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The Online Learning Equity Gap

Innovative Solutions to Connect All Students at Home

Michael Calabrese & Amir Nasr
Acknowledgments

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About New America

We are dedicated to renewing the promise of America by continuing the quest to realize our nation's highest ideals, honestly confronting the challenges caused by rapid technological and social change, and seizing the opportunities those changes create.

About Open Technology Institute

OTI works at the intersection of technology and policy to ensure that every community has equitable access to digital technology and its benefits. We promote universal access to communications technologies that are both open and secure, using a multidisciplinary approach that brings together advocates, researchers, organizers, and innovators.

About Wireless Future Project

The Wireless Future Project, a project of the Open Technology Institute, develops and advocates policies to promote universal, fast and affordable wireless broadband connectivity, including the reallocation of more prime spectrum for shared and unlicensed access. It encourages mobile market competition, an open Internet and other policies aimed at unlocking the full potential of the wireless age for all Americans.
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Executive Summary

The COVID-19 pandemic has revealed deep inequities in the United States, and the lack of high-speed broadband access has been front-and-center because this public health crisis has required a large share of the population to work and learn from home. Among those most adversely impacted have been America’s students. The pandemic resulted in the near total shutdown of schools last spring, impacting 55.1 million students at 124,000 U.S. public and private schools. Schools shifted to remote learning almost overnight. The prevalence of remote learning continued into the 2020–2021 school year, with only 24 percent of school districts returning to in-person instruction full-time.

The digital divide has left millions of households in the United States without access to the broadband connectivity needed for education, work, and accessing a wide range of essential information and services central to equal opportunity in today’s economy and society. For the millions of students who live in households without broadband internet access, the move to remote learning has created new, extensive barriers to learning. While the “homework gap” was a serious problem long before the COVID-19 pandemic, the necessity of remote learning in 2020 has turned the homework gap into a chasm. For students without high-speed broadband access at home, completing homework, researching for projects and papers, and exploring developing interests all become impossible to undertake. Quality education today requires internet access at home, and students who do not have that access—whether due to the fact it is not affordable or because it is not deployed where they live—are at a distinct disadvantage.

The Federal Communications Commission (FCC) has both the authority and the resources to mitigate the homework gap and yet it has refused to act. The FCC oversees the Universal Service Fund, which spends billions of dollars each year on several programs with the statutory goal of connecting all Americans to advanced communications, including specifically for education. One of these

[Image: Source: Shutterstock / elenabsl]
programs, E-Rate, is designed to help schools and libraries build and maintain broadband networks at a discount to further educational needs. E-Rate is a highly successful program that has connected most schools to gigabit-fast internet connections and funded internal Wi-Fi networks to extend broadband to every student and teacher in the school and even around the school’s playing fields and other facilities. The infrastructure is in place to use this program to help school districts and libraries connect students who cannot get online and therefore cannot access education at home. The FCC has the authority to increase E-Rate funding and to grant school districts the flexibility to reprogram funds to extend connectivity to students at home. However, as we explain below, despite petitions from states and education advocates, the FCC has refused to act. The Open Technology Institute (OTI) urges the FCC, as we did in an emergency filing in April 2020, to take action and use the program to provide the immediate relief students need.

Thankfully, hundreds of school districts around the country have not waited for the FCC to grant them more E-Rate funding or flexibility to allocate E-Rate funds to meet this challenge. This report profiles many different examples of school-sponsored broadband networks that have been built and deployed for educational purposes both during the COVID-19 pandemic and in the years prior. In Part II, we profile more than a dozen school districts that have pioneered a range of innovative approaches to connecting students lacking adequate internet access at home. We start with three school districts in Iowa and California that have partnered with their municipality to build out community Wi-Fi networks that connect low-income students directly to the school’s network. The next subsection profiles school districts in Texas, California, and other states that are taking advantage of novel spectrum sharing frameworks, such as the new Citizens Broadband Radio Service in the 3.5 GHz band, to build out private LTE mobile networks that connect students at home, and that are far more financially sustainable longer term than buying subscriptions from mobile cellular providers.

A third subsection describes efforts in Virginia and Colorado to extend the reach of school networks directly to students at home, or to community hotspots closer to their homes, using the free unlicensed spectrum known as “TV white spaces” (TVWS). TVWS refers to the locally-vacant television channels that can be used to transmit internet access over very long distances. Finally, a fourth subsection highlights districts that are outfitting school buses as Wi-Fi hotspots and parking them strategically in neighborhoods where clusters of students lack broadband at home. Some districts are locating internet hotspots in community centers, public housing, or other more permanent locations. Libraries, which are also eligible for E-Rate funding, have also been stepping up by lending out Wi-Fi hotspots and amplifying their Wi-Fi so that students and other patrons can get online even when the building is closed.

newamerica.org/oti/reports/online-learning-equity-gap/
All of these innovative efforts provide a potential blueprint for other school districts, for telecommunications companies, and for local governments struggling to both connect students for remote learning and also keep students connected in a sustainable way for the long term. Each community has different needs and circumstances that will point to one solution over the others. What school districts across the country have in common is the need to find effective and financially sustainable ways to extend connectivity to students who lack it and thereby close the nation’s destructive homework gap.

We must also recognize that the digital divide is a far bigger problem, adversely impacting not just students, but their parents, the elderly, and many other lower-income individuals. The FCC and Congress need to strengthen the Lifeline program and improve broadband competition to ensure that broadband access costs and deployments improve. The FCC, in fact, has a congressionally-mandated obligation to ensure high-speed broadband is deployed in a reasonable and timely manner to all Americans. Clearly, the government is failing to meet this goal. However, as we discuss, there are specific solutions—such as E-Rate—that are specific to education and that we hope can facilitate solutions today and in the future.

Editorial disclosure: This report mentions policy positions of Microsoft and Google, both of which fund work at New America but did not directly support the research or writing of this report. New America is guided by the principles of full transparency, independence, and accessibility in all its activities and partnerships. New America does not engage in research or educational activities directed or influenced in any way by financial supporters. View our full list of donors at www.newamerica.org/our-funding.
I. Pandemic Disruption: From Homework Gap to Remote Learning Chasm

The digital divide has left tens of millions of individuals in the United States without access to the broadband connectivity needed for education and work, as well as to access a wide range of essential information and services central to equal opportunity in today’s economy and society. The COVID-19 pandemic exacerbated a number of longstanding inequities in the United States, and the relationship between internet access and education is no different. The pandemic resulted in the near total shutdown of schools last spring, impacting 55.1 million students at 124,000 U.S. public and private schools. Schools shifted to remote learning almost overnight. The prevalence of remote learning continued into the 2020-2021 school year, with only 24 percent of school districts returning to in-person instruction full-time. Nearly half of all districts (49 percent) relied on remote learning, while 27 percent began with hybrid instruction. Among the 100 largest school districts, 74 percent chose to begin the school year relying entirely on remote learning for their more than nine million students.

Unfortunately, due to systemic inequities that reflect broader societal problems, students in historically marginalized communities lack broadband at disproportionate rates. Students in rural areas also struggle to get connected. The digital divide is a problem of both availability and affordability. Together these barriers have left the United States with a large gap in connectivity that...
policymakers have failed to close. Access to high-speed broadband at home is increasingly critical to modern education, as the Open Technology Institute (OTI) and broad coalitions of advocacy groups have argued for years. Without adequate internet access at home, students have trouble finishing homework, conducting research, or pursuing their curiosity in directions that lead to more learning and lifelong passions. This is why the lack of broadband access as it relates to education has been dubbed the “homework gap.”

The necessity of remote learning in 2020 has turned the homework gap into a chasm. When schools closed last spring, the lack of a high-speed internet connection meant that a student could not go to school at all. Students without access to reliable broadband at home have had to struggle to keep up with the shift to remote learning. Even those students who manage to get online intermittently from a fast food parking lot, on a parent’s smartphone, or on a slow connection at home, are far less likely to absorb a lesson plan that is already being delivered in a sub-optimal way compared to in-person instruction. The homework gap is turning into a cavernous divide that will harm students without robust reliable broadband at home for the rest of their lives, as they lose learning opportunities that students with adequate broadband at home do not.

The Federal Communications Commission (FCC) has both the authority and the resources to mitigate the homework gap and yet it has refused to act. The federal E-Rate program, which is one component of the Universal Service Fund (USF) established by Congress to ensure access to advanced communications for all Americans, is specifically designed to improve broadband access for educational purposes. A recent survey of 2,000 schools and libraries that participate in E-Rate found that 93 percent would use current E-Rate funds to help students get online if the FCC allowed it.\(^7\)

The E-Rate program has historically been centered on strengthening connectivity in schools and libraries, but there is precedent for extending connectivity to students who lack home broadband to ensure that they have the internet access necessary for school work. OTI and other advocates have argued the FCC should move swiftly to increase both E-Rate funding and flexibility to allow schools to connect students beyond the walls of the classroom, at least on a temporary basis for the duration of the pandemic. Remote learning moved the classroom to students’ homes, but without adequate high-speed broadband at their households, these home classrooms are ill-equipped for remote learning.
A. The Homework Gap is a Longstanding Problem Hugey Exacerbated by the Pandemic

Many school-age children live in households without high-speed internet

<p>| % of U.S. households with children ages 6 to 17 who do not have a high-speed internet connection |</p>
<table>
<thead>
<tr>
<th>All</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
</tr>
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<tbody>
<tr>
<td>All households with school-age children</td>
<td>15%</td>
<td>10%</td>
<td>25%</td>
<td>23%</td>
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<table>
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<tr>
<th>BY ANNUAL HOUSEHOLD INCOME</th>
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<tr>
<td>Less than $30,000</td>
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<tr>
<td>All households with school-age children</td>
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<tr>
<td>White</td>
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<td>Black</td>
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<td>Hispanic</td>
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<tr>
<td>Asian</td>
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<tr>
<td>$30,000-$74,999</td>
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<tr>
<td>All households with school-age children</td>
</tr>
<tr>
<td>White</td>
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<tr>
<td>Black</td>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Asian</td>
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<td>$75,000 or more</td>
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<tr>
<td>All households with school-age children</td>
</tr>
<tr>
<td>White</td>
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<tr>
<td>Black</td>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Asian</td>
</tr>
</tbody>
</table>

Note: Race and ethnicity are based upon the race and ethnicity of the head of household. Whites, blacks and Asians include only those who reported a single race and are only non-Hispanics. Hispanics are of any race. Household income data reported for the calendar year prior to the survey year. Source: Pew Research Center analysis of 2015 American Community Survey (IPUMS). NEW RESEARCH CENTER

Even before the current pandemic forced the nation’s schools to implement remote learning, the homework gap reinforced educational inequities for the approximately 16 million students who lack broadband access at home. Students who live in households without an adequate home internet connection are unable to complete homework that requires online access. This is particularly problematic since seven in 10 teachers surveyed said that they assign homework that requires internet access, and that number increases as students advance to high school.

Internet access at home is not merely about homework, though. Students who have access to broadband at home consistently score higher in reading, math, and science than those who do not. Students who either do not have home broadband access—or who need to depend entirely on mobile broadband—need more time to complete homework and tend to have lower grade point averages, according to a study done by Michigan State University. “After controlling for socioeconomic factors, quality of home Internet access has an impact on a range of student performance outcomes,” the study states. The study found that “students who do not have access to the Internet from home, or who are dependent on a cell phone alone for access, perform lower on a range of metrics, including digital skills, homework completion, and grade point average.” For students who are not able to use the internet at home, that lack of access precludes students’ ability to conduct research for essays and reports, or their
ability to read and learn more about personal interests that could grow into academic endeavors or careers.

Other studies have further underscored just how a lack of broadband access at home can harm students, even in non-pandemic times. A Pew Research Center study in 2018 found that 17 percent of teenagers surveyed in the United States reported that they often or sometimes cannot complete homework because of a lack of a reliable computer or internet connection. More generally, a 2016 study by the Joan Ganz Cooney Center at Sesame Workshop found that “children without home Internet access are less likely to go online to look up information about things that they are interested in: 35% of those with mobile-only access say they ‘often’ do this, compared to 52% of those with home access.”

Research released since the pandemic began has detailed the full extent of the homework gap that was already starkly on display when schools closed. A report published by the Alliance for Excellent Education (All4Ed), National Indian Education Association (NIEA), National Urban League (NUL), and UnidosUS found that 16.9 million children—or 8.4 million households—do not have high-speed broadband access at home.

A separate report from Common Sense Media found that an estimated 15 to 16 million K-12 public school students lack either sufficient broadband access or the devices needed to adequately participate in remote learning—a group that represents 30 percent of the more than 50 million students who needed to learn remotely from home when schools closed in March or April 2020. Students in rural areas also lack the broadband connectivity needed for remote learning at higher rates—37 percent of students in rural areas lack access to the broadband needed for online learning compared to 21 percent of students in urban areas.

As detailed further below, this divide harms historically marginalized communities and low-income households at higher rates. The Pew Research survey found that 25 percent of Black teenagers reported that they at times were unable to finish homework due to these constraints, as did 17 percent of Hispanic teenagers, and 24 percent of teenagers from households making less than $30,000 annually. The All4Ed et al. report found that one out of every three Black, Latinx, and American Indian/Alaska Native households do not have high-speed internet access at home. According to that report 34.2 percent of American Indian/Alaska Native households with one or more children age 17 or younger lack high-speed broadband at home, as do 31.2 percent of Latinx households, and 30.6 percent of Black households, compared to 20.9 percent of white households.

Cost plays a central role in the homework gap, as it is arguably the biggest barrier to broadband adoption in the United States. Nearly 45 percent of households with one or more children age 17 or younger and a yearly income of $25,000 or less lack access to high-speed broadband at home, while only 8 percent of those with
an annual income of more than $150,000 lack that access. Studies such as OTI’s recent Cost of Connectivity 2020 report have consistently shown that relatively high costs and affordability are central to explaining why millions of people in the United States do not have access to high-speed broadband at home. A recent survey of low-to-moderate-income families with children ages six to 13 found that “[t]he dominant reason for not being connected at home is financial. . . . 42% of those without home Internet access indicated that cost is the main reason that they do not have it. This is particularly true among families below the poverty level, where half of those without a home computer (53%) or home Internet access (50%) cite money as the main reason.”

The lack of affordable broadband options exacerbates the racial digital divide: The Department of Education found that 46 percent of Black children and 44 percent of Hispanic children surveyed who reported not having internet access at home did not have it because the service was too expensive, compared to just 28 percent of white children who did not have access.

The homework gap is particularly harmful when schools and libraries are closed, leaving millions of students without internet access even during the school day. A 2018 report from the National Center for Children in Poverty highlighted that “children are overrepresented among our nation’s poor; they represent 23 percent of the population but comprise 32 percent of all people in poverty. Many more children live in families with incomes just above the poverty threshold.”

These inequities have wreaked havoc on educators’ ability to teach during the pandemic. Common Sense Media found that in states with the deepest digital divides, half of all students do not have sufficient internet access for remote learning, and that even in states with smaller gaps in connectivity, a quarter of students lack this access. Teachers feel this impact as well. An estimated 400,000 teachers are unable to teach from home because of a lack of internet access. And in some cases when too many students could not participate in remote learning, schools or teachers gave up on it in favor of distributing packets of worksheets on paper.

Local news outlets and the national media have detailed the impact of the homework gap on pandemic-induced remote learning efforts. Connectivity issues in the San Francisco Bay Area demonstrate that these disparities are severe even in a relatively prosperous and tech-savvy region: The Oakland Public Education Fund reported that about half of Oakland’s 50,000 students lack either a computer or internet access and 14,000 of San Jose’s 36,000 students reportedly do not have access to digital resources. A report from the Mercury News in August described one 15 year old who had internet access so slow that he missed deadlines when his assignments did not upload, a problem that worsened when his sister had class at the same time. The article also highlighted one student whose family could not afford broadband service, forcing him to go to friends’ houses to access the internet despite the pandemic. He told the paper:
“I’d rather get a nice education and finish my work instead of my health.”

Students are being forced to make impossible choices because of the failure to ensure all Americans are able to access and afford broadband access at home. The failure to provide reliable broadband access to all households has pit public health against students’ education and futures. Even in the nation’s capital, the D.C. public school system estimates that roughly 30 percent of the students do not have broadband access or a computer at home. 

Students in lower-income areas are experiencing the greatest inequities. Students in one Cleveland family had to share one laptop and as the pandemic progressed, reduced income led them to cancel their broadband service to save money and rely on their phone as a hotspot, but they ran out of data quickly. They later paid a neighbor to use their signal, which turned out to be too weak.

Students cannot be expected to follow along with their online lessons and absorb the material to the fullest extent if they can only barely get online in the first place.

Many students have been connected in areas where a large cable company or other internet service provider (ISP) is offering free or reduced-price basic service for K-12 students in low-income households. A leading example is Comcast’s longstanding Internet Essentials program, which is partnering during the pandemic with many districts to identify and connect eligible students across the country. Among mobile carriers, the most ambitious initiative appears to be T-Mobile’s Project 10Million, which offers students in eligible, low-income households in participating schools a free Wi-Fi hotspot and 100 gigabytes of data over a 12-month period.

While these ISP initiatives can connect many students quickly and often affordably in the context of the COVID-19 crisis, they don’t work for millions more and can be unsustainable long term. The most obvious shortcoming is that the ISPs with the most generous offers, such as Comcast, are only available in certain communities. Millions of student households have no access to any high-capacity internet service, particularly in rural areas. Even if a student is eligible to receive free or discounted service where they live, those offers often come with caveats that often make it difficult for households to actually establish or maintain service. For example, households with a previously unpaid balance or poor credit are typically shut out of these programs. The offers, particularly those using mobile networks, often limit the bandwidth students can consume without paying for a higher tier of service. For example, the T-Mobile 10Million offering noted just above is limited to 100 GB of data per year, which the company says is enough for 320 hours of online learning. These offers are also time-limited and rely on the good will of private companies and/or the ability of local school districts to help fund the ongoing monthly costs.
B. The Homework Gap is Harming Students’ Education, Especially During the Pandemic

The negative impacts of the homework gap on students’ ability to learn has been greatly exacerbated due to coronavirus school closures, inflicting long-lasting educational disadvantages and inequities. For some students, such as those applying to college, or for others who are at crucial stages of their educational careers, this disruption could be particularly harmful to their futures. A recent study published by the Organization for Economic Cooperation and Development (OECD) examined the problem of lost learning and its economic impact. The study projected that if schools in the United States stay out of the building for a full year (e.g., until March 2021), students could face a 9.1 percent loss in lifetime earnings due to “suffering cognitive learning losses typical of different proportions of the school year.”36

A McKinsey analysis estimated that even if students return to traditional in-person class as it was taught pre-pandemic in January 2021 (which is unlikely in many areas given the current trajectory of COVID-19 in the United States), students with “low-quality remote learning” would have lost at least seven months of learning, and those with no instruction would fall at least a school year behind under that scenario.37 The McKinsey study projected that learning loss would be much worse for Black, Hispanic, and low-income students—and that the subsequent lag in learning and increase in dropout rates would drastically harm students’ financial futures as well as the nation’s gross domestic product.
The OECD report notes that if the United States loses two-thirds of a year in classroom learning, it would reduce long-term U.S. GDP by nearly $28 billion. When the share of students without internet access is high, as it is in very low-income areas, it often harms all students, even those with high-speed broadband at home. Districts across the country have grappled with the reality that so many students lack reliable broadband connections at home that schools are forced to offer everyone an alternative set of lessons, typically on paper. After the spring 2020 shutdowns, many schools in low-income areas decided it would be both inequitable and infeasible for teachers to run two parallel instruction programs for students depending on whether their family had internet access at home.

In the Detroit Public Schools Community District, which teaches 51,000 students that live in high poverty, around 90 percent of students lacked home broadband access at the beginning of the pandemic. As a result, teachers resorted to distributing paper packets with lessons to conduct remote learning. That deprives all students of interaction and feedback. An elementary school near Pittsburgh conducted lessons over the radio since most families had access to a radio, but not necessarily a computer and home internet. Teachers in low-connectivity areas across the country typically sent home paper packets and tried to individually answer questions and help students over the phone.
C. The E-Rate Program Could Mitigate the Problem—But the FCC has Refused to Act

During the coronavirus crisis, homes have become classrooms for most U.S. students. As noted above, in the spring of 2020 nearly every school shut down, impacting more than 55 million students; and as the new school year began, 76 percent of all school districts began the 2020–2021 school year relying on remote learning exclusively (49 percent) or partially (27 percent). Unfortunately, even before the crisis, approximately 15 to 16 million K-12 students, as many as 30 percent of all students, lacked the broadband internet access or devices needed to engage in remote learning at home. At the outset of the pandemic, the National Center for Education Statistics (NCES) estimated that 14 percent of school-age children lacked internet access at home and 9 million K-12 students faced difficulty completing assignments online or participating in remote learning.

FCC inaction on E-Rate since March 2020 meant that the millions of students who could have been connected to remote learning from home remained disconnected as the new 2020–2021 school year began. The FCC could be doing far more to connect these temporary home classrooms to schools’ online educational resources with internet access. The commission could allocate as much as $2 billion in additional E-Rate funding on an emergency basis and could also waive restrictions on the use of E-Rate-funded facilities to extend school or library connectivity to students off campus for educational purposes. These two
separate measures should be straightforward and non-controversial steps to take in the context of the pandemic.

One fast and relatively low-cost way to get students online is to fund “hotspots” (personal Wi-Fi routers known as MiFi devices) served by established wireless carriers—predominantly cellular mobile carriers, but also potentially by fixed wireless and satellite ISPs. Hotspots could be distributed efficiently through schools and libraries already receiving support through the FCC’s E-Rate program. Many districts are using coronavirus relief funding and donations to purchase and loan out mobile hot-spot devices as a stop-gap, but both funding and the availability of MiFi-type devices are inadequate.

School districts also need the flexibility to use E-Rate funds and E-Rate-funded facilities to leverage innovative and proven solutions, including the use of school buses as Wi-Fi hotspots, locating Wi-Fi access points in public housing and other locations, extending the reach of the school’s own network using a rooftop transmitter and unlicensed spectrum, and building out community Wi-Fi and other local wireless networks that cover even more students. These innovative solutions are described in the next section. The FCC can readily waive current E-Rate restrictions and grant that flexibility.

There is considerable and diverse support for FCC action to tap funds from the agency’s USF to support local school district initiatives to connect students in their home-schooling classrooms. The Schools Health & Libraries Broadband (SHLB) Coalition suggested at the inception of the school-closure crisis that the “FCC could make emergency funding available from the USF for hot spot lending programs operated by schools, libraries, and other community organizations in areas where schools and libraries close.” The USTelecom Association (USTA), a major ISP trade association, similarly recommended that the commission use its available authority to “allow schools to apply for funding to purchase wired or wireless broadband connectivity on behalf of students and/or teachers that do not currently have broadband access from home during the COVID-19 pandemic.”

In March 2020, 16 U.S. senators called on the FCC to use $2 billion in emergency E-Rate funding to help schools buy Wi-Fi hotspots to distribute to students lacking adequate connectivity, an idea endorsed by the nation’s most prominent associations of principals, teachers, and school technologists. There is at least $2 billion in money immediately available within USF for E-Rate that does not require action from Congress to act. These funds are derived from the combination of $1 billion in carry-forward funding and that total demand for funds was $1.2 billion below the E-Rate funding cap of $4.15 billion for 2019.

The March 2020 letter from 16 U.S. senators, led by the legislative author of E-Rate, Sen. Edward J. Markey (D-Mass.), similarly stated: “We believe that the FCC can use its emergency powers to temporarily waive relevant E-rate program
rules and allow its beneficiaries to utilize universal service funding to provide home wireless service to existing school devices and hotspots for students who lack internet access at home. In September 2020, 38 U.S. senators reiterated their belief the FCC had all the authority it needed to expand funding and flexibility to address the homework gap in the context of the COVID-19 crisis. The senators also noted that the U.S. Department of the Interior “similarly requested that the FCC update its interpretation of what constitutes a school campus under the E-Rate program in order to allow funding to support virtual classrooms.”

More broadly, advocates for mitigating the homework gap called on the FCC to waive restrictions on current E-Rate funding so that schools have the flexibility to decide how best to meet the connectivity needs of their students and teachers. In April 2020, OTI filed an “Emergency Request” at the FCC that described in detail why the agency had the authority to both increase E-Rate funding and to waive restrictions on using E-Rate funds and E-Rate-funded facilities to connect students at home and wherever needed. In September 2020, the State of Colorado filed a formal Petition for Waiver similarly asking the FCC for an “emergency waiver of current restrictions on the use of E-Rate funds and E-Rate-funded facilities to allow schools to extend their broadband network connectivity to students’ homes, or other safe and convenient community access points.”

The commission should also waive many of E-Rate’s cumbersome application procedures and instead define eligibility and authorize reimbursements to schools and libraries that purchase and loan the necessary equipment (e.g. hotspots), as well as for the cost of ISP services. A maximum reimbursement per eligible household should also be established. To multiply the impact, the FCC, schools, and local officials should solicit commitments from participating ISPs to provide service at no cost or at a deep wholesale discount. E-Rate competitive bidding restrictions should also be waived temporarily during the crisis so that orders for hotspots and wholesale agreements for ISP connectivity can be completed as expeditiously as possible.

The FCC Has the Legal Authority to Designate an Emergency Set Aside of New USF Funding to Connect Students Lacking Broadband Internet Service

The FCC should be actively helping schools as they shoulder the Herculean task of solving a digital divide that decades of inaction from policymakers allowed to fester. Instead, the agency has taken no action and offered no formal decision stating its views. Opponents of expanding E-Rate rely on the objection that the advanced telecommunications services for education described in one provision of the Communications Act refers to “public and nonprofit elementary and secondary school classrooms.” In a letter responding to Sen. Amy Klobuchar (D-Minn.), Chairman Pai expressed his belief that the Act "expressly limits the FCC’s use of E-Rate program funding to broadband and other services delivered
to school classrooms and libraries. Connectivity and devices supplied to students at home unfortunately do not qualify for E-Rate support under the law.”

However, as OTI’s Emergency Request and the State of Colorado’s Petition for Waiver both explain in detail, a single reference to classrooms in the provisions authorizing E-Rate is not a persuasive reason to ignore all the other statutory provisions and FCC precedents that support FCC authority. More essentially, in the context of the COVID-19 crisis, homes are very often the only classrooms available while schools are closed. Many educators view “Zoom rooms” and the online sessions provided by Webex, Google Meets, and Microsoft Teams as the new equivalent of classrooms since that is where lessons are actually taking place.

Chairman Pai’s assumption that the FCC is powerless to use E-Rate to mitigate the homework gap is mistaken based on both a fair reading of the statute and FCC precedent. First, the commission has the authority to respond to widespread school closures by designating a new emergency category of E-Rate funding that prioritizes internet access for remote learning where student’s lack broadband at home. Section 254 of the Communications Act requires the FCC to oversee the USF based on a set of “universal service principles” that include “[a]ccess to advanced telecommunications services for schools, health care, and libraries.” As the FCC recognized in its 2014 E-Rate Order, multiple sections of the Communications Act “collectively grant the Commission broad and flexible authority to set the list of services that will be supported for eligible schools and libraries, as well as to design the specific mechanisms of support.” As the FCC recognized in its 2014 E-Rate Order, multiple sections of the Communications Act “collectively grant the Commission broad and flexible authority to set the list of services that will be supported for eligible schools and libraries, as well as to design the specific mechanisms of support.” As the FCC recognized in its 2014 E-Rate Order, multiple sections of the Communications Act “collectively grant the Commission broad and flexible authority to set the list of services that will be supported for eligible schools and libraries, as well as to design the specific mechanisms of support.”

In addition, the Communications Act explicitly gives the Commission discretion to add “special services” for schools from time to time, as needed. Section 254(c) (3) states:

In addition to the services included in the definition of universal service under paragraph (1), the Commission may designate additional services for such support mechanisms for schools, libraries, and health care providers for the purposes of subsection (h).

This authority reflects a recognition by Congress that the technology needs of schools and libraries are constantly evolving in light of “advances in telecommunications and information technologies and services.” Moreover, Congress gave the FCC “specific authority to alter the definition [of services] from time to time, and to provide a different definition for schools, libraries, and health care facilities.” Certainly, during this period of school closures, there are
few things more “essential to education” than broadband internet access for students and teachers.

Moreover, the need to fund equipment or services that extend broadband to students where they are learning, such as Wi-Fi hotspot connectivity, is further supported by Section 254(h)(2)(A). The statute directs the commission to “enhance, to the extent technically feasible and economically reasonable, access to advanced telecommunications and information services” for schools and libraries.\textsuperscript{66} Although the commission has long maintained that Section 254’s focus on access to services precludes funding for end-user devices, such as laptops,\textsuperscript{67} Wi-Fi-enabled hotspots represent network equipment and perform the same function as Wi-Fi routers and other internal connections that distribute wireless broadband connectivity to students and teachers in a school.

Importantly, as the State of Colorado’s Petition for Waiver emphasized, in April the FCC embraced this same authority, under the same statutory provision, to extend funding and flexibility for USF telehealth services to rural patients and veterans at home. In its Report and Order creating a new $100 million Connected Care Pilot Program, the FCC clearly concluded it has the statutory authority under the same Section 254(h)(2)(A)—which applies to schools, libraries, and health care providers—to create a discrete new category of USF support dedicated to “funding health care provider purchase of broadband Internet access service for participating patients,” particularly low-income patients and veterans in rural areas.\textsuperscript{68} The Order described the goal of extending connectivity to reach patients where they are with these services, which apply equally to schools attempting to extend essential education services to students the home:

For the Pilot Program, funding patient broadband Internet access services would expand health care providers’ digital footprints for purposes of providing connected care services and allow health care providers to serve more eligible low-income patients and veterans through the Pilot Program and, thus, enhance health care providers’ access to “advanced telecommunications and information services.”\textsuperscript{69}

The Commission defends its conclusion by arguing it previously determined it has “broad discretion regarding how to fulfill this statutory mandate” under section 254(h)(2)(A).\textsuperscript{70} The Order also relies on the fact that “the costs of broadband Internet access service for patient use in their homes or mobile locations, . . . are an obstacle for certain health care providers and their patients to adopt connected care services.”\textsuperscript{71} To remedy this obstacle, the Order concludes that enhancing program services to extend its reach to patients lacking connectivity represents an “advancement of universal service [based] on the principles outlined in section 254(b) of the Act.”\textsuperscript{72}
These circumstances are as true for students and teachers needing home internet access for education as they are for telehealth patients in the Connected Care Pilot Program. If the FCC can adopt these measures for rural telehealth, it should certainly take this opportunity to do so for connected learning as well.

Additionally, the telehealth pilot program is not limited to the duration of the pandemic, but designed to continue for three years. Like home-schooling classrooms, while the need for this program is greatest now, the commission is certainly correct that the ability of advanced telecommunications to extend the benefits of USF-supported services to locations where they are most needed advances the congressional goals of universal service set out in Section 254.

The Order notes further that relying on Section 254(h)(2)(A) “also ensures that the pilot program is health care provider-driven and enables participating health care providers to select from the broadest range of broadband Internet access service providers to meet the health care needs of participating patients.”

Similarly, in the case of E-Rate, funding to extend services to students and teachers off campus should be school-driven and give schools the flexibility to select the ISP that is most cost-effective and appropriate to their needs.

**The Commission Should Waive Restrictions on the Use of E-Rate Funded Facilities to Extend Connectivity Off Campus for Educational Purposes**

Even in the absence of an emergency increase in USF or E-Rate program funding, the Commission could go further to encourage schools and libraries to expand internet access for unconnected students and teachers at home or in public places. OTI’s Emergency Request, the State of Colorado’s Petition for Waiver, the SHLB Coalition, and other parties have all demonstrated that the FCC has the authority to waive any restrictions on the ability of schools to use their current E-Rate funding or E-Rate-funded facilities (e.g., fiber optic and other high-capacity connections to the internet, known as backhaul) to connect students at home or at community access points. As former Florida Governor Jeb Bush wrote recently: “Done right, we see now that virtual classrooms can be an effective approach to teaching our kids whether in the pandemic or as an enhancement to classroom education.”

Unfortunately, under current E-Rate rules, while the general public can use Wi-Fi networks funded by E-Rate on school property, schools and libraries do not have the flexibility to use E-Rate funds to extend those networks to students and teachers lacking adequate internet access at home. Existing rules require schools to allocate a share of the cost of E-Rate supported networks or devices used off school property so that E-Rate funds are not used. This is a cumbersome and costly deterrent for schools and districts with the greatest need that also prohibits E-Rate funding for home-school hotspots. Denying schools flexibility to use E-Rate funds based on local circumstances and needs imposes the sort of “Washington knows best” approach that many advocates for deregulation often deride. As Chairman Pai stated in his dissent to the 2014 E-Rate Order, which
greatly expanded funding designated for in-school Wi-Fi, the FCC should “let local communities set their own education-technology priorities... The FCC has no business micromanaging the technology priorities of our local schools and libraries.”

Students should not have to rely on school or fast food parking lots to do their homework, especially in cases where the school (or library) could extend network services to reach them at home, at a community center, or other safer and/or more convenient locations. Connectivity at the home is always necessary for students to learn, but this is particularly true during a pandemic. Schools and libraries should have the flexibility to adopt the sort of remedial connectivity strategies described in the sections below. These include allowing schools to purchase and loan Wi-Fi hotspot connectivity to students at home, or in public locations (such as school-bus hotspots in parks and access points in public housing), or to use TV White Spaces (TVWS) and other advanced wireless technologies to extend the reach of the school’s network to connect students off campus.

The Commission acknowledged that it has the authority to give school districts this flexibility when it adopted the E-Rate Deployed Ubiquitously (EDU) Pilot Program in 2011. The order “authorize[d] up to $10 million for funding year 2011 to support innovative and interactive off-premise wireless device connectivity for schools and libraries.” At the time it adopted the EDU Pilot Program, the FCC never questioned its authority to allow E-Rate funding for wireless internet access for students and teachers, provided it served primarily “educational purposes” that met the E-Rate standard of “activities that are integral, immediate, and proximate to the education of students.” The order discussed how even by 2010, teaching and learning had evolved in ways that made access to online learning resources outside the school more and more important: “Advances in technology have enabled students to continue to learn well after the school bell rings, including from their homes or other locations, for example, youth centers.” The Commission further stated that comments received in response to the National Broadband Plan “generally agreed that students need to learn ‘anytime/anywhere,’ which would require Internet access outside schools and libraries.” The FCC’s description of modern education as of last decade is even more applicable to 2020 even prior to the pandemic that forced learning online.

The FCC has also modernized the E-Rate program more recently, allowing school districts to enhance the functionality of their broadband networks to reflect the realities of student and teacher needs. The E-Rate program now has two categories of funding: Category One, which subsidizes a high-capacity internet connection to the school; and Category Two, which can be used to extend the school’s network internally and even outdoors on school property, using Wi-Fi and other internal connections.
funding rules to expand Category Two for the explicit purpose of using Wi-Fi routers to extend the reach and utility of the school’s internet connection throughout the school. Schools now routinely rely on Category Two funding to extend connectivity to every student, teacher, and location where it is useful, including outdoors on playing fields where students could use connectivity to do homework. That change magnified the value of E-Rate’s traditional Category One funding for high-capacity connections to the school building.

Extending the reach of school network connectivity to students or teachers off campus is conceptually no different than adding Wi-Fi access points to extend access within a school, or between buildings on a school campus, to reach more classrooms, students, and teachers at the location where the network can best serve the school’s educational purpose. Functionally, the use of TVWS or other wireless technology to transmit internet access to students at home, or at a community center, is equivalent to a wireless extension cord.

Finally, even if more data and a broader pilot program is needed to inform a permanent change in the E-Rate rules, a temporary authorization of the use of E-Rate funds (or E-Rate funded facilities) for off-campus educational connectivity during the COVID-19 pandemic would both provide suffering communities across the country with immediate relief and offer an opportunity to analyze the long-term possibilities of a similar pilot program to that of 2011.
II. Innovative Options to Connect All Students to Online Learning

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The homework gap has hindered efforts to modernize education for everyone, as millions of students live in households that cannot access or afford broadband internet service at home. Local school districts have been at the forefront of finding solutions to this connectivity gap, adopting innovative strategies tailored to the needs of their communities. This section profiles some of the pioneering and precedent-setting efforts to expand connectivity to students and teachers for educational purposes. These include community wireless networks, leveraging unlicensed spectrum to extend school networks, school bus Wi-Fi networks, and using spectrum-sharing frameworks to create local networks.
A. School District Community Wi-Fi Networks

When schools shut down due to the pandemic, several local school districts were ready from day one to shift nearly all of their mostly low-income students to remote learning. Over the preceding several years, they had built out school-owned Wi-Fi networks with the goal, at the time, of closing the homework gap by extending free, basic wireless internet access to the homes of students in the neighborhoods most in need. The districts had all determined that building their own community Wi-Fi network was the most cost-effective and sustainable long-term way to address the steadily growing disadvantage suffered by students without access to broadband at home. This section profiles three local districts that have pioneered community Wi-Fi initiatives that allow their mostly low-income students to continue—and enhance—their education online. These districts overcame very difficult but different challenges by partnering with their municipality and the private sector to extend their networks directly to students at home using community Wi-Fi.

Lindsay Unified School District—A Farmworker Community in California’s Central Valley

Perhaps one of the most impactful examples of a K-12 school district taking action to close its homework gap—and prepare itself proactively for remote learning—is Lindsay, an agricultural community of 13,000 in California’s Central Valley. Nearly all students at every grade level are connected to the school district’s free community Wi-Fi network. More than 90 percent of Lindsay Unified’s 4,100 students are eligible for the federal free or reduced lunch program. Most parents are farmworkers who share their homes with other families. Nearly

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In 2014, Lindsay Unified decided that it needed to ensure all students had internet access at home to enrich its innovative, performance-based learning model. “Known for personalized learning, Lindsay educators are building a competency-based system where they know exactly where students are in their academic journey and how they are progressing,” wrote Tom Vander Ark, a nationally recognized education expert. Students set their own goals as part of a “blended learning” curriculum that relies on technology and a performance-based learning platform to advance at their own pace. Their teachers “rely on analytics that continuously track their progress.”

“Given Lindsay’s innovative, technology-enabled approach, having access to the Internet isn’t a luxury, but a need,” Vander Ark said. Lindsay Unified initially considered giving students MiFi hotspot devices with internet service provided by a cellular provider. Where mobile signals are adequate, students can use Wi-Fi to connect their laptops to these small portable routers in the same way that many cellular data plans allow consumers to turn their smartphone into a Wi-Fi hotspot, a practice called “tethering.” A national mobile carrier offered the district 2,000 free MiFi hotspot devices if it would purchase the monthly data subscription. However, the district concluded that the total cost of nearly $1 million annually was unsustainable. In addition, the indoor signal strength for mobile carrier 4G networks in much of Lindsay is spotty at best. As an alternative, the district devised a plan in 2015 to initially connect 75 percent of student homes using a meshed network of Wi-Fi access points (APs) mounted on schools, city property, and, as needed, student homes. The district initially tested the concept by installing Wi-Fi hotspots in an apartment complex next to one of the district’s six elementary schools, providing access to 40 students. The pilot period confirmed the viability of the solution, and the district initially extended the network by installing APs on each of its schools, as well as on city property and staff homes.

By relying on free, unlicensed spectrum in the 5 GHz band, the district’s Community Wi-Fi Project is able to deliver a broadband connection to student homes in the town’s more densely populated neighborhoods. The district is able to reach outlying areas and to penetrate into public housing by using lower-frequency Educational Broadband Service (EBS) spectrum at 2.5 GHz, which is licensed free to the county for educational purposes. EBS spectrum propagates better because it’s lower in frequency. However, the district uses it only where needed because the LTE equipment made for this band is more expensive, as it is carrier grade and sold in small volumes. Approximately 500 APs were needed to cover the district which, thanks to the cooperation of the municipality, were installed at an average cost of $600 each.

The primary limitation on student connectivity for education in Lindsay is FCC policy. The commission effectively penalizes Lindsay for relying on the district’s fiber backhaul to give students direct access to the school’s filtered network at home. According to Lindsay officials, the district is forced to throttle the
bandwidth available to students at home to reduce cost, even though the school itself pays for more bandwidth than it needs. And, of course, students are not using the school network’s bandwidth when they are at home. This perverse outcome is due to the FCC’s interpretation of E-Rate, which requires Lindsay to cost-allocate and use funds other than E-Rate to pay for a larger portion of the bandwidth the district purchases from the Central Valley Independent Network (a private ISP consortium that extends the state’s K-12 fiber backbone to rural schools and libraries) than it otherwise would. Although the district’s fiber network has excess capacity, because it is a poor community and receives a 90 percent E-Rate discount for Category One backhaul, Lindsay Unified loses E-Rate funding for using school district fiber to enable its award-winning blended learning curriculum.

Like nearly all California public schools, Lindsay began the 2020-2021 school year remotely. Lindsay Unified officials say that if they had greater flexibility to reprogram their 2020-2021 E-Rate budget, they could use some of their Category Two funding (for internal connections) to upgrade connectivity to students at home. In addition, under current E-Rate rules Lindsay Unified cannot repurpose Wi-Fi APs that they have funds to upgrade. If they had the flexibility, “the old APs could be redeployed as hotspots around the community,” improving the quality of connections for students.

Another innovative aspect of the Lindsay Community Wi-Fi Project is that it’s funded primarily through savings on hard-copy textbooks and print materials that the schools no longer purchases. A Digital Promise profile of the project noted that the district decided “to repurpose budgets and avoid textbook adoptions to instead invest in digital formats and systems that support equity and all learners’ needs, giving us infinitely more bang for our buck” and “a critical investment in the future of [all] students.”

Lindsay Unified believes that the community Wi-Fi network—and ensuring that every student is connected at home—plays a critical role in the proven educational success of the district’s performance-based learning strategy. They boast that 75 percent of their students are going on to college, more than any high school in their county, and that so far their college graduation rate is 59 percent.

**Council Bluffs Iowa—A School and City Community Wi-Fi Partnership**

Council Bluffs, Iowa, provides another example of a public school district that found itself well-prepared for the pandemic-induced remote learning crisis. Beginning in 2014, the Council Bluffs Community School District (CBCSD) partnered with the city and local technology companies to build out a multi-purpose community Wi-Fi network in phases, as funding allowed, beginning with the most high-poverty neighborhoods.
The BLink-Bluffs Free Community Wi-Fi Network is currently in phase six of a 10-phase plan to cover the entire city, neighborhood by neighborhood, as funding becomes available. Google, Iowa West Foundation, and other private donors provide annual expansion funding. “When completed over the next five years in 10 phases, the BLink coverage area will reach more than 20 square miles, providing Wi-Fi access to more than 40,000 people and reaching the doorsteps of nearly every home and business in Council Bluffs,” according to a statement by the mayor of Council Bluffs.¹⁰⁰

The impetus for the network began when Google, which operates a large server farm in Council Bluffs, contributed Chromebooks for a one-laptop-per-student initiative. Teachers quickly realized that integrating technology for homework and team-based projects outside of school was impractical given the share of students lacking access to broadband internet at home. The city of Council Bluffs was already provisioning Wi-Fi as an amenity in some public spaces and agreed to partner with the district to build a joint, free community Wi-Fi network citywide. The city contributes fiber backhaul, locations to mount access points (e.g., street lights), and most of the ongoing operating expenses (roughly $50,000 annually for the entire network), which is mostly electric power.¹⁰¹ In exchange for the city’s support, the Wi-Fi network is open for use by any resident or visitor who logs in through the city’s separate SSID (the 32-character code that uniquely identifies a wireless network). The school’s Chromebooks are configured to automatically authenticate to the school district’s separate SSID so that students are tunneled directly to the school’s content-filtered network. The municipal Wi-Fi service is limited to 5 megabits of symmetrical service (5/5 mbps), which is very slow compared to most cable or other home broadband connections, because the city does not intend it to be a replacement for fixed broadband services to the home.¹⁰²

The neighborhood-by-neighborhood deployment has prioritized high-poverty areas where the largest share of students lacked internet access. For example, phase one targeted a neighborhood that is home to multiple homeless shelters, food banks, and a human services campus. As of June 2020, BLink Wi-Fi connected a total of 4,700 students at home directly to the school district’s network. The district’s goal is to cover at least one additional neighborhood per year. The current phase six, covering the Carter Lake neighborhood, is connecting an additional 800 students at an estimated cost of $186,000. After phase 10, nearly 70 percent of all students will be covered. The CBCSD believes that at least for now, it will not be economical to use Wi-Fi operating on 5 or 6 GHz unlicensed spectrum to connect the roughly 30 percent who live in less densely populated, outlying areas.¹⁰³ Some of this gap is filled by an offer for free installation and $10/month service from Cox Communications, the local cable provider.

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As in Lindsay, CBCSD officials lament that the FCC’s current interpretation of E-Rate rules limits their flexibility to decide how best to allocate their IT resources to meet the learning needs of students. According to district CTO David Fringer, the FCC’s 2014 E-Rate reforms were a huge boost. Because the FCC allowed the district to use Category One funding to lease dark fiber, “we can light our own fiber and so we have our own fiber ring.” However, he said the lack of flexibility in using Category Two funding both encourages unnecessary internal upgrades and deters other initiatives such as Wi-Fi connectivity to needy students at home.

“How what districts need is an option to use Cat Two to extend their networks, such as for Wi-Fi extensions of the school network,” Fringer said. He added that the Council Bluffs perspective is that “when the student is using the school device [Chromebook], that is the classroom. The bandwidth paid by E-Rate would be used only for student use on school-issued devices, so we don’t believe it matters where the student is located while learning.”

San Jose’s East Side Union School District—Community Wi-Fi Funded by a Tech Bond

San Jose’s East Side may be immediately adjacent to Silicon Valley, but it is a world apart when it comes to broadband connectivity. An estimated 30 percent of student households lack broadband internet service. Among students, two-thirds are considered socioeconomically disadvantaged and a majority are eligible for free and reduced-price meals at school. Yet, as in Lindsay and Council Bluffs, nearly all of the 24,000 middle and high school students in the East Side Union High School District (ESUHSD) had direct internet access to their school’s network when remote learning began with little warning in March 2020. The district’s students no longer suffer from a homework gap, thanks to a “Wi-Fi for Everyone” partnership with the City of San Jose that has built out a dual-use, mesh Wi-Fi network, which is currently being expanded into additional neighborhoods.

In 2014 the ESUHSD raised $2.7 million through a voter-approved school technology bond dedicated to closing the digital divide among its students. The district began by deploying 24,000 Chromebooks so that every student had an internet-connected device. It also upgraded the on-campus Wi-Fi coverage at its 11 largest schools. It learned, though, that this would be inadequate so long as 30 percent or more of the students had no access to adequate broadband connectivity at home. As one high school student told the local paper: “Most of our work is online. If you don’t have Wi-Fi at home, how are you going to finish it?”
In 2017, the district partnered with the city on an initial pilot that extended free Wi-Fi internet access to the homes of 1,700 students at a large high school, as well as to 6,000 households within the coverage area. Coverage required 211 Wi-Fi access points. The total cost of the pilot was $1.6 million, which includes a set-aside for five years of operating and maintenance costs for the district (this corresponds to the roughly five-year life of the APs). Ongoing operating costs are estimated at $60,000 per year. The largest cost overall is not equipment, but installation.

As in Council Bluffs, the city provided the fiber backhaul through its municipal fiber network, as well as construction support and free access to city-owned street lights and traffic signals, including the cost of electric power (which was already connected in most locations). In return, the city has opened the network to the general public as a free amenity and source of connectivity for those who cannot afford broadband at home. The city was already providing free Wi-Fi in downtown business areas and at Mineta International Airport, but the partnership with the schools was the first step toward extending basic Wi-Fi connectivity citywide. Like in Council Bluffs, the students are authenticated on the school district’s separate SSID and tunneled directly to the school network and its content-filtered access to the internet.

According to Randal Phelps, the district’s CTO and project lead, the district put pen to paper and concluded that, in the long term, building a community mesh Wi-Fi network was far more cost-effective than buying monthly broadband subscriptions for low-income students from mobile or cable ISPs. He also estimated that, with the experience and infrastructure developed for the James Lick High School pilot deployment, all students across San Jose (including some adjacent neighborhoods just outside the city) could be covered for a total cost of $24 million.

The next expansion of the ESUHSD Wi-Fi network, announced in August 2020, is a partnership with the county that will extend coverage to the rest of the East Side, including neighborhoods where more than 305,000 people reside in the attendance areas of eight high schools. Because the pandemic has extended remote learning into the 2020-2021 school year, the city is also immediately upgrading Wi-Fi at libraries and other facilities, as well as distributing 8,000 hotspots with unlimited 4G LTE data plans to unconnected students through a partnership with AT&T.

As in Lindsay, the district found that ensuring its high school students have both laptops and 24/7 broadband access has allowed teachers to enhance the curriculum, with measurable educational benefits. An educational outcome assessment through a partnership with the Accrediting Commission for the Western Association of Schools and Colleges and the California Department of Education found many positive outcomes, including:
• 58 percent of graduates passed the English college competency exam the first time;

• 88 percent increase in GPAs since 2014 (44 percent of growth occurring since 2017); and,

• 94 percent of students reported feeling more connected and proud of their school (a noticeable increase from 57 percent in 2014).¹¹¹

B. Harnessing Spectrum Sharing Frameworks to Connect Students

Citizens Band Radio Service: Three Tiers of Shared Use (3550 – 3700 MHz)

In addition to Wi-Fi, there are new and innovative options for extending broadband access to students who lack service at home using recently-authorized shared spectrum bands. Most promising is the spectrum-sharing framework in the new Citizens Broadband Radio Service (CBRS) located in the 3.5 GHz band—mid-band spectrum that is considered to offer the best balance between propagation and capacity for wireless broadband. Although the FCC only opened the band for public use in early 2020, CBRS is already providing novel solutions for connecting students to the broadband access they need during the coronavirus crisis and beyond.¹¹² For example, some school districts are using small-cell CBRS networks to connect home Wi-Fi hotspots provided to students and teachers—a higher-quality and financially sustainable alternative to monthly mobile carrier subscriptions.

The FCC adopted rules for the shared public use of the 3.5 GHz band, now known as CBRS, back in 2015. Until then most of the band was allocated exclusively for U.S. Navy radar, but was unused in most locations. The FCC opened the band for public access and commercial use through a three-tiered sharing framework that allows both federal and non-federal users to share the band. The spectrum’s

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The FCC adopted rules for the shared public use of the 3.5 GHz band, now known as CBRS, back in 2015. Until then most of the band was allocated exclusively for U.S. Navy radar, but was unused in most locations. The FCC opened the band for public access and commercial use through a three-tiered sharing framework that allows both federal and non-federal users to share the band. The spectrum’s prime mid-band propagation has great promise for both mobile 5G services and for high-speed fixed wireless connections needed to bridge the homework gap.

The three tiers of CBRS consist of the federal incumbents (Navy radar), a second tier for “priority access,” which is licensed by county based on an auction completed in August 2020, and a third tier for General Authorized Access (GAA). GAA is effectively an unlicensed spectrum that is open and free for any user as long as they do not cause harmful interference to licensed users in the two higher tiers. More than half of the band (80 megahertz) is set aside solely for GAA use, although the portion of the band that is licensed (70 megahertz) is also available in areas where a priority access licensee has not commenced service, as well as in many rural counties where the licenses were not sold.

The FCC’s framework empowers schools and other enterprises to become their own fixed or mobile broadband providers using 3.5 GHz spectrum, a key benefit that school districts and telecommunications providers are starting to leverage to help solve the homework gap. CBRS spectrum is most effectively used by schools as a substitute for mobile carrier connectivity. Using similar and widely-available equipment, a school, library or any enterprise can build a private LTE network that beams internet connectivity to receiving devices, including Wi-Fi hotspots or other home gateway routers.

**CBRS Education Networks in Maryland, Texas, and California**

Since the beginning of the coronavirus crisis, school districts and telecommunications companies have harnessed the capability of CBRS to deliver service to students who need broadband access. The most ambitious of these initiatives may be the state of Maryland’s plan to develop a high-speed broadband network using 3.5 GHz unlicensed spectrum. Maryland’s CBRS network is intended not only for rural areas of the state, but also urban areas where students may live in households that cannot afford broadband. The director of Maryland’s Office of Rural Broadband told the *Baltimore Sun* that the state chose the 3.5 GHz band both because it could deploy on the GAA spectrum without a license, and because service deployed on the mid-band spectrum can reach homes at distances up to six miles and deliver data at high speeds. In addition, because CBRS is already used by dozens of commercial wireless ISPs (WISPs), and soon will be used by Verizon and other large operators, 4G LTE base stations and other needed equipment is widely available and relatively inexpensive.

McAllen Independent School District in McAllen, Texas, has procured what might be the most robust early example of a CBRS-powered educational broadband network. McAllen has been hit hard by the pandemic and had a 2.5 percent infection rate among its 145,000 residents as the 2020-2021 school year began. Faced with such a significant threat to the local population, preparing to continue remote learning was a no-brainer. However, about a quarter of the...
residents of McAllen live below the poverty line.\textsuperscript{116} The district provides Chromebooks to all 21,000 of its students for use in school, but it did not assign homework online because only about 37 percent of households have broadband subscriptions.\textsuperscript{117} This reflects a common reality in lower-income areas nationwide: Millions of families simply cannot afford to purchase the broadband access needed to support online learning and help keep people safe during the pandemic.

The district knew it had to do something to connect its students, but getting a large number of homes connected to high-speed service on a quick timeline is difficult. In fact, the district originally opted to lend 8,000 Wi-Fi hotspots to students without home broadband access, but the district superintendent quickly realized this solution was inadequate. Too many families still had to resort to going to parks and fast food restaurants to actually connect to their online learning materials.\textsuperscript{118} Problems included spotty mobile service, both in terms of coverage and bandwidth, as well as the ongoing costs of mobile carrier monthly subscriptions for connectivity, a financially unsustainable long-term remedy for the homework gap.

As a more sustainable alternative, the McAllen city government is using some of its CARES Act funding to build a network to connect students without access at home.\textsuperscript{119} McAllen’s network uses free CBRS spectrum on a GAA basis as the connectivity for Wi-Fi access points distributed to student households that lack internet access. CBRS currently allows the use of all 150 megahertz (until auction winners commence service) and at least 80 megahertz of shared spectrum long term. Antennas for CBRS base stations are being mounted on city-owned water towers and light poles.\textsuperscript{120} The network, constructed with equipment from WISP supplier Cambium Networks, combines 24 point-to-multipoint CBRS base stations and, initially, 1,000 Wi-Fi hotspots for student homes.\textsuperscript{121} Another 5,000 Wi-Fi hotspots are planned as the network is built out further. Essentially, the CBRS base stations create a private LTE network that beams connectivity to MiFi-like hotspots in student homes, which use Wi-Fi to connect the student’s Chromebook directly to the school’s network (and the internet beyond). Federated Wireless is donating spectrum management services to make sure this effort does not cause harmful interference with the Navy or priority licensed users.\textsuperscript{122}

The city of McAllen’s project is a perfect example of how CBRS spectrum can be paired with Wi-Fi to bridge the homework gap. One of the co-founders of the consulting company the city worked with noted that CBRS spectrum works particularly well in McAllen because several WISPs in the area are already heavily using the unlicensed 5 GHz band that operators rely on for fixed Wi-Fi deployments.\textsuperscript{123} The CBRS network has been such a success that it is providing service to all residents in McAllen who want and need it. By actually owning network infrastructure that offers wireless broadband connections to students
and families who cannot afford it, the city has a resilient, multi-purpose network that will offer much-needed connectivity both during the pandemic and for years to come.

“The deployment of this network delivers on one of the core capabilities of CBRS, which is to extend wireless connectivity to rural areas that traditionally have not had a level playing field with the rest of the country,” Matt Mangriotis, director of product management at Cambium Networks, told Fierce Wireless in a statement. While the mid-band CBRS spectrum is well suited for rural areas due to its propagation characteristics, it can also work well in urban areas, where more than 30 percent of households often lack connectivity. Kurt Schaubach, CTO of Federated Wireless, told LightReading that the company has been receiving requests from urban school districts, noting: “Affordability is the issue... School districts can't pay for a subscription service and they need a lower cost alternative.”

School districts in California are also turning to publicly-available CBRS spectrum to bridge the remote learning gap. Fontana Unified School District (USD), in partnership with Crown Castle Fiber, is constructing a wireless network to deploy high-speed service using CBRS spectrum. Fontana is a city of 200,000 in San Bernardino County, 50 miles east of Los Angeles. The district’s goal is to provide service to over 36,000 of its students. “We’ve estimated that 55 to 60 percent of our students do not have reliable internet access outside of school,” explained Fontana USD Superintendent Randal S. Bassett. The community is overwhelmingly low income, with 85 percent of the district’s elementary school students eligible for the free or reduced school lunch program.

Bassett estimates that approximately 400 cellular access points will be needed to cover the areas where 98 percent of its students reside. While the network remains under construction, its basic architecture appears similar to the McAllen network described above. The 400 CBRS base stations will transmit connectivity to thousands of Wi-Fi hotspots (or similar home Wi-Fi gateway devices) made available for student use at home.

Crown Castle Fiber will own and operate the network. Although the Fontana CBRS network will cost an estimated $40 million over the next five years, Crown Castle will absorb most of the initial costs since it expects the network to be multi-purpose and serve multiple tenants. The school district is the anchor tenant making the project feasible, but the city is expected to be another tenant, spreading the cost over more parties and providing the wireless connectivity needed for city telehealth, public safety, and 5G smart city infrastructure in the future. Bassett said the district decided it is a more cost-effective solution than buying bandwidth monthly from mobile carriers, particularly since it creates 5G-ready infrastructure that can be multi-purposed for Internet of Things applications. The total estimated monthly cost is $14 per student for the initial
five years, but only $7 per student thereafter since the basic network infrastructure will be in place.\textsuperscript{131}

Bassett noted that the FCC has effectively increased the cost of extending connectivity to students at home, since E-Rate rules are forcing the district to lease a separate strand of fiber to carry the traffic from students and teachers back and forth to the school’s E-Rate supported network. This cost is on top of the cost the district already pays to lease fiber optic cable with 30 GB of capacity. Another extra cost is interconnecting the on-campus and off-campus networks. “The backhaul should follow the students: Even if there was no excess capacity on the Cat One fiber, when the students are at home, that capacity is not in use at the school,” he explained.\textsuperscript{132}

Patterson Unified School District in Patterson, California, is similarly building a wireless 4G LTE network using GAA spectrum in the CBRS band to connect 100 student homes without internet access. While this will directly connect only a small percentage of student households, the network demonstrates how CBRS and the unlicensed GAA spectrum in particular can be quickly utilized by schools as a gap-filler to economically extend high-speed broadband to students.\textsuperscript{133}

**Districts are Investing CARES Act Funds in CBRS Networks in Utah and Colorado**

CBRS spectrum offers an efficient option for school districts seeking to invest pandemic-related funding in a high-speed broadband network that offers a greater long run return on investment. The Murray City School District in Salt Lake City, Utah, qualifies for E-Rate funding, but has been restricted from using it to extend connectivity to students because of the FCC restrictions described above. During the pandemic, the district has taken advantage of CARES Act relief and charitable contributions to leverage CBRS spectrum to deploy a private LTE network for students lacking broadband. District and state funds are being used to purchase the CBRS radios and other network infrastructure, while charitable donations are being used to provide the Wi-Fi hotspots loaned out to students in need.\textsuperscript{134} According to the district’s CTO, users receive average speeds of 134 mbps downlink and 16 mbps uplink, with latency (delay) consistently below 38 milliseconds.\textsuperscript{135} The district is also using the network for security cameras around its buildings and playing fields.

Similarly, the Roaring Fork School District in Colorado opted to use CARES Act funding secured from the state to build a private 4G LTE network that relies on the CBRS band to connect students and teachers throughout the 2020–2021 academic year, and potentially even longer.\textsuperscript{136}

The Utah Education and Telehealth Network (UETN), which connects 1,700 schools and other public facilities across the state, is using CARES Act funding to expand an initiative using CBRS access points for internal networks at 25 schools.\textsuperscript{137} The initial goal is to provide LTE connectivity ubiquitously on school property,
both throughout the buildings and in school parking lots and playing fields. Jim Stewart, CTO of UETN, told Fierce Wireless that the system started investigating private LTE and CBRS well before the pandemic because it seemed an attractive alternative to relying on mobile ISPs. “I don’t want the carriers to get into that space and start charging me for every bit that I pass inside... all the 1,700 buildings that we connect,” Stewart said.138

CBRS is working out well enough for education networks that there have been suggestions that the FCC reserve some 3.5 GHz spectrum specifically for schools to connect students who lack access at home. Scott Imhoff, vice president of product at Cambium Networks, which sells CBRS access equipment, suggested to Fierce Wireless that the FCC could hold some CBRS spectrum for education institutions, or even issue special priority access licenses for educational services to ensure school districts would not have to go up against commercial interests in the bidding process.139 Reserving CBRS spectrum for schools would be problematic, however, particularly now that the CBRS auction has already concluded. Something similar could be done with a portion of the immediately adjacent 3450-3550 MHz spectrum that the FCC is currently deciding how to license. Like CBRS, it will be shared with the military, but it’s expected to be available at higher power levels since the military has agreed to move many of its radar operations off that 100 megahertz segment. This approach might be most appropriate in rural areas where there is less demand from mobile carriers. Short of that, the FCC’s Notice of Proposed Rulemaking (released on October 2, 2020) asks whether a portion of the band should be reserved for GAA use, or at least available for GAA use until operators that buy licenses commence service in a local area.140 That could give schools access to considerably more than 80 megahertz on a GAA basis when combined with the current CBRS band.

School Networks also Use the Educational Broadband Service Spectrum at 2.5 GHz

CBRS is proving to be a successful model, but it is not the only option. In addition to the purely unlicensed spectrum bands used for Wi-Fi (at 2.4 GHz, 5 GHz, and soon 6 GHz), the 2.5 GHz band was, until recently, fully reserved for the Educational Broadband Service (EBS), with licenses held by colleges and school systems across the country.141 Although 2.5 GHz can propagate signals farther than spectrum bands higher in frequency, such as the 5 GHz unlicensed bands used for wide-area Wi-Fi networks, it is not available everywhere and licensees typically have limited capacity. As noted in the previous section, the school district in rural Lindsay, California relies on meshed Wi-Fi to connect homes clustered together, but relies on the EBS spectrum to reach the 20 percent of students in less densely populated outlying areas.

The most extensive EBS network is operated by Northern Michigan University (NMU) and connects both college and K-12 students across a wide area in Michigan’s rural and sparsely-populated Upper Peninsula. NMU received its EBS license in 2008 and initially launched a carrier-grade WiMAX network aimed at
connecting its own students off campus within 35 miles of the university. In 2017, after receiving a 66 percent matching grant from the state economic development corporation, NMU began a $10 million expansion of the network to connect K-12 students and other unserved residents in neighboring rural communities. Using LTE, the NMU network aims to provide 25/5 mbps connections, which can drop to 10/3 mbps at greater distances away from the tower. According to Eric Smith, NMU’s director of broadcast and audio-visual services, even the lower throughput works for remote learning because the network is optimized for streaming video. Smith stated that NMU charges individual K-12 students $20 per month for the service, although most are connected through wholesale deals negotiated with local schools to provide free connections to low-income students eligible for the free and reduced lunch program. There are no data caps and non-student households can also purchase the service for $35 per month.

In Virginia, the Fredericksburg City Public Schools district has applied for a special temporary authorization (what the FCC calls a STA) to deploy wireless broadband internet services using EBS spectrum to provide access to the 14 percent of the school district’s population who do not have high-speed broadband access at home. Similar to McAllen and other examples, the school district leaders believe the biggest issue is affordability, not a lack of infrastructure. In the case of Fredericksburg, the EBS network is on hold since T-Mobile is opposing the district’s application for a license. The FCC decided in 2019 to auction non-licensed EBS spectrum, which is mostly in small town and rural areas, and T-Mobile seems to be taking the posture that no additional EBS licenses should be awarded.

Although Fredericksburg has not begun to deploy its network, its plan to use 2.5 GHz spectrum offers a potential blueprint for districts nationwide with access to EBS spectrum, or if the FCC reconsiders its decision to stop granting EBS licenses. According to the senior vice president of product management at Cambium Networks, many school districts have contacted the company about using 2.5 GHz spectrum in a potential partnership with commercial WISPs for connectivity solutions. “We’ve got a number of school districts that are looking at longer-term solutions using that EBS spectrum,” the senior vice president of product management, Scott Imhoff, told Fierce Wireless, adding that schools have existing fiber assets, real estate, and in some cases tall buildings for the antennas necessary to build a network. The 2.5 GHz band has great promise for improved connectivity and remote learning for tribal areas as well.
Libraries have also been trying to help students access broadband since the pandemic began, despite being closed for long periods. Many have relocated or increased the power of their Wi-Fi routers to enable students and other individuals to get online from the parking lot or other areas just outside the building. Some libraries expanded their programs for lending out Wi-Fi hotspots, with the backhaul provided by mobile carriers. Others have parked “bookmobiles” with Wi-Fi in neighborhoods close to students lacking broadband.

In Pottsboro, Texas, a town of 2,500 north of Dallas, the local library went even further. First it put a Wi-Fi access point on the library roof to extend the network’s connectivity to cars in the parking lot. The Pottsboro Area Public Library also dedicated its $25,000 CARES Act relief grant to a partnership with an EBS licensee to provide Wi-Fi access points to the 40 local high school students lacking broadband at home.

At the start of the pandemic, the FCC attempted to facilitate pilot projects to demonstrate how the mostly unused 5.9 GHz band could be used to connect the disconnected when it issued Special Temporary Authority (STA) grants to about 100 wireless providers, allowing them to use 5.9 GHz band spectrum to support these providers’ networks and keep people online. The FCC’s pending proposal to reallocate 45 megahertz of the 5.9 GHz band would make free public access permanent, and combined with the adjacent Wi-Fi band at 5.8 GHz, create the potential for gigabit-fast Wi-Fi networks both indoors and outdoors on 160 megahertz of contiguous unlicensed spectrum. The large new band of unlicensed spectrum in the 5.9 GHz and 6 GHz band will also provide a way for school districts to build networks to empower students to continue learning remotely.
C. Wireless Extensions of School Networks

Technology companies, school districts, and ISPs have teamed up in pilot projects to demonstrate exactly how schools could use spectrum to extend their networks and resources directly to students at their homes. These projects were developed years ago, long before COVID-19, but could offer a quick and targeted option for schools and other community and educational pillars to extend broadband networks to student homes, housing projects, community centers and other locations—particularly those within a few miles of a school or other municipal building with fiber backhaul.

Districts Using “Super Wi-Fi” to Extend School Networks to Students at Home

Four years ago, school districts in two states filed petitions with the FCC urging the agency to issue waivers allowing them to use rooftop transmitters to extend their E-Rate-funded networks from the school directly to the homes of students lacking internet access. One petition was filed by two rural Virginia districts—the Charlotte and Halifax County public schools—along with Microsoft, a local fiber provider and a WISP. The other was filed by the Boulder Valley School District, in Boulder, Colorado. Both efforts sought FCC permission to leverage a combination of innovative spectrum technologies and E-Rate-supported fiber backhaul to connect students without internet access in rural and outlying areas.

The projects rely on the unused broadcast television channels in each local media market—vacant broadcast frequencies known as TVWS. Because the low-
frequency spectrum allocated for TV broadcasting has exceptional propagation characteristics, TVWS spectrum allows schools, libraries, rural ISPs, and others to beam high-speed broadband connections over greater distances and to easily penetrate obstacles such as trees and outer walls of buildings. While most Wi-Fi used by consumers at home or work will cover only relatively small areas, the superior propagation of TV spectrum led a former FCC chairman to describe the unlicensed use of TVWS as facilitating “super Wi-Fi.” TVWS technology has been particularly effective at expanding broadband access in rural, tribal, and other hard-to-serve areas.

The Southern Virginia districts began their pilot project in 2016, working with 18 schools that receive E-Rate funds and teach about 7,500 students. The participating schools were selected based on the deployment of fiber optic cables to these schools (giving them plentiful bandwidth), the availability of towers or high sites at the schools to mount transmitters, and the dearth of broadband service providers in the rural and small town communities around the schools. The population living near the schools is low-income and the petitions emphasized that about half of the students at these schools do not have home broadband access. Because the population density is low—and the population has been shrinking—it is very costly to build and deploy high-speed wireline broadband services. The school districts’ petition for waiver described the unique advantages of TVWS in rural areas:

This project will employ Dynamic Spectrum Access (“DSA”) technology . . . [that] allows devices to opportunistically use available radio spectrum, including unused or unassigned TV broadcast channels (known as “TV White Spaces”). Signals broadcast over TVWS can travel long distances to deliver high bandwidth internet service at low network costs. The areas surrounding the Participating Schools are well-suited for TVWS deployment because they contain a large number of vacant UHF channels eligible for TVWS transmission. . . . These TVWS base stations will enable students to connect from home to safe school district networks and access content and applications needed to complete their homework assignments and engage in other school-sanctioned educational activities. Students will connect via a specialized, in-home, TVWS access point, . . . allowing Wi-Fi-enabled devices within the home to connect to the network.

These pilot projects provide a roadmap for how TVWS technology can extend connectivity directly from a school to student homes or community hotspot locations in rural and remote areas. Unfortunately, the FCC never acted on the petitions. However, the pilots continue to play an important role, both in those communities and as a model for potential future TVWS initiatives, which could be even more robust now that the FCC has updated its TVWS rules.
After the pandemic began last March, the Boulder Valley School District (BVSD) expanded its TVWS pilot program, called ConnectME (Connect My Education), extending it beyond a few schools in Lafayette and Boulder to every single school in the district. ConnectME helps students without broadband access receive the service needed to participate in remote learning during school shutdowns due to COVID-19.\textsuperscript{160} BVSD Chief Information Officer Andrew Moore has stated that even if mobile carrier hotspots were sustainable financially, neighborhoods with the greatest need also typically have the worst cell phone coverage. “With multiple students in a household, you can run into issues pretty quickly,” he told the \textit{Daily Camera}.\textsuperscript{161} In an October blog post, Moore explained that even the discounted programs offered by cable and other ISPs to low-income students were often inadequate for learning because the uplink throughput is capped at a lower level (typically 3 mbps) that wasn’t working for households with more than one student. Even worse, CenturyLink DSL connections are limited to 2 mbps in many areas, he said.\textsuperscript{162}

Since the FCC has still not granted BVSD’s waiver request, the district has forged a partnership with a local WISP to use CBRS spectrum to reach students lacking connectivity. The public-private partnership not only offers free 25/5 mbps broadband service to students in the school district’s free or reduced lunch program. The partnership also gives the district 25 percent of the proceeds earned by LiveWire, the partner ISP, which uses the same network to sell fixed wireless broadband to households in the same areas.\textsuperscript{163} To avoid running afoul of the FCC’s E-Rate rules, the company relies on school district fiber backhaul funded by public bonds, rather than already-paid-for school district fiber.\textsuperscript{164}

In response to the pandemic, Microsoft has urged the FCC to grant the 2016 petition filed by the Virginia districts. In its filing, Microsoft noted that the 2016 TVWS pilot in rural Virginia extended broadband connections from 18 schools to more than 200 student households.\textsuperscript{165} Microsoft reports that although the pilot project ended before the FCC acted on the petition, its partner Adaptrum and a local WISP still provide free broadband to around 80 households. Expanding on this work, Microsoft is collaborating with the Nebraska Education Service Unit, and Grand Island Public Schools to use TVWS technology to bridge the homework gap in Grand Island, Nebraska. The initiative will offer free TVWS devices for connectivity at home to students who do not have access to home broadband and normally depend on Wi-Fi at school for homework and school assignments.\textsuperscript{166}

These successful pilots suggest the FCC should be facilitating these efforts by giving districts greater flexibility to extend their networks beyond the walls of the classroom. As detailed above, the FCC has the authority to do so, but the current chairman is relying on a narrow reading of its authority to reject requests to use E-Rate funding or E-rate funded facilities to extend connectivity beyond school property.
The use of school buses as Wi-Fi hotspots dates back to 2016, but the strategy became more widespread after the coronavirus shutdowns created an urgent need to bring internet connections closer to low-income students at home. The original idea was to address the homework gap by strategically locating Wi-Fi-enabled school buses after school hours, when students could use them as an option for completing homework. Schools install a Wi-Fi router on the roof of a bus, which is then parked in a high-need location where students who come within 200 or 300 feet can share a mobile broadband connection. When schools are open, school bus Wi-Fi allows students to study and complete homework on what can be long commutes to and from school or sporting events. When schools are closed, the buses can provide continuous hotspot access in targeted locations. As a stop-gap measure, school bus Wi-Fi can be particularly cost-effective where students without internet access are clustered in low-income neighborhoods, or in targeted locations such as public housing, trailer parks, or community centers.

A related innovation has been to locate more permanent and high-speed Wi-Fi hotspots at community centers or public housing locations where low-income students can more easily get online outside of school hours. More than five years prior to the coronavirus shutdowns, the school district in Kent, Washington (just south of Seattle), placed three Wi-Fi kiosks in community centers at public housing complexes and also coordinated with local businesses and organizations to establish a network of school-sponsored Wi-Fi hotspots. The district used
donations and partnerships to help defray some of the costs associated with the $6,500 kiosks. The kiosks transmit free Wi-Fi in a 75-foot radius and feature a 42-inch LED screen to display the latest district news—very much like the hundreds of LinkNYC kiosks that provide free Wi-Fi access by connecting to fiber at former Verizon pay phone locations up and down the commercial avenues in Manhattan. “For many students who live in nearby public housing and go to school in the surrounding 27,400-student school system, the kiosk acts as a bridge between the digital connectivity they have through laptops and other devices at school and the lack of Internet access they cope with at home,” according to a report in Education Week.168

The use of school bus Wi-Fi burst onto the scene in the Coachella Valley School District in California in 2015. The buses were fashioned to essentially serve as mobile hotspots in a school district where over 95 percent of the students live below the poverty line and a high percentage live in households that cannot afford home broadband.169 When schools were fully open, the buses’ mobile hotspots gave students internet access on the drive to and from school. The district also left eight Wi-Fi buses parked in targeted neighborhoods after school hours.170

School-Bus Wi-Fi has Become Widespread Since the COVID-19 Shutdowns

School districts across the country have adopted this tactic to connect students during the pandemic. In South Bend, Indiana, schools equipped 20 buses with Wi-Fi hotspots. Wi-Fi routers on the buses connect to student Chromebooks within 300 feet in any direction at over 30 sites throughout the city initially, with the goal of adding even more.171 One rural school district in Oregon, Crook County, parked 30 school buses with Wi-Fi hotspots in targeted locations to offer the service for students who do not have internet service at home.172

This method has not only been used in rural districts, but also in urban areas. Montgomery Public Schools (MPS), in Alabama, installed Wi-Fi transmitters on 11 buses to serve as hotspots at different locations. MPS Superintendent Dr. Ann Roy Moore told a local news outlet: “The idea is that any parent, any child in any neighborhood where they see that yellow school bus, they can access the WiFi hotspot... They don’t have to be right down the street from their home. If they’re at home, it’s fine, but if they’re at their grandma’s house and there’s a bus down the road, they can also access from that location.”173

School bus hotspots have been used on a larger scale as well. When the schools closed due to the pandemic, Austin Independent School District, a large public school district in Texas, outfitted 110 school buses with Wi-Fi and sent them out to neighborhoods and apartment buildings that the district targeted as needing internet access the most.174 The buses were parked in those areas every weekday from 8 a.m. to 2 p.m. and had the capability to connect to school-issued laptops (not personal devices) from up to 300 feet away.175 On an even larger scale, the
state of South Carolina started parking hundreds of school buses with Wi-Fi capability around low-income neighborhoods—all 3,000 school district school buses were already equipped with Wi-Fi modems, but mostly the larger districts had actually activated the service previously.

The initiatives described above represent just a few of the many school districts using school bus hotspots to bridge the connectivity gap—even if only temporarily in an imperfect way. School districts in southern Illinois; Hoover, Alabama; Clark County School District, Nevada; Abilene, Texas; Victor Valley Union High School District, California; Topeka, Kansas; and Mosinee School District, Wisconsin, are among the many that have also adopted this solution. School districts with drastically different characteristics have all used school bus-powered hotspots, demonstrating how powerful a solution school buses can be.

School bus hotspots are certainly an imperfect solution. Hours are often limited and the cellular connections for mobile hotspots often suffer from weak connections, particularly in less affluent or rural areas where mobile carriers have had little incentive to invest in high-capacity infrastructure. Reaching a larger share of the households that need internet connectivity using this method is difficult. Students typically cannot connect from home and often need to travel a considerable distance to do so, possibly to or through areas their parents would consider unsafe. However, the use of school bus hotspots as a stopgap option for students who have no other way to access broadband is still an important development and has been an innovative solution for school districts and families during the pandemic.

School bus and community hotspot connectivity can be improved through the use of TVWS spectrum (described in the previous section) and other wireless extensions of networks, particularly where cellular network signals are weak or monthly subscription costs are high. In response to the coronavirus shutdowns, Microsoft told the FCC that its own projects with partner ISPs have shown “how TV White Space technology could be used to provide wireless connectivity to Wi-Fi hotspots on school buses during their morning and afternoon pickups and dropoffs.” These signals would likely be much stronger and closer to a consistent Wi-Fi signal than those offered by mobile hotspots, and as this technology develops, more school districts could adopt TVWS to connect school buses with more reliable high-speed broadband for trips to and from school, and for future emergencies similar to the current pandemic.
III. Policy Recommendations

The digital divide has put millions of students at a distinct disadvantage, as it has undermined educational achievement and equity. This homework gap was stark before the pandemic and it is even more harmful now for students in schools that continue to rely on remote learning. Simply put, homes are now classrooms and yet our nation’s policies fail to reflect this fact. Remote learning is likely to continue, perhaps off and on unpredictably, in large parts of the country for the remainder of the 2020-2021 school year. Millions of students with either nonexistent or inadequate broadband access at home are facing months of lost learning, and could potentially fall further behind due to a lack of connectivity at home. Steps taken to improve connectivity and technology adoption now will pay dividends even after schools reopen on a more permanent basis, since studies show that student achievement is higher at schools that rely on technology to enhance their curriculum.

This report profiles the many innovative options that school districts have pioneered to build or extend wireless broadband connectivity out to student households that cannot afford to purchase high-speed internet access at home. More and more school districts and local governments are concluding that investing in public network infrastructure—including community Wi-Fi networks and private mobile networks operating on public access CBRS spectrum—are a cost-effective way to ensure nearly all students have the broadband internet access they need, as well as to direct access to the school’s network resources.
from home and other locations. Thanks to recent efforts to open more unlicensed and shared spectrum for public use, an increasing number of school districts are partnering with their local government to extend network access to students at home and, in some towns, Lifeline internet access to the general public as well. Local schools and other institutions know the specific needs of their students and community, and should be empowered to devise their own solutions to the homework gap.

Because the homework gap is far wider in low-income communities, public funding dedicated to this problem will be required. Congress recognized this when it created the E-Rate program. Initially, the need was a high-capacity connection to the school building. Later, in 2014, the FCC correctly recognized it had become critical to create a second category of E-Rate funding to wire the individual classrooms, labs, and ultimately entire school campuses with Wi-Fi so that students and teachers could be on their own devices in any class at any time. E-Rate’s Category Two funding for Wi-Fi and other internal networking needs has largely met this goal.

Now, particularly as the country has and continues to experience the pandemic closures, it’s clear that E-Rate needs to add a third category of support for schools. This third category would provide service for schools with a large percentage of low-income students who are disproportionately disconnected from digital technology when they go home each afternoon. At a minimum, the FCC needs to ensure that the E-Rate program, and the rules associated with it, do not preclude schools and libraries from using the networks they build using program funding to extend connectivity beyond their walls and campuses. Remote learning should not be a mere happenstance of the current pandemic; and it should also not be treated, as it is now, as a luxury for the better-off students who benefit as their disconnected peers fall behind. Increasingly all students are reliant or heavily dependent on a strong home broadband connection to foster the best learning environment.

Whether or not overall funding for E-Rate is increased, the FCC needs to provide Category Two funding flexibility for schools and libraries to decide how best to allocate their IT budget to best serve their communities. If the FCC continues to refuse to update E-Rate’s outdated and restrictive rules, then Congress should step in and enact legislation to increase both funding and local flexibility. Congress can and should direct both funding and clarifying language to send support to local institutions to bridge the homework gap and ensure students and their families without broadband access are connected.

Finally, Congress and the FCC need to take a holistic look at solving the homework gap, and this means solving the digital divide generally. Improving broadband competition, strengthening programs such as Lifeline, and taking measures to catalyze broadband adoption will not only help education, but also empower individuals with modern-day employment options, health care, financial services, information services, communication, commerce, entertainment, and much more.
Notes


4 For more on the distinctions between remote or distance learning, online learning, and hybrid or blended learning, see the report published in May 2020 by New America’s Education Policy Program, *Pandemic Planning for Distance Learning: Scenarios and Considerations for PreK-12 Education Leaders*, available at https://www.newamerica.org/education-policy/reports/pandemic-planning-for-distance-learning-scenarios-and-considerations-for-prek12-education-leaders/.


12 *Id.* at 5.

13 *Id.* at 5.


17 *Common Sense Media Report*, supra note 8.

18 *Id.* at 3.


21 *Id.* at 2.

22 *Id.* at 2.


27 *Id.* at 3.


35 Ibid.


38 Ibid. Another study by the Annenberg Institute at Brown University estimated that as students return to school for the 2020–2021 year they will have already lost anywhere from 32 to 37 percent of their otherwise projected learning in reading and between 50 to 63 percent of their advances in math. Kuhfeld, Megan, James Soland, et al., “Projecting the potential impacts of COVID-19 school closures on academic achievement,” EdWorkingPaper: 20-226, Annenberg Institute at Brown University (2020), available at https://doi.org/10.26300/cdrv-yw05.

39 OECD Report at 11.


42 See e.g. Tony Romm, “‘It shouldn’t take a pandemic’: Coronavirus exposes Internet inequality among U.S. students as schools close their doors,” The Washington Post (March 16, 2020), https://www.washingtonpost.com/technology/2020/03/16/schools-internet-inequality-coronavirus/ (“Many of the roughly 136,500 students in Prince George's County, Md., likely have some way to get online at home. But local officials last week said they still came to the conclusion they couldn’t ensure all of them did — so the district couldn’t shift classes fully to the Web starting Monday, when state schools close for the next two weeks. Instead, district educators have put together packets of instructional materials.”).


44 Common Sense Media Report, supra note 8, at 6.

45 See USA FACTS, “Children don’t have consistent access to computers for online learning during the pandemic” (April 6, 2020). In 2018 the Department of Commerce estimated that at least 7 million K-12 students lived in homes without internet access. Rafi Goldberg, “Digital Divide Among School-Age Children Narrows, but Millions Still Lack Internet Connections,” NTIA Blog (Dec. 11, 2018), available at https://tinyurl.com/ut3jewv. See also “America’s Digital Divide,” U.S. Congress Joint Economic Committee (Sept. 2017) (estimating 12 million
children live in homes without internet access), https://tinyurl.com/teybqpk.


48 In response to the ongoing homework gap, two districts in southern Virginia used unlicensed TV White Space frequencies to extend internet access from schools to students within range who lacked broadband access at home. See Ex Parte of Microsoft, ET Docket No. 20-36, CC Docket No. 02-6, WC Docket No. 10-90, WC Docket No. 13-184, WT Docket No. 18-353 (March 17, 2020) at 1-2.

49 Letter from John Windhausen, Executive Director, Schools Health & Libraries Broadband (SHLB) Coalition, at 5 (March 17, 2020).

50 Letter from Jonathan Spalter, President & CEO, US Telecom—The Broadband Association, at 5 (March 27, 2020), https://tinyurl.com/vnz9xmn. USTA further recommended that the FCC “support the purchase of, and distribution to students and/or teachers that do not currently have access at home, devices such as laptop computers, tablet computers, hotspots, smartphones or similar devices capable of connecting to mobile broadband internet access service, either by receiving such service directly or through the use of Wi-Fi, as well as applications that protect students from accessing inappropriate content to support e-learning outside of the school premise during the COVID-19 pandemic.”

51 Letter from Senators Edward J. Markey, Brian Schatz, Michael Bennet, et al., to Chairman Ajit Pai (March 16, 2020) (“Letter from 16 Senators”), available at https://tinyurl.com/qr9bjoa. Commissioner Jessica Rosenworcel, in her March 2020 FCC monthly meeting statement, noted support for emergency E-Rate funding for hotspots by AASA—the Superintendents Association, the American Federation of Teachers, the American Library Association, the Association of Educational Service Agencies, the Association of School Business Officials International, CoSN—the Consortium for School Networking, the Council of Chief State School Officers, the International Society for Technology in Education, the National Association of Elementary School Principals, the National Association of Independents Schools, the National Association of Secondary School Principals, the National Association of State Boards of Education, the National Catholic Education Association, the National Education Association, the National PTA, the National Rural Education Advocacy Consortium, the National Rural Education Association, the National School Boards Association, State Educational Technology Directors Association, the United States Conference of Catholic Bishops, and many other organizations.” Statement of Commissioner Jessica Rosenworcel on Agenda Meeting (March 31, 2020).

52 Public Notice, “Wireline Competition Bureau Directs USAC to Fully Fund Eligible Category One and Category Two E-Rate Requests,” CC Docket No. 02-6, at 1 (July 17, 2019), available at https://www.fcc.gov/document/wcb-directs-usac-fully-fund-eligible-c1-and-c2-e-rate-request-0. E-Rate appears to continue to have this level of budget
availability for the current 2020 budget year that began July 1, 2020. See FCC Wireline Competition Bureau, Order, Schools and Libraries Universal Service Support Mechanism, CC Docket No. 02-6 (Sept. 16, 2020) (“During the [2020 application] window, USAC received 38,207 applications requesting $2.91 billion in discounts for eligible services.”).

53 Letter from 16 Senators, supra.


55 Ibid.


58 To obtain E-Rate support, an applicant must comply with the Commission’s competitive bidding rules, enter into an agreement with a service provider, and then file an FCC Form 471 with USAC to request E-Rate discounts for the purchase of the services. See 47 CFR § 54.503.


62 Id. at ¶ 73, citing 47 U.S.C. § 254(c)(1)(A).


64 47 U.S.C. § 254(c)(1).


66 See 47 U.S.C. §§ 254(h)(1)(b) and 254(h)(2)(A) (emphasis added); 2014 E-Rate Modernization Order at ¶ 69. See also Texas Office of Public Utility Counsel v. FCC, 183 F.3d at 444 (the Commission’s “primary directive is to ‘enhance access to advanced telecommunications and information services’ for schools and libraries”).

67 See, e.g., Modernizing the E-rate Program for Schools and Libraries, Order, 33 FCC Rcd 11219, 11231, Appendix B, Eligible Service List for Funding Year (WCB 2018) (“Examples of items that are ineligible components of Internet access services include applications . . . and end-user devices and equipment such as computers, laptops, and tablets.”).


69 Ibid (emphasis added).
70  Id. at ¶ 90.

71  Ibid.

72  Id. at ¶ 91. For support, the Order cites to a Lifeline pilot and states: “In 2012, the Commission previously relied in part on the universal service principles in section 254(b) to establish a limited duration pilot program to explore how USF funding could increase broadband adoption among Lifeline consumers. See Lifeline Link Up Reform and Modernization, Report and Order and Further Notice of Proposed Rulemaking, 27 FCC Rcd 6656, 6797, paras. 328-330 (2012).” Id. at ¶ 91, n. 352.

73  Ibid.


75  Schools and libraries “are permitted to allow the public to access E-Rate funded services even when they are closed to the public due to the coronavirus pandemic.” Public Notice, “Wireline Competition Bureau Confirms that Community Use of E-Rate Supported Wi-Fi Networks is Permitted During School and Library Closures Due to Covid-19 Pandemic,” WC Dockets 02-6, 13-184 (March 23, 2020). The Commission adopted this off-hours, community-use exception in its Sixth E-Rate Report & Order in 2010. See Sixth E-Rate Report and Order, at ¶¶ 25-26.

76  Government Accountability Office, “FCC Should Assess Making Off-School Premises Access Eligible for Additional Federal Support” (July 2019) at 23 (“School districts we met with said that existing E-Rate program rules that require cost-allocation . . . limit their ability to address the homework gap and providing off-premises access remains a challenge for schools and school districts.”) (“GAO Report”). Id. at 27-28.


78  A Petition for Rulemaking, filed by several school districts and Microsoft in 2016, requested a waiver or clarification allowing schools to extend internet access from the school’s E-Rate supported network to students without connectivity using TV White Space and other wireless technologies. The Petition received widespread support. It remains pending. See Joint Petition for Clarification or, in the Alternative, Waiver by Microsoft Corporation, Charlotte and Halifax County Public Schools, et al., WC Docket 13-184 (March 22, 2016) (“TV White Space E-Rate Petition”).

79  Sixth E-Rate Report & Order ¶ 46.

80  Id. at ¶ 20. See 47 C.F.R. §54.500(b).

81  Id. at ¶ 42. The Order further stated: “We recognize the benefits of enabling innovation in learning outside the boundaries of the school building and the traditional school day, as well as of enabling libraries to innovate with new models of delivering service to library patrons. We note the potential for meaningful gains in student achievement that new devices and applications may deliver. We also see significant utility in devices that allow remote access to the Internet for library patrons.” Id. at ¶ 43.

82  Id. at ¶ 42.

83  According to the FCC: “Funding may be requested under two categories of service: category one services to a school or library (telecommunications, telecommunications services and Internet access), and category two services that deliver Internet access within schools and libraries (internal connections, basic maintenance of internal connections, and managed internal broadband services). Discounts for support depend on the level of poverty and whether the school or library is located in an urban or rural area. The discounts range from 20 percent to 90 percent of the costs of eligible

84 Modernizing the E-Rate Program for Schools and Libraries, Second Report and Order and Order on Reconsideration, 29 FCCRcd 15538 (2014).


86 OTI Interview with Peter Sonksen, Network Administrator, and Barry Sommer, Director of Advancement, Lindsay Unified School District, June 1, 2020 (“Lindsay USD Interview”).


89 Lindsay USD Interview, supra.

90 “Lindsay Unified’s Path to Community-Wide Wi-Fi: Connecting All Learners,” The Learning Accelerator (Sept. 2016) (“Learning Accelerator Profile”).

91 Learning Accelerator Profile, supra, at 4.

92 Lindsay USD Interview, supra. See “Lindsay Unified Community Wi-Fi Project,” Overview Video, Digital Promise, Innovation Portfolios, Lindsay Unified School District, available at https://portfolios.digitalpromise.org/ip/Portfolio_Intro?Id=a2z1G000000X5bYQAS

93 Learning Accelerator Profile, supra, at 3.

94 Ibid.

95 Ironically, Lindsay has been able to indirectly offset some of this financial penalty thanks to merit-based grants from the U.S. Department of Education. For example, Lindsay USD announced on Sept. 30, 2020 that it “is proud to announce that we have been awarded a continued Teacher and School Leader (TSL) grant from the federal Department of Education.” See https://twitter.com/Lindsay_USD/status/1311123127473111042. In 2012 USD was one of only 16 districts nationwide to receive a Race to the Top District award based on its innovative personalized learning strategy.

96 Lindsay USD Interview, supra.

97 Digital Promise, “Lindsay Unified School District,” Innovation Profiles, description and video available at https://portfolios.digitalpromise.org/ip/Portfolio_Intro?Id=a2z1G000000X5bYQAS.

98 Lindsay USD Interview, supra.


101 OTI Interview with David Fringer, Chief Technology Officer of Council Bluffs CSD, May 28, 2020 (“CBCSD Interview”).

102 Ibid.

103 Ibid.
104 Ibid.

105 Ibid.


109 OTI Interview with Randal Phelps, Chief Technology Officer, ESUHSD, May 7, 2020.


111 Ibid.


114 Ibid.


116 Ibid. See https://www.census.gov/quickfacts/fact/table/mcallencitytexas/PST040219.


120 Ibid.

supports-texas-citywide-hotspot-deployment-targeting-students/.

122 Ibid.


126 “FUSD will launch private network, offer wireless access to all students at home,” Fontana Herald News (April 17, 2020), https://tinyurl.com/yyd9u4no.


128 OTI Interview with Randal S. Bassett, October 20, 2020 (“Bassett Interview”).

129 Ibid.

130 Ibid.

131 Ibid.

132 Ibid.


135 Ibid.


138 Ibid.


Ibid.


“MuralNet and Cisco Launch Sustainable Tribal Networks Program,” Yahoo! Finance (Sep. 9, 2020), available at https://tinyurl.com/y6s9zjyn. In September 2020 the FCC closed the final window period during which educational institutions in tribal areas can apply for an EBS license prior to the expected auction of the remainder of the band in 2021.


James K. Wilcox, “Libraries and Schools are Bridging the Digital Divide During the Pandemic Crisis,” Consumer Reports (April 29, 2020), available at https://tinyurl.com/y6d67xw8. “In Kansas, the Topeka and Shawnee County Public Library repurposed two of its bookmobiles as WiFi hotspots . . . to support local high school students who lack internet access at home.”

Ibid.


156 Southern Virginia Schools Coalition E-Rate Petition at 8.

157 Ibid.

158 Ibid.

159 Id. at 11-12.


163 Ibid.

164 Ibid.


166 Ibid.


168 Ibid.


170 Ibid.


175 Ibid.


184 Microsoft Ex Parte at 3.
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