Connecting in Crisis: Investigating Equitable Community Internet Access in the US During the COVID-19 Pandemic

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Although internet access and affordability are increasingly at the center of policy decisions around issues of the "digital divide" in the US, the complex nature of usage as it relates to structural inequality is not well-understood. We partnered with Project Waves, a community internet provider, to set up connectivity across the urban landscape of a city in the Eastern United States to study factors that impact the rollout of affordable broadband internet connectivity to low-income communities during the COVID-19 pandemic. The organization endeavored to meet structural challenges, provide community support for adoption, and stave off attendant privacy concerns. We present three dimensions of equitable use prioritized by the community internet provider: safety from COVID-19 through social distancing enabled by remote access, trusted connectivity, and private internet access. We use employee interviews and a phone survey of internet recipients to investigate how the provider prioritized these dimensions and who uses their service.

CCS Concepts: • **Human-centered computing → Empirical studies in interaction design**;

Additional Key Words and Phrases: Community internet access, digital inequality, COVID-19 pandemic, privacy

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1 Introduction

Although the digital divide has been identified as a profound concern for a few decades, the COVID-19 pandemic, which left individuals dependent on home internet for school and work for an extended period, presented a unique opportunity to revisit exacerbated systemic issues. As the pandemic reached a global scale in early 2020 and social distancing rules were put in place across the United States and elsewhere, it was clear that lack of access to broadband connectivity would provide a major obstacle for low-income families with limited resources to pay

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for sustained internet service. While the **Federal Communication Commission (FCC)** took several initiatives, chief among them the Keep America Connected Initiative, to keep low-income Americans connected during the early stages of the pandemic, much of this effort was to keep existing subscriptions and delaying late fees rather than connecting people without previous internet access [5, 30]. Furthermore, many programs rolled out by Big ISP-providers (including at the site of the current study) were limited in duration and low in speed, prompting grassroots efforts across the country to explore innovative community-based approaches to providing internet connectivity to families in need. Indeed, internet inclusion advocacy organizations like Librarians Without Borders noted that they were cautious about recommending federal Internet programs because of their record of leaving some households out [12]. We use the term Big ISP to refer to large-scale for-profit **Internet Service Providers (ISPs)** in the United States that have historically dominated the internet connectivity market using different measures, including lobbying for restrictive state legislation against municipal broadband networks [9].

Beyond technical challenges in addressing the infrastructural and service gaps left by Big ISP-providers during a pandemic, community-based and grassroots approaches for providing internet access to underserved communities, face issues related to technology uptake and use. Simply giving people broadband home internet in no way ensures its utility to families who have learned how to construct a life around public and limited (i.e., cellular) access. Scholars have noted that the digital divide is not a binary (on or off) concept and that even after overcoming material access issues, new (and potentially greater) obstacles emerge [26]. Technology introduction should thus be combined with consideration of sociotechnical factors, such as the roles of trust and familiarity, network and device challenges, and the culture and contexts of use, among others [1].

In this project, we used an **Action Research (AR)** approach [27, 28, 40] in collaboration with Project Waves, a community partner providing digital broadband access and online resources during the COVID-19 pandemic, to low-income residents in an urban context in the Eastern US. Project Waves is fiscally sponsored by one of our other long-term community collaborators, the **Digital Harbor Foundation (DHF)**, a non-profit organization that provides technology-rich learning experiences to youth in our city. At the outset of the COVID-19 pandemic and the increasing recognition of the importance of access to high-bandwidth connectivity by the US government, DHF connected us with Project Waves, and together, we co-developed a research and implementation project to provide free internet connectivity to low-income residents, and to answer research questions about implementing such a program in the process. In our initial conversations with the organization, we identified three characteristics of safe connectivity that the organization prioritized: safety from COVID-19 through social distancing enabled by remote access, trusted connectivity, and private internet access.

Given the lack of prior research on understanding the priorities of community internet providers and the potential of this understanding to inform future practice and enable effective implementation strategies, we set out to answer the following research questions: (1) What are the perspectives and priorities of community internet providers in providing equitable access to low-income residents at the time of a global pandemic? (2) Who uses community internet in low-income urban settings, and what other financial challenges do they face? In this paper, we define a low-income individual as one living in a low-income household whose income is below the 2021 US national poverty line, which was $12,880 for the annual income of a household with one person with $4,540 added for each additional person [50]. We conducted interviews with the community internet provider employees and asked their perspectives on the service they provided and the importance of the three dimensions described above. Additionally, we report results from a phone survey conducted by the community partner with 41 recipients that provides an overview of who uses this service. While our focus is on a city in the US, internet hegemony has a large-scale

detrimental effect, especially in non-Western regions [15], which also motivates our investigation into the characteristics of equitable community internet access during a global and long-lasting pandemic.

2 Related Work

Community internet providers that offer an alternative to big business network infrastructure—by drawing on grassroots efforts and resources— are increasingly being studied in CSCW and **Information and Communication Technologies and Development (ICTD)** communities (e.g., [33]). Previous scholarship has highlighted the technical difficulties of installing and maintaining community-based networks [15, 35, 39]. Examples of community networks include Guifi.net (based mainly in Catalonia and Valencia in Spain) [4, 35], Digital Tribal Village (based in Southern California) [43], and StreetNet (based in Havana, Cuba) [14], among others. The study of community internet and network providers is timely, as the need for equitable access bridging the digital divide persists and is amplified in times of crisis, such as the COVID-19 pandemic.

As of 2021, roughly four in ten low-income US adults lacked home broadband internet [47]. In 2018, nearly one in five US teens struggled to complete homework due to broadband access issues [3]. When, due to the social distancing measures resulting from the COVID-19 pandemic, hundreds of millions of people in the US became dependent on the internet for school, work, and health and safety information, the underlying systemic issues became more urgent.

During the pandemic, in cities across the US, schools connected thousands of homes through Big ISP providers only to find there were limits to these subsidies [5, 30]. Big ISPs like Comcast continue to have an important role in bringing internet to low-income families, but questions about the long-term responsibilities of these companies, as well as how they are measuring digital divides (or bridging them), illustrate the need for more nuanced approaches. For example, as of 2020, while the FCC reported that there are 14.5 million people without broadband internet, Microsoft reports that over six times as many (120.4 million) are not using the internet at broadband speeds [49]. These divergent narratives suggest that access does not guarantee quality use. This impermanence of access and lack of reliability is a cause for concern. Scholars increasingly argue that digital divide research overlooks issues of "inclusion" [42], focusing on access but not the relative need to be connected.

While digital redlining (i.e., the practice of denying equitable access to digital resources, including broadband coverage or adequate speeds, to low-income communities of color) is illegal, studies have found that lack of broadband access disproportionately affects low-income communities of color [46]. According to the National Digital Inclusion Alliance report from 2019, roughly 30% of households across 185 US cities lack a wireline (such as cable, fiber optic, or DSL) broadband connection [36]. City council members from across the US sent a letter in 2021 to the Acting Chairwoman of the FCC requesting a commission be assembled focused on "ending digital redlining, as well as to reclassify broadband under Title II authority," allowing the FCC to regulate broadband as a public utility as they do telecommunication carriers [46]. This could allow, for instance, the US Department of Housing and Urban Development to cover the costs of discounted internet that low-income families still cannot pay.

Numerous studies have shown that income, geography, education, and age are critical attributes in describing digital divide access issues. While many studies have looked at the importance of affordability in access in other countries (e.g., [31]), less research has been done in the US. How the US government defines "the divide" is itself problematic. In practice, in the US, the **Federal Communications Commission (FCC)** is largely responsible for defining the digital divide, and their focus is on access to material infrastructure, not usage [32]— though even these efforts seem hamstrung by bureaucratic priorities. Facing the challenges of the digital divide requires seeing it

as not merely a material access problem but also as a usage problem. The issue of usage remains somewhat more elusive in terms of what structural factors (not what personal attributes) impact it and why. The gap between access and usage is difficult to bridge, and arguably, we have not explored how to traverse it properly in the US [41].

Hargittai suggests the term "digital inequality" to capture "a spectrum of inequality across segments of the population depending on difference along several dimensions of technology access and use" [24]. What defines digital inequality is that the benefits of the internet will privilege those who are already in a privileged position. The rich get richer, particularly when it comes to the quality of support that may be essential in long-term adoption [29]. Those with more exposure and experience using the internet will be able to use it, essentially, "better" [24]. Even with access to public WiFi, libraries, and even cellular networks that allow (mobile) access anywhere—including home—the nature of these resources means that access is limited in terms of time, freedom of use (what sites you can visit, which is a function of time and speed), and privacy.

Other research on technology adoption by new digital technology users has shown that utilizing in-person training opportunities, such as those offered in **community technology centers (CTC)** can be effective in supporting internet uptake and use [48]. For example, in a study with 144 residents in the Mathare Slum in Nairobi, Kenya, Wamuyu found that access to free training and internet connectivity could lead to increased internet self-efficacy and perceived usefulness, factors that along with positive perceived service cost could lead to increased internet technology satisfaction [48]. Key implications of the study included the centrality of cost as a factor for internet adoption and the effectiveness of CTCs in enabling marginalized communities to start a move towards technology adoption and use. In another study, Fernandez et al. illuminated misconceptions about digital usage in low-income urban communities in the US, and showed that rather than residents being less engaged digitally, they are often overly dependent on mobile phone connectivity rather than accessing services from an ISP, which limits their use of online services (e.g., health information seeking) [17]. Finally, Devanju and Joshi developed a two-dimensional model of technology adoption for emergent users in India, where one dimension maps to factors impacting users' predisposition to technology and another to skillful ICT usage over time [10]. Using the model, they argue that usage can be characterized along different stages and that at each stage, barriers and facilitators impact usage. For example, for a novice user, complexity acts as a barrier, whereas for a fluent user, a lack of adequate conceptual model can be a barrier to use [10].

This paper takes as a given that internet access is a human right essential for participation in civics (e.g., civic education, voting registration, etc.) for access to healthcare and social welfare (including critical COVID-19 vaccine access), and for education. While providing internet technology presents infrastructural barriers that are rooted (and routed) in structural inequality, those same inequities might make adoption and usage inexorable challenges. The COVID-19 pandemic, of course, widened this divide with higher absentee rates reported in schools among low-income students who have less consistent access to the internet [20]. Whether reliance on digital technology for essentially everything is desirable or sustainable is an open question, with some scholars examining what would happen during extended outages [21] after some countries have lived it [38]. However, this paper leaves these issues unaddressed—while noting that the kind of internet access we are exploring is more local and needed during a crisis to fill a gap that Big ISPs failed to address.

In this work, we also study what roles structural inequalities (not digital literacy per se) play in the priorities of community internet provider employees and how these are impacted by underlying considerations in relation to the social isolation and public health challenges imposed by the COVID-19 pandemic.

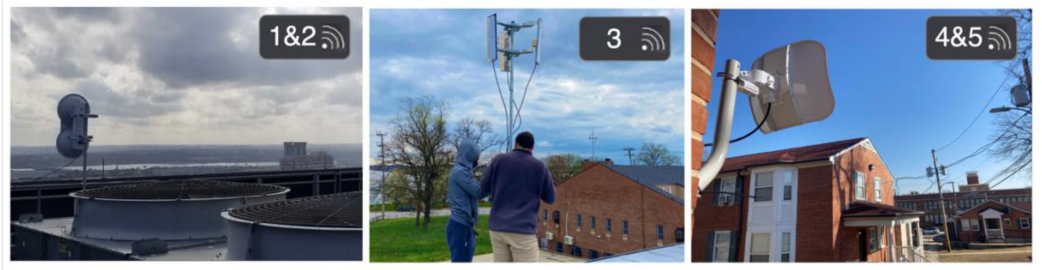

Fig. 1. Five different stages in setting up a community mesh network in the urban context: (1) Point-of-Origin is created through broadcasting back-bone internet connection from Internet Exchange from high viewpoint Primary Sectors, (2) point-to-multipoint backhaul units are setup, (3) community-based geographic high points (such as school buildings) are used as Relay Sectors that receive signal from a Primary Sector and relay to nearby households, (4) household connections are setup with onsite receiver, cabling, and router, (5) (optionally) community WiFi hotspots are set up in the immediate vicinity.

3 Providing Affordable Community Internet Access during the Covid-19 Pandemic

During the initial stages of the COVID-19 pandemic (Spring 2020), our university research team partnered with the local community internet provider (Project Waves) to conduct an **Action Research (AR)** project to study how to introduce broadband internet connectivity to low-income urban communities during a global pandemic. Project Waves used mesh network technology to deploy connectivity in underserved neighborhoods across Baltimore, our mid-sized Eastern US city, and endeavored to meet structural challenges, provide community support for adoption, and stave off attendant privacy concerns.

Project Waves follows a similar approach to other community initiatives in setting up a decentralized system of antennas to provide connectivity to diverse neighborhoods in the city. The network structure starts with connectivity to several local commercial internet exchange centers that have agreed to provide in-kind access to their fiber cable and network backbone structure. These access points are then connected to Gigabit high-capacity Sector Antennas, as well as backhaul units used to connect relays across the city back to the internet. These units are connected to the Backbone Internet Source through underground fiber optic cables, serving as Primary Sector Antennas, and transmit this high throughput signal to key Relay Points as well as directly to household receivers. The signal is received by Relay Sector Antennas installed at community-based geographic high points from one or more of the Primary Sector Antennas, then relay the signal to household receivers. Each household has an onsite receiver, cabling, and router providing broadband connectivity through line-of-sight to a Sector Antenna. Since late 2019, the provider has secured access to locations for seven Primary Sector Antennas throughout the city, providing line-of-sight coverage to approximately 29 neighborhoods in the city. Chief among these is an antenna installed on top of a major building in the downtown area that, at 350 feet tall, provides significant line-of-sight coverage to many low-resource neighborhoods in the city. This coverage would allow the community internet provider to reach more than 27,500 households in neighborhoods that the American Community Survey Trust data found do not have internet. Figure 1 provides an overview of the network setup process. Figure 2 provides a schematic diagram of the overall network.

While at the time of the study (Spring/Summer 2020), the community internet provider primarily relied on mesh networks to provide connectivity, their long-term plans were to replace the underlying infrastructure with high-capacity fiber, which is currently (Summer/Fall 2023) being implemented. In this approach, wired fiber is provided to each terminal access point before being connected to a Gigabit Access Multiplexer unit, a central switch, and a gateway router that can

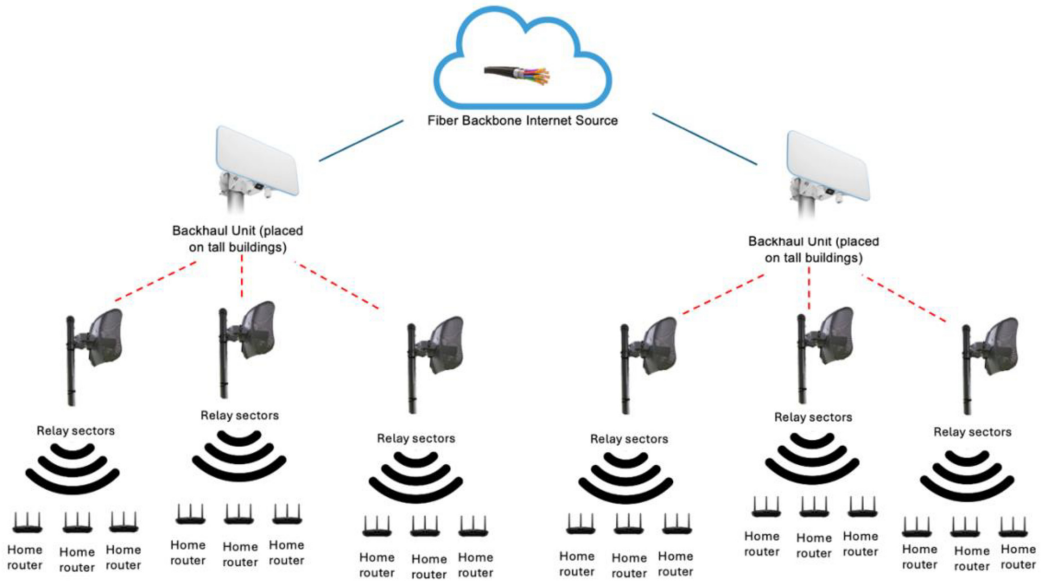

Fig. 2. A schematic of the mesh network deployed at the time of writing. Internet connectivity is provided through a fiber backbone internet source, which supplies signal to backhaul units placed on tall buildings in the city through underground fiber optic cable. Backhaul units transmit high throughput signals to relay sectors placed in neighborhood sites. Each relay sector then sends the signal to household routers and receivers.

then provide a stable broadband WiFi connection in the surrounding area. Project Waves had originally chosen mesh networks as the starting technology due to the ease of their installation and geographical reach, which were important to an efficient deployment during the pandemic.

At the time of the interview study (Fall 2020), the community internet provider served 322 households (151 wireless connections in homes and 171 apartment residents) and roughly 800 individuals. These numbers increased to 371 households and approximately 960 individuals by the time of the survey (Summer 2021).

Project Waves offered "affordable" internet based on donations (a suggested amount is $10 a month). Monthly donation and installation fees (recommended donation of $120) were Pay-What-You-Can. To protect their members' privacy, the provider did not keep logs of member-visited websites or other online resources in the network. They offer high-speed internet (25mb+) with no data cap and no throttling.

While Project Waves was established in 2019 in response to the need for internet connectivity in Baltimore, its parent organization and fiscal sponsor, the **Digital Harbor Foundation (DHF)**, is a well-established non-profit that has been providing low-cost technology-rich programs to youth in the city for the past 8 years and has established many long-term relationships with local schools, advocacy groups, and governmental and non-governmental organizations. While Big ISPs were available, Baltimore has low internet connectivity rates, with only 60% of households reporting having broadband internet at home in 2019. The population included in this study are low-income families who previously had no home broadband internet. The US city where this study takes place is home to roughly 600,000 people. It is also a city among many across the US that suffers from digital redlining, with recent surveys (2018-2022) showing that approximately 19% of its households

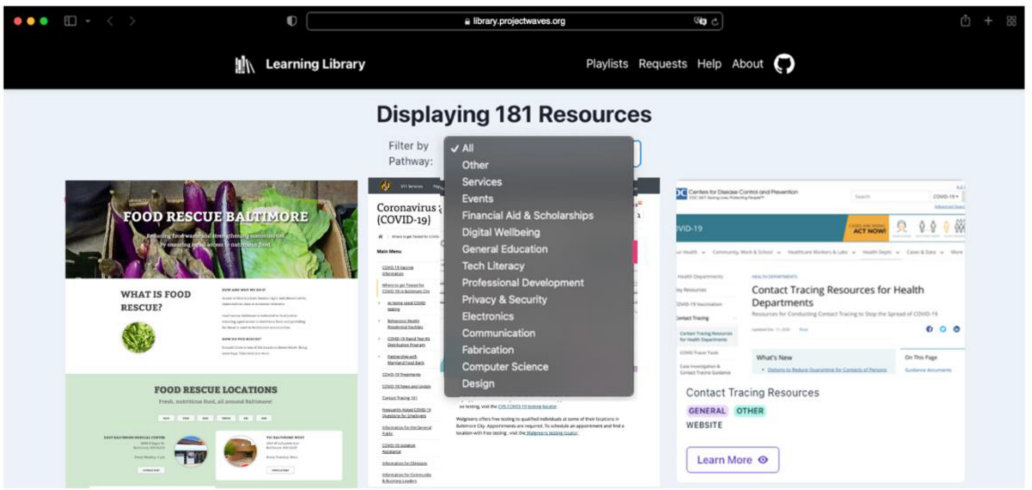

Fig. 3. A screenshot of the Learning Library created by the youth technology non-profit organization in collaboration with the community internet provider (courtesy of website link removed for anonymized review). The main page features top resources and a mechanism for filtering resources by category. The top navigation bar features a link to curated "playlists" of resources, a resource "requests" form, a "help" page where users can submit a ticket or reach out via email, an "about" page contextualizing the Learning Library within the non-profit's scope of service, and a link to the Learning Library's open-source GitHub repository.

were lacking broadband internet connectivity (based on US Census Data [51]). While providing affordable, community-based, and private internet is at the center of Project Waves' mission, its ability to support end-user safety by providing remote access to essential services emerged during the pandemic.

In addition to the physical infrastructure, Project Waves and DHF were also developing an online, curated set of approximately 50 resources in both English and Spanish, focused on education, tech literacy, professional development, government programs, and digital well-being (Figure 3). While the resource was still under development during the interview study, our research team was able to see initial prototypes being developed and tested online. Of note is that the resource was designed to be open-ended in that after deployment, community members could submit existing resources or requests for resources to be reviewed and added to the library.

3.1 Research Team Positionality

Our research team has maintained several long-term collaborations with the Digital Harbor Foundation, the youth technology learning non-profit organization that serves as the fiscal sponsor and collaborator of Project Waves, the community internet provider. Project Waves was established in 2019 and emerged from DHF. The current project was initiated as a collaborative effort between DHF and our research team in response to the COVID-19 pandemic and received seed funding from the National Science Foundation federal funding agency. Our research team and the leadership of DHF and Project Waves collaboratively developed and submitted the funding proposal. This effort included articulating the first iteration of the three dimensions of connectivity that we investigate and refine in this paper. Our relationship with Project Waves and DHF has afforded us access and insight into the practicalities of ideating, initiating, and progressing this type of community-engaged effort.

3.2 Community Internet Provider Priorities

As mentioned above, when conceptualizing the current research project with Project Waves and DHF, we collectively identified three primary priorities beyond internet affordability that motivated and organized the project. These priorities, which we elaborate on below and describe how they are related to prior research literature, focused on enabling equitable internet connectivity that, in addition to being materially available to users by being free or low-cost, supports *safety through social distancing during the COVID-19 pandemic*, is *trusted connectivity* by being provided by a trusted community organization and focusing on localized resources, and prioritizes *private internet access* free from Big ISP oversight.

3.2.1 Safety through Social Distancing during the COVID-19 Pandemic. By *safety through social distancing during the COVID-19 pandemic*, we refer to the ability of home internet access to enable remote access to online resources and services, thereby reducing the chance of being exposed to and spreading the COVID-19 virus infection. Across the world, the internet has been a crucial tool during crises to quickly disseminate information to the public, identify areas in need of assistance, and even provide mental health treatments to those affected by the crisis [35, 55, 57]. Responding to the increased community need for internet connectivity during the COVID-19 pandemic was an important short-term priority of Project Waves. At the time of the study, the pandemic had necessitated government responses in the US mandating social distancing and closure of many institutions and establishments, such as schools, community centers, and businesses deemed nonessential. The combined isolating nature and prolonged length of the crisis had amplified the need for internet connectivity.

At the time, the pressing need for internet access had led institutions ranging from the FCC to public school systems to acknowledge how the Digital Divide puts disadvantaged communities at an even greater risk of profound educational, economic, and social alienation as better-resourced portions of society shift to operating remotely under quarantine [61]. Furthermore, it was becoming increasingly clear that low-income workers were less likely to be able to social distance [9] and were at higher risk for COVID-19 infection [86]. Further, with the closure of libraries and other public or open-to-the-public internet connection locations such as workplaces, schools, and dining establishments closed or restricted under pandemic "stay-at-home" orders, accessing the internet could involve risking exposure by visiting the homes of friends or family members with an internet connection, running counter to public health recommendations.

3.2.2 Trusted Connectivity. By *trusted connectivity,* we refer to community internet recipients having more buy-in and trust in the local community internet provider than Big-ISPs. Project Waves emphasized the importance of trust in usage supported through their organization being embedded in the communities they serve. The organization is comprised of members living in the communities they serve and offers service, whether in-person or by phone, that is engaged and personal. Project Waves originated and operates in close collaboration with DHF, a local community space that focuses on youth technology education for low-income youth and has a strong community presence. As part of the effort to build trust, Project Waves partnered with 26 local organizations, including libraries, schools, universities, community centers and associations, nonprofit technology and youth outreach organizations, and churches to offer free internet, as well as information about online learning, technology, and employment resources, and also counted on them to refer households to them for service.

Although providing internet access becomes more urgent during disasters, communities also rely on offline networks to rebuild [37, 44] and, in this case, that might include tapping into libraries, schools, and churches for insight and referrals for those in need. We can extrapolate the potential for involvement by community advocacy groups to help in overcoming second-level

digital divides [25]. Project Waves connected communities to relevant resources through its relationship with DHF, the trusted, local non-profit organization. Together, the two organizations provided an online library of curated resources that users could suggest additions to. The resource library included general online resources as well as community-based resources, including information about food access, education opportunities, career development, COVID-19, and government programs. The library (Figure 3) also included information about local technology assistance programs and other online resources designed to introduce internet recipients to popular applications and tips for maintaining privacy online. Curated local resource libraries can help communities normalize access.

3.2.3 Private Internet Access. By *private internet access*, we refer to the increased community internet recipients' online privacy supported by the community internet provider's explicit practices and policies for online privacy protection. Issues of privacy were also of deep concern to Project Waves. Low-income users may depend more on secure online community spaces to explore and conceal identity and for safe self-disclosure, which is critical to well-being [43]. This study took place at a time of protest and heightened surveillance concerns (2020), including the nationwide protests ignited by the high-profile killings of Ahmaud Arbery, Breonna Taylor, and George Floyd in 2020 [10, 41, 45] and in response to family separation policies at the US-Mexico border [20, 46], efforts by the police to monitor and even hack individuals' phones [54] put at risk those who are already vulnerable to government profiling [17] and policing [18]. Facial recognition, drones, hacking, and other technologically-enabled mechanisms are now integral to policing (e.g., [54]) and disproportionately harm marginalized individuals (e.g., [12]). These privacy violations exacerbated discrimination and have lasting impacts on communities and families. For those whose identity puts them at increased risk of discrimination, as a matter of course, experience with surveillance offline has chilling effects online [42]. Having home internet without oversight by Big ISPs may be a crucial safeguard for participation. Local community networks advocate net neutrality, protecting individuals from traffic monitoring [56] and throttling more secure communication platforms. In addition to issues of equity and access, Project Waves was in part founded as a response to the repeal of net neutrality and the way that traditional ISPs were able to access user information and use it. In the US, people who cannot afford home internet access may experience a lack of financial resources for identity-based reasons, such as race, gender, and immigration.

Project Waves' focus on privacy is supported by recent research that shows the amplified negative impact of online privacy threats to vulnerable populations. Social discrimination practices, such as racial disparities in incarceration, may make some low-income people in the US more vulnerable to public surveillance. Furthermore, infringements on privacy increase during health crises [36], making any internet participation riskier, particularly through shared public access. Additionally, offline discrimination can potentially affect online experiences and behavior. In their study of low socio-economic status young people, predominately of color, Marwick et al. [53] find that marginalized social positions amplify risks online and contribute to the avoidance of social media and self-censorship [40]. They find that low socio-economic young adults of color often experience structural racism in the form of policing and physical surveillance and that they are well-aware of the connection between social media activities and offline consequences (e.g., being doxed, bullied, or fired) and often could not avoid it. Recent research has suggested that people from low-income, high-crime neighborhoods may be more worried than higher-income counterparts about police use of social media in crime prevention [37].

Finally, income insecurity is correlated with other marginalized identities; these identity vulnerabilities may lead individuals to seek increased privacy or anonymity to explore complex identity [25], to partition parts of their identity [39] in the service of safe self-disclosures of abuse [3], to contribute to open collaboration projects when identity-vulnerability or viewpoints put

Table 1. Community Internet Provider Employees

Participant	Gender	Race
S1	F	White
S2	M	White
S3	–	–
S4	F	White

them at risk for harassment, doxing, or violence [19], and to evade government censorship and surveillance [59].

4 Methods

We conducted four semi-structured interviews with Project Waves employees and analyzed data from a phone survey with 41 households collected by Project Waves from their membership. Our study protocols were reviewed and approved by our university's **Institutional Review Board (IRB)** before data collection.

4.1 Interviews

4.1.1 Participants. We conducted interviews with four employees of Project Waves during the Winter of 2020 and Spring of 2021. Participants included technical staff supporting internet installation and maintenance, administration staff supporting community outreach and paperwork, and leadership. See Table 1 for demographic details. One respondent was uncomfortable having their information recorded, so we did not capture their demographics. Two employee participants worked both for DHF and Project Waves, and two worked exclusively for Project Waves. Their roles (not in order) include lead product designer (youth learning outreach), program coordinator (youth learning outreach), head of operations (community internet provider), and bilingual community support specialist (community internet provider). At the time of the study, the organization had six total employees, and the two employees that we did not interview were new technical staff who were active in installing on-site hardware. Our selection criteria for the participants were that they had worked at the community internet provider for at least three months, so they had substantial experience working with low-income community members during the pandemic and applying the organization's priorities. We interviewed participants with diverse roles within the organization to understand different perspectives. We recruited Project Waves representatives directly. The employees' participation was optional (i.e., it did not impact their employment), and they did not receive compensation for participation.

4.1.2 Data Collection and Analysis. Interviews were conducted over the phone and ranged from 48 to 68 minutes in length. We asked participants about their role at the organization, their day-to-day encounters with recipients, and how they think about safety, trust, and privacy.

Interviews were recorded and transcribed by a transcription service approved by our university's Institutional Review Board (IRB). Research team members who conducted the interviews reviewed transcripts and notes and wrote memos, which were organized into themes that were both emergent and based on the study framing. We met and agreed on initial codes and themes. The interviewers revisited transcripts to code key noted themes and anecdotes for use in this paper. We took an iterative thematic analysis [7] approach to identifying and synthesizing themes within the interview transcriptions. Examples of initial codes included "factor impacting privacy" and "barrier to community involvement." We ultimately used the dimensions of safety through social distancing during the COVID-19 pandemic, trusted connectivity, and private internet access to interpret and frame our findings.

4.2 Phone Survey

A year after the start of the project (Summer 2021), Project Waves conducted a brief phone survey with a subset of their network recipients. Overall, 41 households, representing 11.05% of the total population of their network recipients at the time, participated in the phone surveys. The community partner had reached out to 100 households to invite them to participate, resulting in a response rate of 41%. The phone survey was conducted in two languages (Spanish and English) and included questions about participants' annual income, experiences with financial challenges, and employment. Example questions in this survey included: "Do you or other members of your household currently have a source of primary healthcare?" and "Have you or members of your household experienced gun violence in the past 12 months?" Other than the demographic questions, the participants were asked to only answer yes or no to questions about their experiences. While Project Waves acknowledged the limitation of using this type of survey and the advantage of using open-ended questions, they made the decision to use the shorter phone survey to reduce the time to complete it and lessen the burden of participation. Project Waves conducted the surveys to collect population-level data on who was using their services and what needs or challenges they face, which also aligned with our research goals.

The community internet provider conducting the phone surveys is not ideal since it might introduce bias into the results since participants may be motivated to answer questions in a way that they expect the provider to expect since they are receiving desired services from them. However, we decided to use this data because, despite our research team's initial efforts to collect data directly from internet recipients, we could only reach a handful of participants over six months. This was due to several factors, including participants not using email, which limited communication to phone calls and text messages, and the presence of social distancing safety measures, which made it difficult to reach out to participants in person. Therefore, we decided to use an anonymized version of the phone survey results conducted by Project Waves as well as high-level descriptive data about the recipient population. The survey results were anonymized by removing all identifying information about the participants (e.g., phone numbers and names) before being given to our research team. We analyzed this data by calculating descriptive statistics about each of the questions.

5 Findings

Our findings provide both a high-level view of who the recipients of community internet are in our urban setting (Section 5.1) and insights into the similarities and differences of priorities for community internet providers and recipients (Section 5.2). Together, these findings illuminate the reality of low-income internet access during the COVID-19 pandemic. Table 2 provides an overview of the findings organized along the three dimensions described in Section 3.

5.1 How Does the Community Internet Provider Prioritize Different Aspects of Connectivity?

5.1.1 Safety through Social Distancing during the COVID-19 Pandemic. Project Waves employees say that COVID-19 has led to an urgent demand for home internet, both to address concerns about providing stable, safe home access to children in need of remote schooling, and for parents to find employment or remain employed from the safety of their home.

> I'd say that our rapid growth has been because of COVID, because of closures, specifically school closures during the spring of 2020, our first pilot, at scale pilot project was funded by DHF, and it was a rapid response project in partnership with city public schools to ensure that students who currently did not have

Table 2. Overview of Participants' Perspectives towards Community Internet Access

Dimensions of Community Internet during COVID-19	Community Internet Provider Employee Perspectives
Safety through Social Distancing	Employees see increased safety needs due to the COVID-19 pandemic amplifying the need for affordable home internet, but that community internet is needed regardless of the pandemic.
Trusted Connectivity	Employees prioritize working directly with community members and collaborating with other established local community organizations and groups. They face challenges in communicating technical issues with community members and developing and maintaining localized online resources.
Private Internet Access	Employees prioritize internet users' privacy in their policies and practices, and this as distinct from Big ISPs.

> internet access could have stable internet connections that would allow them to learn online. I'd say that also for their parents, it's allowed them internet access that has been a crucial employment tool, either finding employment or remaining employed remotely during COVID-19. (S4)

That said, S3 doesn't perceive that COVID-19 has changed the mission to bring internet to all homes, regardless of whether there is a pandemic.

5.1.2 Trusted Connectivity.

Community involvement: A big way that Project Waves establishes trust is by partnering with local organizations like schools, churches, community development partners, and libraries. Libraries have historically been essential points of access for internet connectivity and thus represent a critical bridge to help connect people in their homes. This builds trust, but it also, they believe, lets Project Waves get to those in need quicker by giving them access to the community.

Providing trustworthy internet means also being a gateway to access to community resources like food pantries, churches, and other community charities. Although Project Waves has been recommended through the schools, as we heard from our participants, that has still been a challenge from the organization's perspective. The schools have access to critical data, like who lacks access, that Project Waves could use for outreach but can't get access to. Indeed, communication has been a challenge here:

> One of the biggest ongoing challenges right at the moment is communicating with larger partners who may have access to data that would be helpful to us. For example, the city school system knows exactly how many and who in their dataset currently lacks access to broadband connectivity at home. (S4)

One employee points out the importance of community networks for finding trusted resources, especially during uncertain times and for those who may have concerns based on their immigration status:

> Many times, people don't know where to call or who to get help from, especially with this pandemic, and who they feel they can trust, because maybe their immigration status is not the best, and they call, and I help. That's what we do. (S3)

Project Waves employees tended to agree that their project was subverting corporate structure and, by providing internet, giving access to opportunities like housing, education, jobs, and so on, that might instill trust from the community. This is a sentiment that some of the recipients agree with. According to S1:

> What Project Waves is doing directly is, number one, it's getting people connected, which is impacting all those areas that we just talked about, like housing, education, jobs, other opportunities. It's also subverting a dubious corporate or capitalist structure that has not been serving the general population very well. (S1)

Perhaps, the biggest challenge we heard is that those with the most need for internet are most likely to be disconnected and hardest to find. This has required that they depend on in-person community outreach, which is time-consuming and especially difficult during the pandemic:

> Obviously, when you don't have an internet connection, you're specifically hard to connect with, right? A lot of organizations are doing outreach online, and all those things. But if I'm trying to connect with the 40% of Baltimore residents who don't have an internet connection, I'm really focusing on in-person outreach that's community-based, right? (S4)

One barrier to community involvement that Project Waves has faced is overcoming the distrust that exists among community members surrounding "free services." Employees find that people are a little taken aback by their promise of free service, believing there to be a "catch." Skepticism is heightened in this current climate, with employees reporting that clients are more sensitive to scams:

> We're doing this for free ... We get a lot of suspicious reaction to that. (S4)

> People are very skeptical, guarded, when you reach out to them, especially during these times, and you're not trying to con them into a contract ... 'Oh, but there's a catch...' (S3)

Continued technical support: One of the major obstacles to providing stable access for Project Waves has been that sector antenna routes mirror socioeconomic and racial inequality. That is, services are hardest to maintain in the areas where it is most needed:

> It can make the work a little bit more challenging, but we're not going to give up, we never do. And we are continuing to explore other options. But I would say that it's not necessarily like a community partnership, like a lack of community partnership, it's more lack of infrastructure needed to work as efficiently and as effectively as we can. (S4)

Continued inequities in infrastructure access and maintenance in historically marginalized neighborhoods are well-documented in Baltimore [8]. However, this might explain outage frustrations that recipients report, but not why recipients sometimes remain in the dark about how these infrastructural challenges impact them. S4 goes on to explain that Project Waves has focused on servicing the most marginalized. The employees we spoke with described the scale of the problem of lack of internet connection as motivation for their work. S4 notes that, in their city alone, 24,000 students don't have access to the internet and have not been attending school since March 2020. S4 laments that a lack of internet connectivity can exacerbate domestic violence. These motivating factors relate to Virginia Eubanks' research showing that social services can punish households for being poor [16]. As a result, they have focused on maintaining the health of their existing

networks, despite persistent maintenance challenges, to provide continuous connectivity for families with children in school. This has meant being proactive in going out to unconnected areas and also creating "priority list[s] of households" based on need (S4).

Resources: Employees say they are motivated by segregation in their area, which affects access to housing, food, jobs, and the like, to help families get access that might "level the playing field" (S1, S2). They perceive that in this current climate, education is virtually inextricable with internet access, though others point out that internet access is critical to finding food pantries, churches, Medicaid,and other services, in addition to courses, job searches, and other community-based resources. While infrastructure is a barrier, so too is education and skills training "to use a service like Project Waves to their greatest benefit" (S4). The employees point out the weird space they occupy, between providing something mundane, such as entertainment, to something life-saving, such as language resources and access to health insurance exchanges and information. As S4 articulates:

> I see it as really shaping that out, the way that the future is seen by people who previously didn't have internet connectivity. It can be as simple as something like I can pay my bills online now. Choose something as complicated or really deep as I think my future is brighter, or this has saved lives. We've helped clients connect to healthcare through the Maryland Healthcare Exchange… It's a matter of just truly having more access to the resources that are really critical to thriving rather than just surviving in a lot of ways. (S4)

Project Waves employees say they are very attuned to the idea that digital literacy should not be a barrier to access. For them, being a "community-focused organization" means they "are really mindful of the fact that digital literacy (for example, being able to connect their devices to WiFi) may not be at its highest among our users. And that should not be a barrier to connectivity." (S4) In practice, this has meant being aware of what people don't understand about their network setup:

> It could be really difficult for someone who's never had home internet service to identify that their connection is not stable or is not working the way that it should. And for us, it's really important to ensure that again, that's not a barrier to connectivity. And to normalize that we're here to help. And we're here to walk folks through any of the challenges that they may face in using the service, whether it's on our end or just on the customer's end. We're used to fielding calls of all types and helping customers with all kinds of things. Yeah, often, a big problem that comes up in customer calls is a customer calling and reporting that their network isn't working the way that they think it should. But it's really that their WiFi-enabled devices have not yet connected to the service. So, often, what we do is just help customers connect their smart TVs or their cell phones, or their Chromebooks for their students [i.e., children] to the network. And that is a really common call on our part. (S4)

Employees recognize that feedback from the community is vital to producing better resources but it's also challenging. They realize that the best resources will be those that are actually being used by the community, but logistically it can be hard to get them connected and informed about what resources are there.

> The biggest challenge has been getting feedback directly from recipients, or people who have been connected via Project Waves. I think that a big part of that is just the logistical challenge of getting all those people connected. (S1)

Employees emphasize that it's critical that they not develop resources in a "bubble." One example is that they have begun to develop Spanish resources for individuals they connect to the internet:

> We wanted to make sure that we're not just developing things in a bubble without actually getting the feedback. I think a great example of that was the identification of a need for Spanish translated resources, or Spanish resources. I think that's one of the challenges that we're facing, just ensuring that what we're providing is actually what is needed by the folks that are being connected. (S2)

5.1.3 Private Internet Access. Employees are unsure if Project Waves has an official policy about privacy, but perceive that, at a bare minimum, they are not endangering their customers by selling data or revealing their identity: "I don't really know what Project Waves', as an organization, official stance or views are on matters of privacy and security" (S1).

Project Waves does not monitor customer traffic the way that Big ISPs might, a fact about which they feel proud and that differentiates them from Big ISPs. This is written in their contract. S4 notes that many people do not care but that occasionally, recipients do ask why it's important for them to know that the community internet provider does not monitor their internet traffic—presumably because they do not know that ISPs monitor their traffic.

> Our contract does outline that we don't monitor any of the information, how they're using the network, what devices are connected, etc., and that we can't. So, it is a conversation that we have. A lot of people just accept that and there are no questions about it. Others asked why we don't monitor network traffic. And others will ask, 'Why is it important for me to know this?' Which is useful because this is pretty unique for an ISP to not do it this way. Typically, traditional ISPs have access to the traffic that flows over their network at a very aggregate level. (S4)

This refusal to monitor network traffic stands in stark contrast with the practice of sharing and selling internet users' personal data (e.g., web browsing history), which, following the 2017 repeal of privacy protection legislation [18], can be conducted by an ISP in the US without users' consent or anonymization [6]. Our interviews with service provider employees demonstrate their commitment to privacy as a foundational value but also indicate possible underappreciation of the possible harm of lack of regulation, which may not, in fact, be "at a very aggregate level" but rather at an individual or community one, whereby, "ISPs can infer different types of personal information such as users' political views, sexual orientations, and financial information based on the sites they visit [6:213]."

S2 notes that vulnerable populations, in particular, "should have access to information without needing to give out their data as a bartering piece for it" (S2). S2 refers to the problematic practice of "free" online services, including internet access services, collecting and selling user data for profit. S2 also feels that more needs to be done to educate people about how their data can be accessed and used. Project Waves is particularly attuned to the vulnerability of its immigrant population. For example, S4 notes that she has to be careful when contacting customers whom she learns about through the library. She is aware of the history of government subpoenas for information about immigrant communities that might make them distrustful.

Another big part of trust with regard to privacy, according to service providers, is "ensuring that people trust [the] technicians when they're in person doing work ... and continuing to build a rapport with the community members that are trusting Project Waves to install equipment on

their homes and to be in their homes often. Trust is a huge thing" (S4). As a result, technicians are given access to household names or other household details. They try to be careful not just in how they store information ("as securely as possible") but in who has access to it and how it's getting communicated.

5.2 Who uses the Community Internet?

The survey outcomes provide a high-level view of the community network recipient population and an overview of who is impacted by the digital divide in our context and what other challenges they might be experiencing. We found that the majority of community network recipients live below the poverty line, and a substantial proportion struggle with unemployment, access to food, and affordable childcare. The vast majority have school-aged children.

Based on the phone survey, the average household size was 4.8 individuals, and 80.4% of participants reported having school-aged children at home. 67% of the participants reported speaking Spanish at home. The median income of households was $13,000, which is well below the 2021 national poverty line, which was $12,880 for the annual income of a household with one person with $4,540 added for each additional person in 2021 (i.e., $26,500 annual income for a household of four) [50]. Only 14.6% of the participants owned their homes.

At the time of the survey, 34% of the participants were unemployed. Further, 46% of the participants answered yes when asked if they experience difficulty in accessing nutritional food, 39% answered yes when asked if it is challenging for them to find safe, affordable childcare, and 34.1% of the participants answered yes when asked if they lacked a source of primary healthcare. Finally, 12% of participants answered yes when asked if they had experienced gun violence in the 12 months prior to the study.

6 Discussion

When it comes to providing safety through social distancing during the COVID-19 pandemic, community internet employees believe that affordable community internet is essential to ensuring children can access school and the opportunities it provides for job seeking. The survey findings show that significant numbers of participants experience challenges in managing essential costs of housing, utilities, and services such as childcare and healthcare. These numbers confirm the focus of Project Waves on offering affordable connectivity to households that are not served by Big ISPs due to a lack of material resources and adequately subsidized plans.

Building trust through existing community networks is important to create awareness and ongoing attention to community internet. At the same time, one employee we spoke with remarked that they must be careful when that community broker is the library, given concerns, particularly among immigrant communities, about government surveillance [22]. While Project Waves may be aware of the challenges that recipients face in connectivity, they perceive themselves to be trusted—pointing specifically to the fact that recipients remark on how "human" they are. When it comes to resources, they are mostly focused on ensuring that their resources are applicable, but not as much done on awareness and deployment, a focus that may be reasonable given that the resource library was still being developed at the time of interviews. These findings show that trusted connectivity is an important factor to consider when implementing community internet and that establishing and maintaining it requires initial buy-in and continued communication and relationship building.

Trust and confidence in technologies and technology companies are widely studied [45, 52] though their importance in technology use and adoption may be increasingly waning [2]. For example, many people use social media platforms that they do not trust [34]. The concept of trust is still important to community development, and the kinds of arrangements that this community

internet provider espouses rely on collective action, ingenuity, and sacrifice. For example, in the context of community development, trust, as a belief in the reliability of a community and expectations for future opportunities within that community, is associated with increased engagement [11, 23]. While trust may not influence adoption when a platform is convenient or normalized [2], it does when it is not. Our research shows that community internet providers are aware of the importance of trust for their network recipients and, therefore, prioritize it in their practice. The challenge for them going forward will be how to create a community around its infrastructure and, in so doing, inspire trust that results in people sticking with it.

Our findings show that while Project Waves has connected to community members through local partners, maintaining effective communication and trust once they connect households remains challenging. According to Project Waves, these problems are driven by structural inequalities that have left the areas they need to serve barren when it comes to infrastructural support. These findings add to the limited existing knowledge about the social context of community internet initiatives, their establishment and maintenance, challenges and opportunities, and factors in their success or failure. Community-based internet is notoriously difficult to establish and maintain since its strengths can also pose technical and sociotechnical challenges [4, 35, 39]. The community internet provider will perhaps have to educate users about the larger structural conditions and practical ways to troubleshoot—as well as create permission structures for reporting issues (even if tedious). In a way, community internet is a feature of urban planning and development and should be treated as such: a ground-up effort to educate and empower customers and connect them to their community as well as to the internet.

Addressing the digital divide in the US requires more than just providing network access; it requires devices, education, and confrontation with structural barriers that leave people out. In addition to exploring the potential impact of low or no-cost home internet, devices, and education available via the non-profit community internet provider, we also aimed to explore immediate needs with regard to the pandemic that left millions of households in the city we studied without access to the internet for school or work, and potentially exposed to longer-term challenges with respect to online privacy. Clearly, the COVID-19 pandemic presented an opportunity to get home internet in households that desperately needed it for continued online learning access for their children and for participation in remote work, as well as everyday information access. Assuming the particular community internet under study continues to be offered on a sliding scale, including for free, work will be needed to understand barriers and facilitators of usage, usage patterns, and the definitions and measures of successful service for recipients and providers; and to further explore the role of trust and privacy on sustained usage. There is an opportunity for community-based internet providers to collaborate with community partners to involve community leaders and internet recipients in the research and design of the service. Future action research [19, 27] can further explore how to address the information needs of network providers and facilitate participatory design to promote relevance and sustainability [13].

When it comes to network privacy, community internet providers perceive that the advantages of not having a service provider monitor traffic go largely unrealized; this aspect of their contract with recipients gives them conviction about what they are doing. Future research should explore ways that community service providers can further educate recipients about network privacy.

7 Limitations

The main limitation of the current study is that we did not include qualitative input from network recipients whose perspectives can complement and, indeed, contrast with those of the community internet providers. While we made a number of attempts to recruit participants, we faced major challenges, partially due to the limitations imposed due to the COVID-19 pandemic and the

populations' limited access to email and other forms of asynchronous communication. In the future, we plan to include these perspectives, which would include those underrepresented in technology-focused scholarship. Furthermore, as mentioned in Section 4.2, we acknowledge the possibility of bias in the survey data since it was conducted by the community internet provider. Types of bias that may be present in the data include social desirability bias, in which network recipients may provide answers that they think the provider expects, and sampling bias, in which the internet provider may have recruited participants more likely from low-income families. Since the data does not include direct comments about the community internet provider's services, we expect the likelihood of social desirability bias to be small.

8 Conclusion and Future Work

Our research considered the implementation of a community internet service during the height of the COVID-19 pandemic along the three dimensions of safety through social distancing, trusted connectivity, and private internet access. We build on the idea that the "digital divide" is not just about access or literacy but about the nature of that access.

Our findings also motivate additional research to explore how people use community-based home internet, including for entertainment and learning, as well as possibly follow-on effects, opportunities, and challenges. Being able to provide individuals with trusted, inclusive, and customized resources alongside affordable internet connectivity remains an under-explored area. We hope to conduct a follow-up study in the future to reach out directly to network recipients to verify and update the survey results.

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