Baltimore's Digital Divide: Gaps in Internet Connectivity and the Impact on Low-Income City Residents

By John B. Horrigan, Ph.D.

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EXECUTIVE SUMMARY

A new analysis of American Community Survey (ACS) data shows that large numbers of Baltimore households lack two essential tools for getting online: wireline broadband service at home and computer access. Wireline service gives people latitude for online activities, i.e., fast service with few data limits, that wireless access on smartphones or hotspots constrain. Computers enable web browsing on large screens that are better suited to learning, applying for jobs, or accessing government services. Smartphones, which enjoy wider adoption than other digital devices, are not a substitute for connectivity through a laptop or desktop computer.

This report examines internet access in 33 cities, including Baltimore. It includes cities to which Baltimore is frequently compared, such as Washington, D.C., Philadelphia, and Pittsburgh, and also ones that are known to contain clusters of the technology industry, such as Boston, Seattle, and San Jose.

Compared to other cities, Baltimore has a significantly higher share of households lacking wireline broadband and desktop or laptop computers. Underscoring the persistence of Baltimore's access gaps, wireline broadband adoption nationwide grew three times faster in the cities examined than in Baltimore from 2016 to 2018.

Key Findings

In 2018, 96,000 households in Baltimore (40.7%) did not have wireline internet service, such as cable, fiber, or digital subscriber line service.

- Some 59.3% of Baltimore households have wireline internet service.
- Across a selection of 33 cities, 69.9% of households have wireline service.
- Nationwide, 69.6% of households have wireline service.

Some 75,000 Baltimore City households, or one in three, do not have either a desktop or laptop computer.

- This means that over two-thirds (68.5%) of Baltimore households have a desktop or laptop computer in Baltimore.
- For the 33 cities studied, 75.7% of households have desktop or laptop computers.
- For the United States as a whole, 77.5% have such computers in the home.
- In Baltimore City, nearly 20,000 households with children under the age of 17 do not have wireline broadband or computers at home.

- Specifically, 19,200 households with children in the city do not have wireline broadband at home, or 34.7% of such households.
- More than one-quarter (27.3%), or 15,000 households with children, do not have either a desktop or laptop computer.
- These gaps are pronounced for low-income homes with children; 80% of homes lacking computers are in the bottom half of the city's income distribution.
- For wireline broadband at home, 64% of homes without this service are in the lower 40% of the city's income distribution for households with children.

Baltimore fares poorly in comparison to other cities and the nation on both levels of home wireline broadband adoption and growth in adoption since 2016.

- Baltimore ranks 29th out of the 33 cities examined for home wireline broadband adoption.
- Looking at trends, since 2016, Baltimore's home wireline subscription rate has barely moved, going from 58.4% in 2016 to 59.3% in 2018.
- For the 33 cities studied, home wireline broadband adoption grew from 67.1% in 2016 to 69.9% in 2018.
- For the United States, home wireline broadband adoption grew from 67.3% in 2016 to 69.6% in 2018.

Gaps for home wireline broadband adoption and computer adoption are particularly severe in Baltimore City for low-income households and communities of color.

- For home wireline broadband, 73.3% of white households in Baltimore City have this service compared with 50.2% of African American households and 46.4% of Hispanic households.
- For desktop or laptop computers, 80.7% of white households have these devices, while 60% of African American ones do; the figure for Hispanic households is 47.5%.
- With respect to income, just 33.8% of low-income Baltimoreans (those whose annual household incomes are less than $25,000) have home wireline service compared with 83% for households whose annual incomes exceed $75,000.
- For computers, 42.8% of low-income Baltimore homes have a desktop or laptop compared with 90% of households with annual incomes above $75,000.

Recommendations

The pandemic crisis has led to calls for a "connectivity stimulus" to get more people online with quality internet service at home. Although this will involve federal action, there are things cities can do immediately to address digital inequality.

In Baltimore, policymakers and other stakeholders should work collaboratively to:

- Develop a pipeline of device delivery to low-income households, prioritizing families with school-age children. This would also entail increasing awareness of and subscription to discount home internet service plans for low-income households. The City Council's recent announcement that $3 million from the Baltimore Children and Youth Fund will be used for internet connectivity for students in need is a positive development.
- Enhance the capability of community anchor institutions such as libraries and neighborhood nonprofits to provide tech support and digital skills training, as well as expansion of wireless access.
- Enlist a wide range of stakeholders to address digital inequality, e.g., deeper engagement among the business and university communities. This was a point made in a 2017 report by the Robert W. Deutsch Foundation, a local foundation that has been a leader in calling attention to digital equity issues in Baltimore City. The newly founded Baltimore Digital Equity Coalition shows promise in further expanding the range of stakeholders addressing Baltimore's access gaps.
- Build capacity in city government on digital access issues so that Baltimore's city government can have a stronger leadership position on this issue. This means having the city's elected officials place greater priority on digital equity and investing in staff capacity and expertise in how broadband can help increase educational and economic opportunity.

BACKGROUND

The COVID-19 pandemic has made internet access part of the social safety net. With large portions of society driven to cyberspace during the pandemic, new attention has come to gaps in Americans' internet connectivity. Those on the wrong side of the digital divide are left out during a national crisis that in many ways necessitates online connectivity for accessing education and health care services.

The pandemic thus gives a sense of urgency to understanding the nature of digital access for decision-makers at all levels of government, especially cities. Data that the U.S. government collects via the American Community Survey (ACS) makes this possible, as this large-scale survey asks households questions about the nature of their online connectivity. Research organizations that have used ACS for analysis include the National Digital Inclusion Alliance (NDIA), which ranks the "least-wired" cities in the United States. The Brookings Institution has also examined internet connectivity in metropolitan areas and the different factors that influence the rate of connectivity in different places. (See the "Methodology" section in the Appendix for more on the ACS and the questions used in this report for analysis.)

This analysis will examine broadband connectivity in a selection of U.S. cities, focusing on trends across cities from 2013 to 2018 (the last year ACS data is available). The city of Baltimore will be the center of the analysis with a comparison of 32 other cities that have a range of economic and demographic characteristics.

A new focus on broadband metrics

The COVID-19 pandemic has shed new light on metrics when it comes to high-speed internet access. If having everyone online is a priority

for education, telehealth, employment, access to benefits, entertainment, and socializing, what are the right tools for accessing those services? Unlike the 2000s, when online access at home was mainly through a computer connected to a wire, there are now multiple ways to get online. Recent research shows that not all modes of access are equal. Specifically:

1. *Wireline broadband and education:* A team of Michigan State researchers recently surveyed students in Michigan and examined educational outcomes by mode of access. Students with wireline broadband at home (as compared to those who rely on the smartphone only or have no home internet) performed better in a number of ways, such as measures of digital skills, homework completion, and grade point average.

2. *Mobile devices and government benefits:* A recent analysis by the Information Technology and Innovation Foundation (ITIF), done after the pandemic crisis began, found that 86% state unemployment websites failed at least one test of "mobile friendliness," underscoring the disadvantages of mobile-only access.

3. *Computers and adult learning:* The Pew Research Center found that, for lifelong learning, adults overwhelmingly use their desktop or laptop computers for such pursuits relative to their smartphones—by a margin of 69% to 11%. Such learning, whether it is about personal interests or job skills, works better for people on larger screens. Pew also finds that the smartphone-dependent users are more likely to report problems navigating online job resources than those with desktops or laptops.

Simply having internet access—which 90% of Americans do when access measures include smartphones, at-work access, or use of the internet from anchor institutions such as public libraries—may not address every kind of online need. (For a definition of terms used in this report pertaining to the internet, please see the Glossary in the appendix to this report.) A home internet subscription, as the Michigan State research demonstrates, is crucial for students. Computers, as the Pew research shows, are preferred by adults for learning; their larger screens are also important for telehealth and other applications.

For those reasons, this report will examine not just internet access broadly conceived, but also home wireline subscriptions, and whether households have laptop or desktop computers. ACS provides data reports on whether a household has "broadband of any type," including wireline access through cable, fiber, or digital subscriber line (DSL) service, and whether a household has a working laptop or desktop computer. Note that smartphone access is considered to be broadband; speeds on 4G wireless networks generally exceed the Federal Communications Commission's (FCC) 25 megabits per second threshold that defines broadband. That is why the incidence for "broadband of any type" is greater than home wireline adoption.

Fixed wireless broadband service is different, however, in that it is a subscription service that sends a wireless signal from a nearby tower to a receiver in the home. This segment of the market counts as broadband under the FCC's definition, but this report's focus on wireline subscriptions excludes fixed wireless home service in the analysis. As a practical matter, fixed wireless home services are targeted mainly for rural markets. Fixed wireless for urban locations, such as mesh networks, may hold great promise in low-income areas where subscription options might be confined to service plans out of the financial reach of many households. But such networks are not yet widely enough deployed to have much impact on local or national adoption figures.

Cities for comparison

The report places Baltimore in the context of other cities by looking at a total of 33 cities, half of which have populations greater than Baltimore City and have of which do not. It is important to note that the focus is on cities—not on metropolitan areas. For a city such as Baltimore, this means Baltimore City is the geography discussed, not surrounding areas in Baltimore County. Chosen cities track roughly with the most populous 33 cities in the United States, with some discretion used to include cities likely to be of interest to a Baltimore readership, such as Washington, D.C., Philadelphia, and Pittsburgh. There are also cities that are known to contain clusters of the technology industry, such as Boston and Seattle. The table on pages 6 and 7 shows the cities analyzed for this report, ranked by the number of households in the city in 2018.

Table 1: Selected cities, ACS Data

City	Number of Households, 2018	Median Income, 2017	% Change Median Income, 2013-2017	Poverty Rate, 2017
Philadelphia, PA	608,233	$39,759	7.9%	25.7%
Columbus, OH	366,034	$42,107	4.0%	23.7%
Jacksonville, FL	345,865	$51,497	8.6%	15.1%
Indianapolis, IN	339,536	$47,225	14.2%	17.5%
Seattle, WA	338,002	$86,822	23.7%	11.1%
Charlotte, NC	335,918	$61,350	20.2%	12.4%
San Jose, CA	327,848	$104,675	29.3%	8.4%
Denver, CO	310,324	$65,224	27.7%	12.2%
Fort Worth, TX	308,188	$60,205	14.8%	12.9%
Washington, DC	287,476	$82,372	21.9%	16.6%
Boston, MA	274,674	$66,758	24.6%	18.7%
Portland, OR	273,607	$66,187	19.1%	14.7%
Nashville, TN	272,826	$57,737	23.4%	14.6%
Detroit, MI	266,333	$30,344	22.3%	34.5%

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City	Number of Households, 2018	Median Income, 2017	% Change Median Income, 2013-2017	Poverty Rate, 2017
Memphis, TN	252,517	$39,333	7.1%	24.6%
Louisville, KY	247,339	$51,960	15.7%	15.1%
Oklahoma City, OK	245,772	$52,062	12.6%	15.8%
Baltimore, MD	**237,204**	**$47,131**	**11.5%**	**22.2%**
Las Vegas, NV	234,592	$62,718	27.2%	14.5%
Milwaukee, WI	231,041	$39,098	11.1%	25.0%
Albuquerque, NM	228,491	$50,456	4.3%	15.2%
El Paso, TX	227,506	$44,754	8.8%	19.3%
Atlanta, GA	211,819	$57,597	23.9%	19.3%
Tucson, AZ	209,383	$41,613	16.5%	22.1%
Kansas City, MO	207,377	$51,330	12.7%	15.5%
Raleigh, NC	188,941	$64,660	17.2%	12.6%
Mesa, AZ	185,509	$55,014	15.7%	15.0%
Omaha, NE	184,831	$56,406	18.7%	13.0%
Sacramento, CA	182,677	$56,943	18.5%	15.6%
Colorado Springs, CO	181,745	$59,514	11.1%	12.8%
Minneapolis, MN	175,233	$60,789	20.2%	18.3%
Cleveland, OH	173,025	$28,974	11.0%	33.1%
Pittsburgh, PA	141,881	$45,851	9.2%	20.2%

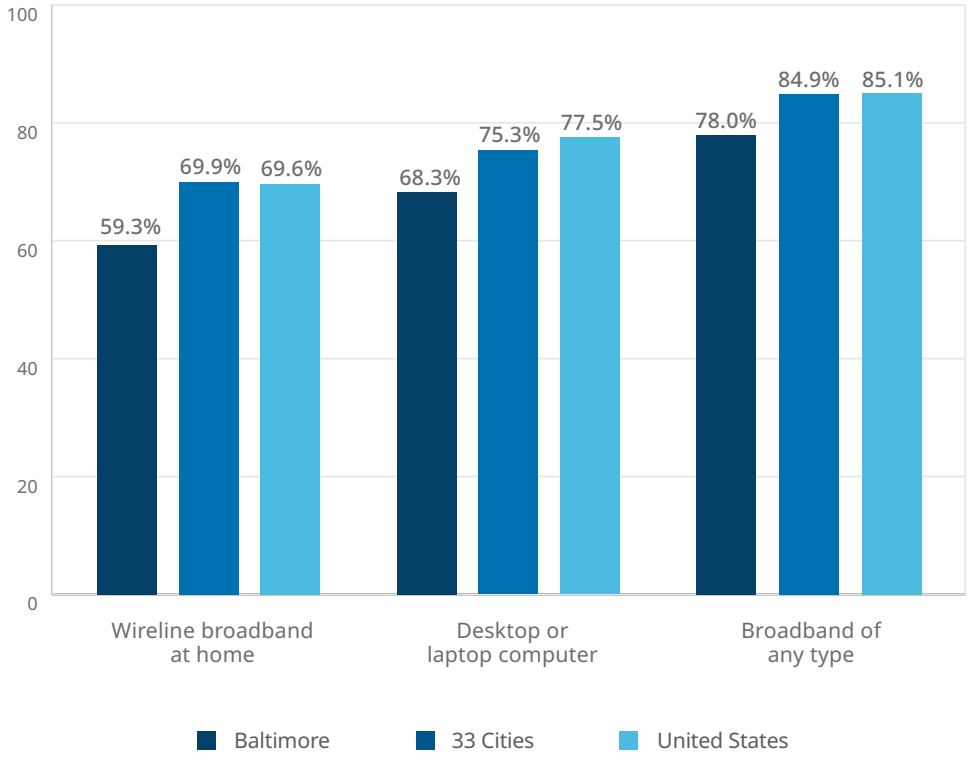
The figures on median income are not adjusted for cost of living across jurisdictions. When looking only at the 33 cities in this analysis, the average median income is approximately $56,000 for 2017. For the five years between 2013 and 2017, the cities collectively experienced a 16.1% growth in median income. The poverty rate for all these cities was 17.9%. Baltimore City, economically at least, is less robust than the cities studied, with a lower median income, higher poverty rate, and slower income growth from 2013 to 2017.

This report will:

1. Examine where Baltimore stands in relation to other cities and national rates of broadband adoption.
2. Look at access among households with children age 17 or younger.
3. Explore trends, i.e., how Baltimore's growth in broadband adoption of any type compares with other cities and the nation from 2013 to 2018. For wireline adoption at home (i.e., DSL, fiber, and cable), the trend analysis will be from 2016 to 2018, the only years for which ACS has such data.

The following charts provide an overview of where Baltimore stands in comparison to other places. The body of the report will explore these issues in greater detail. Chart 1 shows how Baltimore compares to other cities studied and the nation for access to broadband of

Chart 1: Comparing Baltimore to the Nation and Other Cities, 2018



any type, wireline home subscriptions, and computer (desktop or laptop) ownership. Baltimore City lags in these comparisons by substantial margins.

Chart 2 examines Baltimore in comparison to the United States for households with children. Baltimore City does not do much better in a comparison with the United States as a whole when it comes to households with children age 17 or younger, with a particularly large gap for having a desktop or laptop computer at home.

A final note: this report does not address network deployment, i.e., whether locations have any networks to serve households or networks that meet the FCC's 25 Mbps definition of broadband service. Though an important topic, it is separate from the one at hand.

FINDINGS

Cities and broadband access

Table 2 on pages 10 and 11 shows broadband access by city across the two metrics noted above: broadband access at home of any type and wireline broadband access. The cities are ranked according to broadband adoption of any type, which generally tracks the wireline adoption figure, though not perfectly.

Of the 33 cities selected for analysis, Baltimore ranks 29th on the list. Baltimore also ranks 29th out of 33 when looking at wireline broadband adoption. For the set of cities in the analysis, 84.9% of households have broadband of any type and 69.9% have wireline service. Baltimore City, with 78.0% and

Chart 2: Comparing Baltimore to the nation - households with children age 17 or younger, 2018

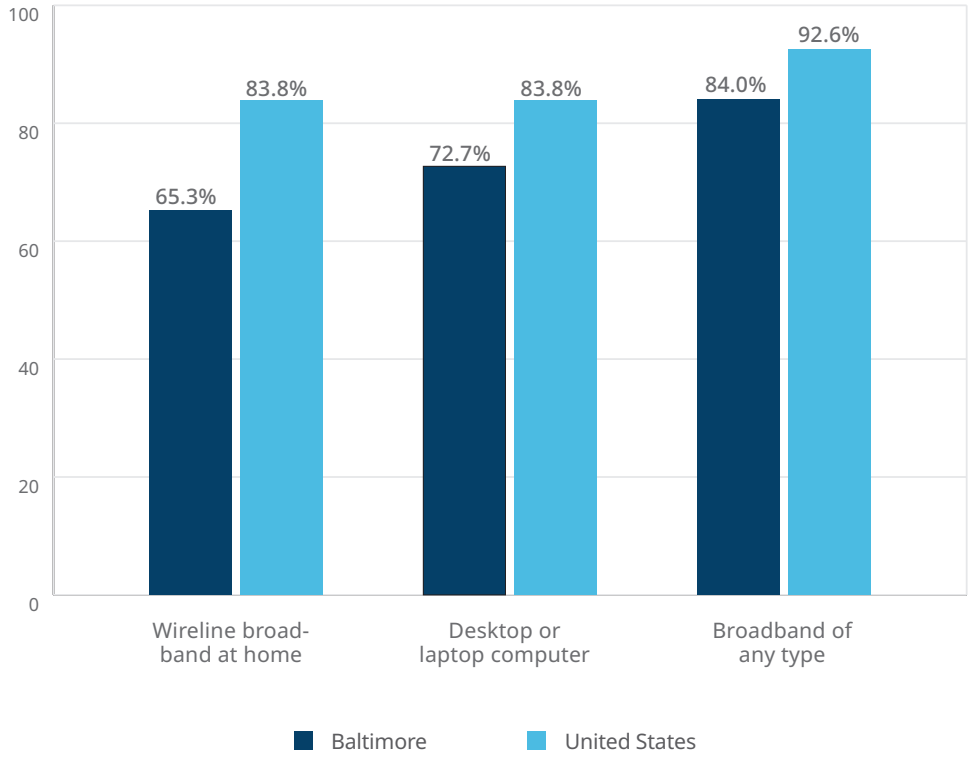


Table 2: Cities and broadband adoption, 2018

City	Any	Wireline
San Jose, CA	93.1%	82.3%
Colorado Springs, CO	91.7%	80.0%
Seattle, WA	91.4%	82.8%
Raleigh, NC	90.6%	79.6%
Portland, OR	90.6%	77.7%
Sacramento, CA	90.2%	75.5%
Mesa, AZ	90.0%	70.9%
Charlotte, NC	89.8%	78.0%
Nashville, TN	89.7%	73.6%
Fort Worth, TX	89.2%	68.9%
Denver, CO	88.7%	77.6%
Jacksonville, FL	87.9%	67.1%
Columbus, OH	87.3%	73.5%
Omaha, NE	87.2%	74.3%
Boston, MA	87.1%	76.6%
Atlanta, GA	86.9%	70.8%
Washington, DC	86.1%	75.6%
Minneapolis, MN	85.8%	74.4%
Oklahoma City, OK	85.2%	66.7%
Kansas City, MO	85.1%	67.1%
Louisville, KY	85.0%	66.9%
Tucson, AZ	84.9%	67.9%

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City	Any	Wireline
Pittsburgh, PA	83.6%	71.9%
Albuquerque, NM	82.2%	67.7%
Las Vegas, NV	81.4%	69.4%
Indianapolis, IN	81.2%	65.8%
El Paso, TX	79.8%	59.0%
Philadelphia, PA	79.8%	65.9%
Baltimore, MD	**78.0%**	**59.3%**
Milwaukee, WI	77.1%	60.9%
Cleveland, OH	72.6%	55.8%
Memphis, TN	70.6%	51.8%
Detroit, MI	70.3%	47.9%

59.3% respectively for broadband of any type or wireline service, trails considerably.

In terms of households, these figures mean that approximately 96,000 households in Baltimore do not have home wireline broadband service. Some 52,000 Baltimore City households lack broadband of any type.

Baltimore's gap between wireline broadband and broadband of any type is wide and larger than the other cities included in the analysis. For Baltimore, the difference between those with broadband of any type and wireline subscriptions at home is nearly 19 percentage points—higher than the 15 percentage point gap for the entire sample. Table 3 on page 12 shows that Baltimore ranks seventh out of the 33 selected cities in the wireline broadband access gap.

This gap is closely associated with cities' poverty rates. In fact, the top seven cities in the table above collectively had a 2017 poverty rate of 20.3%, while the seven cities with the smallest gaps at the bottom of the table had a collective poverty rate of 13.6%. Metrics on household incomes tell the same story. In the

Table 3: Percentage point gaps by city between any broadband access and wireline, 2018

City	Percentage point gaps
Detroit, MI	22.4
El Paso, TX	20.9
Jacksonville, FL	20.8
Fort Worth, TX	20.3
Mesa, AZ	19.1
Memphis, TN	18.8
Baltimore, MD	**18.8**
Oklahoma City, OK	18.6
Louisville, KY	18.2
Kansas City, MO	18.0
Tucson, AZ	17.0
Cleveland, OH	16.8
Milwaukee, WI	16.2
Nashville, TN	16.2
Atlanta, GA	16.2
Indianapolis, IN	15.4
Sacramento, CA	14.6
Albuquerque, NM	14.5
Philadelphia, PA	13.9
Columbus, OH	13.8
Omaha, NE	12.9

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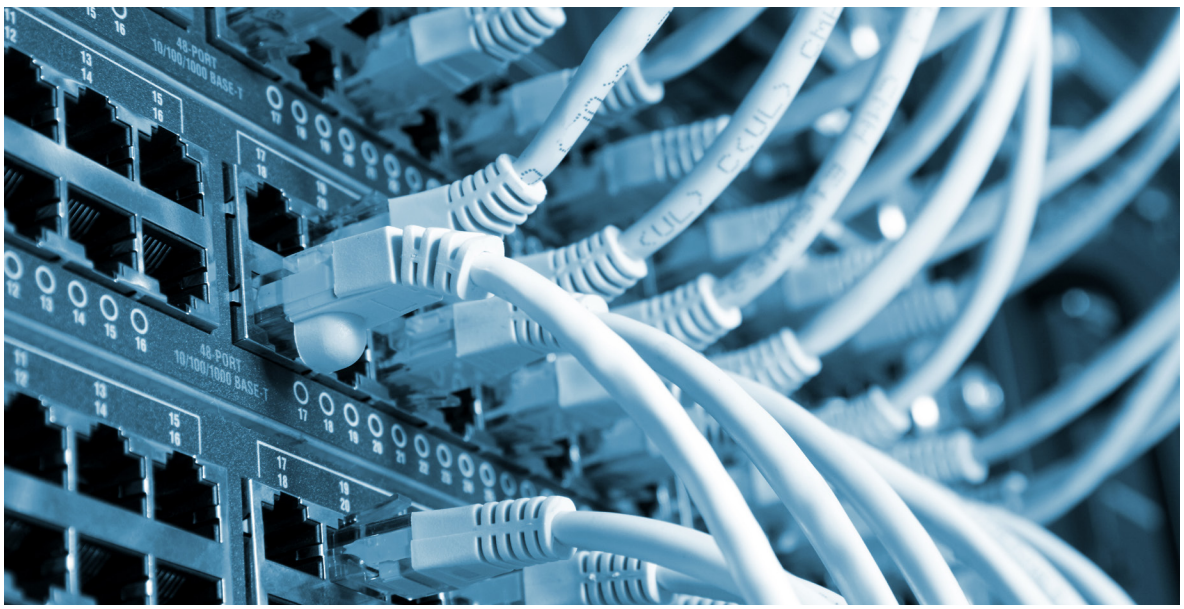
City	Percentage point gaps
Portland, OR	12.9
Las Vegas, NV	12.0
Charlotte, NC	11.8
Pittsburgh, PA	11.7
Colorado Springs, CO	11.7
Minneapolis, MN	11.4
Denver, CO	11.1
Raleigh, NC	10.9
San Jose, CA	10.8
Washington, DC	10.5
Boston, MA	10.4
Seattle, WA	8.5



seven cities with the largest wireline broadband gaps, 27.5% of households had annual incomes of $25,000 or less in 2017, while that figure was 17.5% for the seven cities with the smallest gaps. For Baltimore, the poverty rate was 22.2% in 2017, and 28.5% of households reported annual incomes of $25,000 or less.

Table 4: The demographics of adoption and the homework gap, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Broadband of any type	78.0%	62.3%	70.9%	82.5%	91.8%	96.1%
Wireline access such as cable, DSL, or fiber	59.3%	33.8%	51.1%	62.3%	81.0%	87.0%
Number of households	237,144	65,994	54,271	37,965	52,817	26,097

The demographics of adoption and the homework gap

Here is a closer look at how online access in Baltimore plays out along measures of income and race. For poor households in Baltimore, wireline broadband is a rarity relative to their upper-income neighbors, with just one-third of the lowest-income Baltimoreans with wireline access.

Table 5: Broadband and wireless access in Baltimore City by race and ethnicity, 2018

	All	White	African American	Hispanic
Broadband of any type	78.0%	86.2%	72.8%	72.9%
Wireline access such as cable, DSL, or fiber	59.3%	73.3%	50.2%	46.4%

There are also sizable differences across racial and ethnic categories. Half of African American households and less than half of Hispanic ones have a wireline broadband subscription compared to three-quarters of white households.

Given that the COVID-19 pandemic has resulted in school closures and growing reliance on online learning, looking at households with school-age children is worthwhile. The degree to which households with children do not have online access is typically referred to as the "homework gap." In Baltimore City, 23% of households have children age 17 or younger.

The figures for Baltimore trail the national average. Overall, 92.6% of households nationwide that have children age 17 or younger have broadband of any type and 77.3% have a wireline subscription. See Table 7 on page 16 for details.

Out of Baltimore's approximately 238,000 households in 2018, about 55,400 have children age 17 or under living in them. This means that some 8,900 households in Baltimore with children age 17 and under lack any broadband and 19,200 households do not have a wireline broadband connection at home. With two children per household (which is the national figure), this means more than 38,000 children in Baltimore City live in homes with no wireline broadband access. If Baltimore's rate of broadband adoption were comparable to national rates for households with children age 17 and under, 6,600 more households would have a wireline broadband subscription and 4,900 more would have broadband of any type.

Table 6: The homework gap in Baltimore: households with children age 17 and younger, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Broadband of any type	84.0%	68.5%	76.4%	87.7%	93.8%	96.9%
Wireline access such as cable, DSL, or fiber	65.3%	43.6%	52.1%	59.4%	86.4%	87.2%
Number of households	55,397	12,229	11,347	9,598	14,611	7,612

Table 7: The homework gap in the United States:
Households with children age 17 and younger, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Broadband of any type	92.6%	81.1%	88.9%	93.1%	96.3%	98.2%
Wireline access such as cable, DSL, or fiber	77.3%	55.5%	67.8%	76.4%	84.9%	91.6%
Number of households	36,865,539	5,198,507	7,000,278	6,090,540	11,817,937	6,758,277

Access to computing devices: Comparing Baltimore to other cities and the United States

Broadband connections at home are a necessary, though not sufficient, condition for doing things online such as completing homework assignments, applying for jobs, searching for information on and enrolling in benefit programs, and paying bills. People need computing devices to connect to the internet and, as noted above, research shows the importance of computer access as part of the online experience that enables education and learning. The ACS offers data on that for Baltimore City by asking people if they have desktop or laptop computers in the household, tablet computers, and smartphones. Table 8 on page 17 shows adoption rates for Baltimore City, with breakouts by income category.

The lowest-income Baltimore homes are less than half as likely to have a computer than their upper-income counterparts and even less likely to have a tablet device. Smartphone gaps are less pronounced—probably because the smartphone, in addition to its many features, allows a household to forgo the expense of a landline telephone.

As shown in Table 9 on page 17, adoption rates nationwide are uniformly higher than in Baltimore City, on the order of 9 percentage points for computers and tablets. The data also shows greater inequality in Baltimore than the nation, as low-income households in the city are less likely to have computers or tablets when compared to overall adoption rates in the United States.

In terms of the number of households lacking devices, these figures show that about 75,000 Baltimore City households lack

Table 8: Computing device adoption in Baltimore City, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Desktop or laptop computer	68.3%	42.8%	62.2%	75.8%	88.6%	92.8%
Tablet computer	53.3%	30.7%	43.7%	60.1%	71.3%	83.9%
Smartphone	81.9%	68.3%	80.2%	83.8%	91.8%	96.6%
Number of households	237,144	65,994	54,271	37,965	52,817	26,097

Table 9: Computing device adoption in the United States, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Desktop or laptop computer	77.5%	51.2%	70.0%	82.1%	91.0%	96.1%
Tablet computer	62.6%	36.1%	51.6%	64.5%	77.4%	87.6%
Smartphone	84.5%	66.0%	79.6%	87.8%	93.9%	96.6%
Number of households	121,474,000	24,661,407	26,539,959	20,566,465	32,840,673	16,865,496

a desktop or laptop computer, and nearly 111,000 do not have a tablet computing device. If Baltimore's adoption rate for computers were on par with the nation's, then thousands of Baltimore homes would have greater digital connectivity. Specifically, 29% more would have computers (or roughly 22,000 more households with computers).

For households with children age 17 or younger, the adoption patterns are much the same in Baltimore.

More than one-quarter (27.3%) of households with children in Baltimore do not have a desktop or laptop computer—approximately 15,000 households. Not only are the gaps

Table 10: Computing device adoption among households with children age 17 and under, Baltimore City, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Desktop or laptop computer	72.7%	44.2%	56.4%	78.3%	93.0%	91.8%
Tablet computer	71.2%	45.2%	73.3%	68.3%	83.3%	92.2%
Smartphone	92.9%	89.3%	93.8%	90.8%	95.3%	95.4%
Number of households	55,397	12,229	11,347	9,598	14,611	7,612

significant across income categories—low-income residents with children are half as likely to have a computer or tablet as upper-income ones—but also the deficiencies are heavily concentrated within lower-income households. Some 80% of households with children who lack a desktop or laptop computer have annual incomes of $50,000 or less.

As with all households, Baltimore trails the nation in adoption of computing devices for households with children age 17 and under, as the following table shows. If Baltimore's household adoption rate for computers or laptops matched the nation's figure, about 6,000 more households would have access to these devices.

Comparing Baltimore to the other 32 cities studied, Baltimore is behind in overall computer adoption and, modestly, in recent growth. Table 12 on pages 20 and 21 shows that, while two-thirds of Baltimore households have a desktop or laptop computer, the combined figure for all the cities in this study is about three-quarters. Cities such as Pittsburgh, Columbus, and Kansas City come in at about the overall household adoption rate for cities, while about 80% of homes in Washington, D.C. and Boston have computers at home.

Also of note are the recent trends in home computer ownership. The availability of alternatives such as tablet computers and smartphones means households without laptops or desktops may choose other kinds of digital devices—hence the fairly flat trend line for all 33 cities. Baltimore, however, with a downtick in adoption of 0.6 percentage points since 2016, compares less favorably to the other cities.

Table 11: Computing device adoption among households with children age 17 and under, United States, 2018

	All	Under $25,000	$25,000-$49,999	$50,000-$74,999	$85,000-$149,999	$150,000 and greater
Desktop or laptop computer	83.8%	58.2%	73.7%	83.9%	92.9%	97.9%
Tablet computer	77.8%	53.9%	66.5%	76.8%	86.4%	93.6%
Smartphone	95.9%	89.3%	93.9%	96.2%	98.0%	98.9%
Number of households	36,874,182	5,198,507	7,000,278	6,090,540	11,817,937	6,758,277

Table 12: Desktop or laptop computer adoption in 33 cities, 2018

City	2016	2017	2018	Change from 2016-2018
Seattle, WA	88.9%	89.4%	88.4%	-0.5
San Jose, CA	88.4%	87.5%	87.3%	-1.1
Raleigh, NC	86.6%	85.9%	86.0%	-0.6
Portland, OR	85.7%	84.9%	85.5%	-0.2
Colorado Springs, CO	83.4%	85.8%	84.7%	1.3
Denver, CO	81.0%	81.5%	84.7%	3.6
Mesa, AZ	80.8%	83.0%	83.1%	2.2
Charlotte, NC	82.0%	81.3%	82.6%	0.6
Sacramento, CA	79.1%	78.8%	82.4%	3.3
Minneapolis, MN	81.6%	82.2%	82.2%	0.5
Boston, MA	78.7%	79.0%	80.3%	1.7
Washington, DC	77.5%	79.5%	80.2%	2.7
Atlanta, GA	78.2%	77.1%	79.6%	1.4
Nashville, TN	79.1%	79.6%	78.2%	-0.9
Omaha, NE	77.7%	77.1%	78.1%	0.3
Albuquerque, NM	75.9%	78.9%	77.1%	1.2
Jacksonville, FL	76.0%	75.1%	76.3%	0.2

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City	2016	2017	2018	Change from 2016-2018
Las Vegas, NV	75.5%	76.8%	75.6%	0.1
Kansas City, MO	73.8%	73.1%	75.1%	1.3
Columbus, OH	76.5%	77.6%	75.0%	-1.5
Pittsburgh, PA	74.1%	75.9%	74.8%	0.7
Tucson, AZ	74.7%	74.4%	74.7%	0.0
Fort Worth, TX	75.4%	76.2%	73.6%	-1.7
Oklahoma City, OK	74.0%	73.8%	73.2%	-0.8
Indianapolis, IN	73.4%	72.3%	71.8%	-1.6
Louisville, KY	72.3%	71.8%	71.6%	-0.7
El Paso, TX	70.6%	70.0%	69.7%	-1.0
Philadelphia, PA	67.9%	67.2%	68.8%	0.9
Baltimore, MD	**68.2%**	**67.0%**	**67.6%**	**-0.6**
Milwaukee, WI	65.3%	61.3%	65.2%	-0.6
Cleveland, OH	57.7%	57.1%	57.1%	-0.7
Memphis, TN	59.6%	59.7%	56.2%	-3.4
Detroit, MI	52.9%	54.9%	54.7%	1.8
All 33 cities	**75.4%**	**75.5%**	**75.7%**	**0.3**

Trends: How Baltimore compares to other cities and the nation in the rate of broadband adoption

The preceding research shows Baltimore has significant gaps in broadband adoption in comparison to other cities and the nation. In other words, there is work to be done to close those gaps. What do trends extending back several years say about the prospect for progress?

Between 2013 and 2018, Baltimore experienced a steady growth in broadband adoption from 63.7% to 78.0% of households with broadband of some sort. This means that the number of households in Baltimore City without any sort of broadband connection declined from 88,600 in 2013 to 52,200 by 2018 (these figures account for a fall in the number of households in the city of about 7,000 during that time).

Relative to other cities in the study and the nation as a whole, Baltimore's increase in broadband of any type stacks up fairly well. The city's 14.3 percentage point growth is slightly above the average growth rate for all

Table 13: Broadband of any type, 2013-2018

City	2013	2014	2015	2016	2017	2018	Change from 2013-2018
San Jose, CA	85.6%	87.5%	87.2%	90.5%	91.4%	93.1%	7.5%
Colorado Springs, CO	82.9%	85.2%	86.1%	90.0%	90.4%	91.7%	8.7%
Seattle, WA	83.1%	84.7%	86.8%	90.3%	91.3%	91.4%	8.2%
Raleigh, NC	79.6%	81.5%	83.6%	90.2%	92.4%	90.6%	11.0%
Portland, OR	80.3%	83.8%	82.6%	87.5%	89.7%	90.6%	10.3%
Sacramento, CA	71.8%	73.9%	78.3%	83.3%	89.5%	90.2%	18.4%
Mesa, AZ	73.3%	75.0%	78.5%	86.1%	88.8%	90.0%	16.6%
Charlotte, NC	78.1%	80.7%	81.1%	86.1%	87.8%	89.8%	11.7%
Nashville, TN	73.2%	75.7%	75.3%	84.5%	85.9%	89.7%	16.5%
Fort Worth, TX	72.8%	71.9%	71.3%	84.0%	86.4%	89.2%	16.4%
Denver, CO	75.0%	77.2%	80.3%	85.6%	87.4%	88.7%	13.7%
Jacksonville, FL	73.7%	74.3%	77.4%	81.1%	82.2%	87.9%	14.2%
Columbus, OH	74.7%	77.8%	78.9%	78.5%	87.5%	87.3%	12.6%
Omaha, NE	72.6%	73.8%	78.4%	80.7%	84.6%	87.2%	14.6%
Boston, MA	75.4%	78.8%	81.6%	84.9%	85.5%	87.1%	11.7%

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City	2013	2014	2015	2016	2017	2018	Change from 2013-2018
Atlanta, GA	72.8%	71.4%	69.5%	80.6%	85.0%	86.9%	14.1%
Washington, DC	73.4%	73.4%	76.8%	79.8%	82.7%	86.1%	12.8%
Minneapolis, MN	76.2%	77.0%	79.6%	81.2%	84.0%	85.8%	9.6%
Oklahoma City, OK	69.8%	71.5%	74.6%	83.3%	84.7%	85.2%	15.4%
Kansas City, MO	69.6%	72.0%	74.9%	79.2%	82.3%	85.1%	15.5%
Louisville, KY	69.9%	70.3%	71.2%	83.3%	85.2%	85.0%	15.2%
Tucson, AZ	70.2%	74.0%	75.9%	83.9%	84.8%	84.9%	14.8%
Pittsburgh, PA	71.8%	72.4%	74.5%	80.1%	82.5%	83.6%	11.8%
Albuquerque, NM	72.5%	72.6%	71.0%	81.0%	84.4%	82.2%	9.7%
Las Vegas, NV	73.9%	73.0%	76.7%	80.1%	79.3%	81.4%	7.5%
Indianapolis, IN	68.9%	69.8%	71.2%	79.2%	80.8%	81.2%	12.3%
El Paso, TX	65.4%	66.3%	68.6%	79.2%	80.8%	79.8%	14.4%
Philadelphia, PA	64.6%	67.4%	70.1%	74.2%	71.6%	79.8%	15.2%
Baltimore, MD	**63.7%**	**67.0%**	**66.7%**	**74.4%**	**76.2%**	**78.0%**	**14.3%**
Milwaukee, WI	61.5%	64.8%	68.7%	75.3%	73.1%	77.1%	15.6%
Cleveland, OH	55.7%	58.3%	62.1%	67.7%	70.0%	72.6%	16.9%
Memphis, TN	58.6%	57.4%	62.2%	68.3%	71.8%	70.6%	12.0%
Detroit, MI	46.4%	49.0%	50.0%	60.9%	67.5%	70.3%	23.9%

the cities, which was 13.4 percentage points. For the United States as a whole, home broadband adoption grew from 73.4% to 85.1% from 2013 to 2018, an 11.7 percentage point increase.

The story for wireline broadband adoption for Baltimore is very different. Table 14 below shows that Baltimore's 59.3% adoption figure for wireline broadband has changed little since 2016.

In comparison to the nation and other cities in the study, Baltimore performed poorly on wireline broadband. For the collection of 33 cities, the average growth in wireline adoption was 2.8 percentage points from 2016 to 2018, as adoption rates for the 33 cities grew from 67.1% to 69.9%. That is three times the 0.9 point gain for Baltimore City. For the United States as a whole, wireline broadband adoption grew from 67.3% of households in 2016 to 69.6% in 2018— a 2.3 percentage point gain.

Table 14: Wireline broadband adoption, 2016-2018

City	2016	2017	2018
Seattle, WA	82.6%	84.1%	82.8%
San Jose, CA	81.8%	82.0%	82.3%
Colorado Springs, CO	76.6%	76.2%	80.0%
Raleigh, NC	81.9%	81.1%	79.6%
Charlotte, NC	74.8%	74.3%	78.0%
Portland, OR	76.3%	77.9%	77.7%
Denver, CO	75.3%	76.0%	77.6%
Boston, MA	74.8%	75.3%	76.6%
Washington, DC	70.3%	72.2%	75.6%
Sacramento, CA	70.6%	74.2%	75.5%
Minneapolis, MN	71.5%	73.3%	74.4%
Omaha, NE	68.5%	72.3%	74.3%
Nashville, TN	69.4%	71.3%	73.6%
Columbus, OH	62.2%	74.2%	73.5%
Pittsburgh, PA	69.4%	71.4%	71.9%
Mesa, AZ	67.8%	80.1%	70.9%
Atlanta, GA	67.6%	73.8%	70.8%
Las Vegas, NV	68.7%	66.6%	69.4%
Fort Worth, TX	66.7%	81.1%	68.9%
Tucson, AZ	66.4%	66.9%	67.9%
Albuquerque, NM	64.7%	71.9%	67.7%
Kansas City, MO	64.4%	67.2%	67.1%
Jacksonville, FL	68.0%	66.9%	67.1%

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City	2016	2017	2018
Louisville, KY	68.8%	68.8%	66.9%
Oklahoma City, OK	66.0%	65.8%	66.7%
Philadelphia, PA	60.6%	59.8%	65.9%
Indianapolis, IN	59.2%	64.4%	65.8%
Milwaukee, WI	57.9%	55.8%	60.9%
Baltimore, MD	**58.4%**	**59.3%**	**59.3%**
El Paso, TX	62.9%	60.2%	59.0%
Cleveland, OH	50.8%	54.5%	55.8%
Memphis, TN	50.1%	63.3%	51.8%
Detroit, MI	42.7%	45.8%	47.9%

Across all 33 cities analyzed, Baltimore is in the lower quarter in terms of wireline adoption growth from 2016 to 2018. It trails cities such as Philadelphia, Washington, D.C., Detroit, and Cleveland significantly; those places saw wireline adoption growth of about 5 percentage points from 2016 to 2018. Baltimore is behind the nation at large in wireline broadband adoption by about 10 percentage points, which means that 25,000 fewer households have wireline broadband than would be the case if Baltimore's wireline adoption rate equaled the nation's. If Baltimore's growth in wireline broadband kept pace with the cities noted above, 12,000 more Baltimore households would have wireline broadband.

RESPONDING TO THE CRISIS

Proposals at the federal level

Since the COVID-19 pandemic, there has been no shortage of proposals at the federal level for getting more people online. These proposals offer a significant opportunity to increase broadband adoption at home for low-income Americans and those whose livelihoods have been put on hold by the crisis.

Expanding the Lifeline program: This program, run and overseen by the FCC, provides a $9.25 per month subsidy for qualifying low-income households. The subsidy can be used either for phone or internet service, though most

beneficiaries use it for their phone service. Proposals focus on increasing the subsidy and encouraging more service providers to participate in service provision.

Expanding discount internet offers: Many internet service providers (ISPs) have discount plans for qualifying low-income households, with many focusing on households with school-age children. Comcast's Internet Essentials (IE) program, which operates in Baltimore City, is one example, with an offer of $9.95 per month for 25 Mbps service. IE initially aimed at households with school-age children, but eligibility has expanded to cover a wider population. Since the pandemic, IE has offered a 60-day free introductory offer to encourage greater subscription. Different ISPs have different price points, eligibility criteria, and service attributes. Many have called greater attention to them in the face of the pandemic. In addition, many ISPs have signed onto a pledge to not disconnect service and to waive late fees on billing.

Using E-rate to increase home connectivity for students: E-rate is an FCC program that funds broadband connectivity to schools and libraries to help these institutions fulfill their educational missions. Advocates have proposed allowing E-rate to include home broadband connectivity for low-income students. The rationale is that, because school for so many students now takes place at home, E-rate has legal authority to use its fund to support connectivity for home broadband connections. In a similar vein, Representative Grace Meng has introduced legislation establishing a $2 billion fund for schools and libraries to purchase Wi-Fi hotspots, routers, modems, and internet-connected devices for students and library patrons.

Supporting digital inclusion programs: The Corona Aid, Relief, and Economic Security (CARES) Act funded the Institute for Museum and Library Services (IMLS) with $50 million to expand digital network access, aid in the purchase of digital devices, and support digital inclusion programs at public libraries. Many libraries, of course, already provide computer access and digital skills training, and this funding aims to bolster these programs in response to the pandemic. Members of the House and Senate have also introduced the Digital Equity Act, which would establish a $250 million grant program over five years to fund digital equity plans by states as well as grants to local governments for digital inclusion.

Recommendations for Baltimore City

Regardless of how these federal and private sector initiatives may play out, it is important to underscore that promoting broadband adoption is a ground game. It unfolds in neighborhoods and communities. This means cities will play a strong role in turning federal recommendations into reality. Recommendations for cities fall into four categories:

Develop the pipelines for the delivery of digital resources for low-income households: As this report shows, there are sizable gaps in broadband adoption and ownership of computing devices to access the internet in Baltimore. Providing both resources—affordable home broadband subscriptions and digital access devices—is most urgent for low-income households. Nascent efforts are underway in Baltimore in both areas. The nonprofit PCs for People refurbishes computers and distributes them to low-income individuals at little or no cost to them. A group called DigiBmore has also formed to distribute laptops to students in need, and the Fund for Educational Excellence has established an emergency fund to support technology needs in Baltimore City Public Schools. For internet service, the city is widely served by Comcast for cable modem online service, and the company has the Internet Essentials (IE) program, a discounted internet offering for low-income households. In response to the pandemic,

Comcast offers 60 days of free service for new customers and free access to its Xfinity Wi-Fi hotspots to everyone. Deepening the reach of these initiatives could address access gaps in Baltimore City.

Enhance tech support: A dearth of digital skills is a well-known barrier to getting people online and using the internet for education, job search, and workforce skills development. About one-third of new internet subscribers generally seek out digital skills training, and this training does help them engage with the internet faster than those without training. Having digital skills training available nearby results in quicker and better payoffs. Such skills training takes place at local public libraries, as well as community nonprofits, such as (in Baltimore) Byte Back and the South Baltimore Learning Center. IMLS funds from the CARES Act could help the Enoch Pratt Library in Baltimore bolster its programming in this area.

Enlist a wider range of stakeholders: A 2017 report by the Robert W. Deutsch Foundation pointed out the low priority city officials and other stakeholders placed on digital equity gaps in Baltimore. In addition, as the Deutsch report showed, the private sector and anchor institutions such as hospitals could do more in Baltimore to address digital equity. This is something that Baltimore's Digital Equity Coalition, formed partly in response to the pandemic, is trying to do.

Build capacity in city government: The recommendations above show that much can be done as nonprofits, foundations, the private sector, and other stakeholders work together. But there is a role for city government. Across the nation, many cities focus on digital equity because elected officials make it a priority. This may include city funds to support digital inclusion programs, but it also involves developing staff expertise over time in cities to help integrate digital inclusion into all city initiatives. City government in Baltimore can borrow on lessons from other cities to bolster its internal capacity and expertise on digital access issues—with the goal of having broadband play a role in improving educational and economic opportunity in Baltimore City. Baltimore City Council's recent decision to fund $3 million for computer and internet access for low-income students is a positive step in building city capacity.

The analysis in this report can help stakeholders in Baltimore set goals for closing connectivity gaps. No set of initiatives will get 96,000 Baltimore households connected to wireline broadband overnight. But trying to move Baltimore to a place that looks more like the nation would mean that 22,000 *more* Baltimore households would have computers. Similarly, if Baltimore's home wireline broadband matched the nation's, 25,000 more homes in Baltimore would have wireline connections. More modestly, had Baltimore's growth in home wireline adoption from 2016 to 2018 been like cities such as Philadelphia, Washington, D.C., Detroit, and Cleveland, 12,000 more households in the city would have wireline broadband service.

ABOUT THE AUTHOR

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APPENDIX I: GLOSSARY

Broadband: The FCC defines broadband as any internet service that supports download speeds of 25 Megabits per second (Mbps) and uploads of 3 Mbps. This may include data plans on hotspots or smartphones, as the 4G wireless networks on which most of these plans operate can support these speed thresholds.

Wi-Fi: This refers to a wireless networking protocol that broadcasts a wireless signal from an access point (for homes, this is commonly known as the wireless router) to devices that essentially tune into the signal. The signal gives users access to the internet. Wi-Fi signals are unlicensed, meaning people are able to use the frequencies that broadcast the signal without paying for a license to use the spectrum in these frequencies. Wi-Fi is used broadly in people's home in conjunction with a home broadband subscription.

Wireline broadband: Refers to the provision of internet service to a location using wired transmission capabilities, which for broadband service is commonly digital subscriber line (DSL) service, cable modem service, or fiber optic service. Download speeds for wireline service vary by technology. The median observed DSL speed, according to the FCC, is 16 Mbps, while median speeds for cable are 97 Mbps and 73 Mbps for fiber services.

Fixed wireless broadband: This refers to broadband service by which a wireless signal is broadcast from a tower some distance away to a receiver at the customer's location (i.e., a fixed point). The customers' digital devices then connect to the internet (typically) using Wi-Fi. Speeds for these services can vary greatly, with some comparable to DSL service and others (that may use unlicensed spectrum) offering speeds of 1 Mbps.

Mesh network: This refers to a type of network architecture that relies on a number of radio-connected nodes that broadcast signals to one another in such a way as to create a wireless network that covers a specific geography. The multiple nodes help make mesh networks robust in the face of natural disasters. A key feature of a mesh network is that its data signals need not pass through a central internet service provider (such as a cable company) to deliver the internet to users. For consumer solutions, a mesh network might cover a community or neighborhood.

APPENDIX II: METHODOLOGY

The data used for this report come from the American Community Survey (ACS). This survey, conducted by the U.S. Census Bureau, contacts 3.5 million households per year. Households receive notices through the mail that they have been selected for the survey, and they can respond through the mail, using the internet, or by telephone. If contacted households do not respond, ACS follows up with phone calls to ask that the survey be completed. Some 90% of contacted households complete the ACS.

The large sample size of ACS allows analysis of fairly disaggregated geographic units, and, since the ACS is an ongoing survey, the Census Bureau aggregates the data in different ways. For analysis of census tracts (generally having populations of about 4,000 people though census tracts can be geographically large in rural areas), ACS aggregates data over five years, meaning some 17.5 million households are available for analysis. This report seeks to analyze year-to-year change, so it focuses on 1 year of ACS data at a time. These so-called "1-year ACS estimates" are appropriate for places with populations of 65,000 or more – which fits the descriptions of cities used in this report. Much of the report's analysis for Baltimore City comes from the 2018 analysis of ACS' 2018 Public-Use Microdata Samples (PUMS).

This report primarily analyzes two questions from the survey:

1. At this house, apartment, or mobile home – do you or any member of this household have access to the Internet?
    - **a.** Yes, by paying a cell phone company or Internet service provider
    - **b.** Yes, without paying a cell phone company or Internet service provider
    - **c.** No access to the Internet at this house, apartment, or mobile home
2. Do you or any member of this household have access to the Internet using a:
    - **a.** cellular data plan for a smartphone or other mobile device?
    - **b.** broadband (high speed) Internet service such as cable, fiber optic, or DSL service installed in this household?
    - **c.** satellite Internet service installed in this household?
    - **d.** dial-up Internet service installed in this household?
    - **e.** some other service?

For the report's analysis, "broadband of any type" includes "yes" responses for cellular data plan on a smartphone, broadband internet service such as cable, fiber optic, or DSL, and satellite service. Discussions in the report focusing on "wireline broadband" refers only to "yes" responses to having broadband internet service such as cable, fiber optic, or DSL.

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**Baltimore's Digital Divide:
Gaps in Internet Connectivity and the
Impact on Low-Income City Residents**

by John B. Horrigan, Ph.D.

About the Abell Foundation

The Abell Foundation is dedicated to the enhancement of the quality of life in Maryland, with a particular focus on Baltimore. The Foundation places a strong emphasis on opening the doors of opportunity to the disenfranchised, believing that no community can thrive if those who live on the margins of it are not included.

Inherent in the working philosophy of the Abell Foundation is the strong belief that a community faced with complicated, seemingly intractable challenges is well-served by thought-provoking, research-based information. To that end, the Foundation publishes background studies of selected issues on the public agenda for the benefit of government officials; leaders in business, industry and academia; and the general public.

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