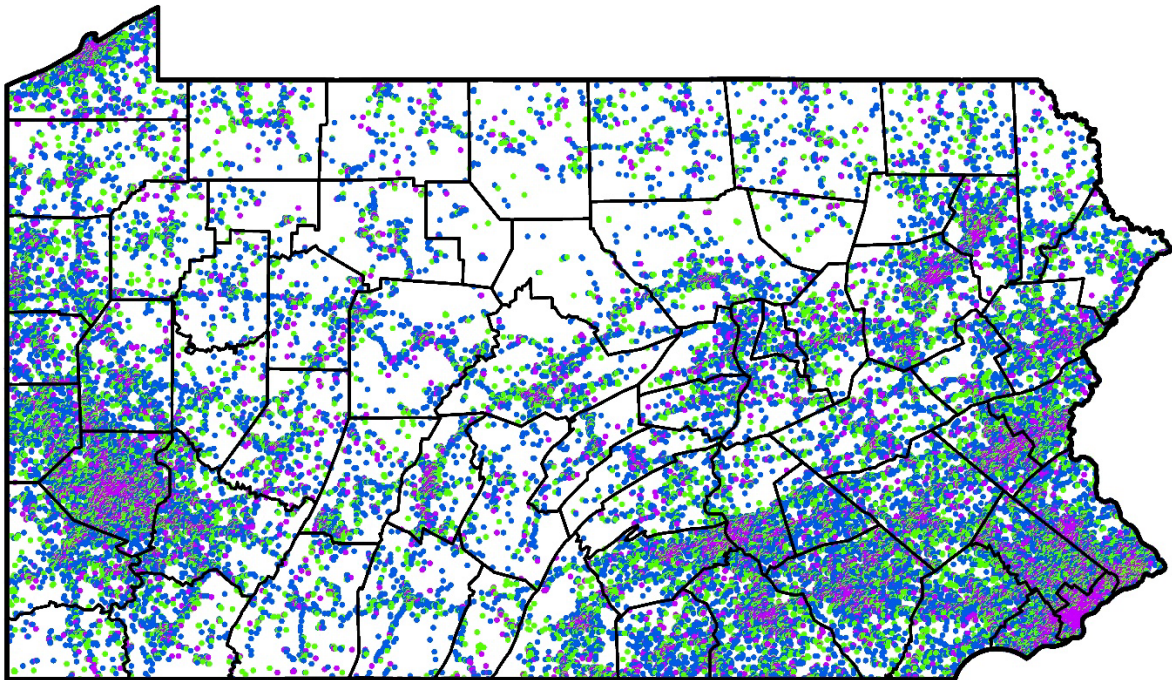
Total Number of Polygons with Speed Tests = 85,727

• Polygon with 1 Speed Test   • Polygon with 2 to 4 Speed Tests   • Polygon with 5+ Speed Tests

Data source: Ookla.