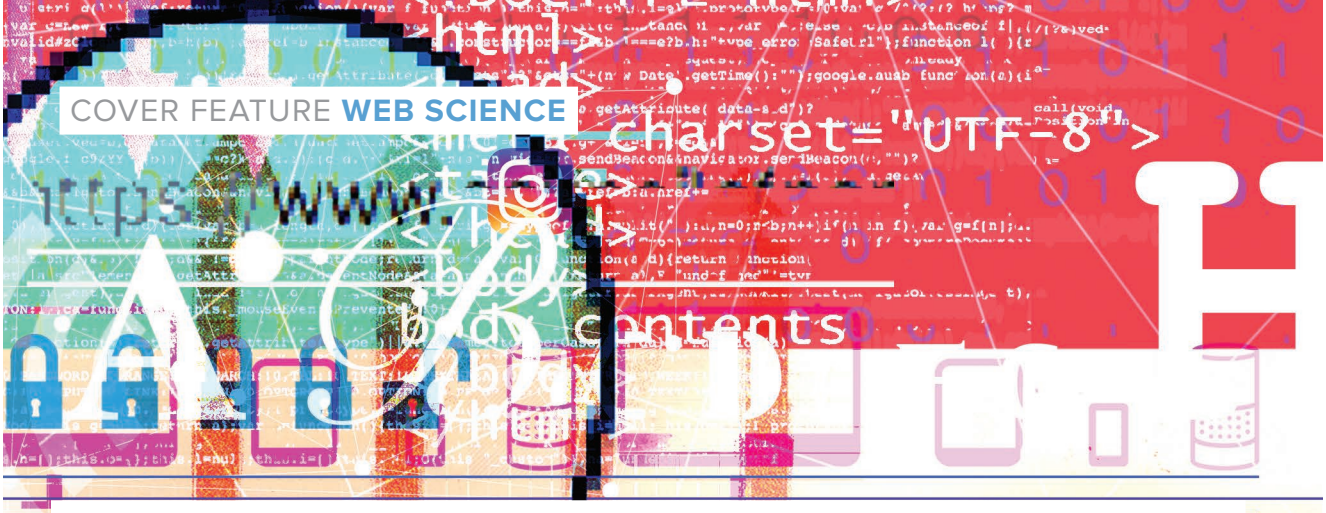

Now You See It, Now You Don't: Digital Connectivity in Marginalized Communities

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For marginalized communities around the globe, lack of stable Internet access can result in a "digital divide." The author's sociotechnical analysis of three marginalized communities—rural Native Americans in the US, Syrian refugees in Jordan, and Congolese refugees in Rwanda—identifies several key contributing factors, including aid agencies' changing priorities, goals, and political concerns, as well as technological, geographic, and cultural challenges. Through novel insights about these contributing factors of digital divides, the author generates a set of technical, organizational, and policy solutions.

Information and communication technologies (ICTs), similar to all infrastructures, are best enjoyed while invisible. Typically, only when broken or in disrepair do we become aware of their importance and complexity.[1] However, for many in marginalized communities, invisibility has less to do with the fundamental nature of ICTs, and more to do with the service itself. Just like a magician's disappearing act, service is provided and then taken away, often for unexplained reasons.

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Despite the rapid spread of mobile infrastructures across the globe, ensuring all people benefit from Internet access requires addressing the complex needs of systematically marginalized communities. Whether in the US, Europe, or developing nations, minimizing this digital divide has taken on greater urgency as local governments and social service agencies aim to provide services online. For these agencies, the disconnected pose a hurdle to innovation and lowering costs. Yet, for the people who are marginalized, when connectivity is provided solely as a means to accessing social services, it can be ethereal, subject to changing organizational and governmental priorities, program goals, and political concerns. When a program's budget runs dry, the Internet connection simply disappears.

Ensuring reliable connectivity requires sociotechnical analyses of the persistent divides, which are unlikely to be resolved through traditional market mechanisms. Existing in high- and low-income countries alike, these digital divides have common elements that can be useful to generate solutions with the scale necessary for sustainability. Drawing on empirical research in Native American communities in the US and refugee communities in the Middle East and sub-Saharan Africa, this article examines wireless-based connectivity and service programs and informs a broad framework for addressing the global connectivity divide through the integration of technological, organizational, and policy dimensions.

BACKGROUND

Marginalized communities is a general term referring to groups of people who are systematically excluded from meaningful participation in mainstream economic, political, cultural, and social life. People in such communities face increased challenges in accessing and using the Internet. Whether residing in Brazilian favelas or US urban centers, people in marginalized communities often gain Internet access through libraries or public computer centers.[2,3] Others, relying on prepaid mobile phones for their Internet connection, lose access when their airtime minutes run out. With a handset and phone number, they may appear to be connected, but they lack consistent service. In the US, healthcare and social service providers find that "phonelessness"—that is, a person's lack of access to a phone for voice calls, Internet connection, and access to care—prevents care providers from reaching their clients, and has other negative effects in terms of clients' privacy, employment, welfare benefits, and social support. In turn, phonelessness increases costs for these social and healthcare service providers.[4]

Marginalization can transcend poverty, it can have roots in political, social, and cultural exclusion, making it more challenging to overcome. A global analysis demonstrated that groups such as the Xhosa in South Africa, Albanians in Serbia, and indigenous peoples in Peru have 30 percent less Internet connectivity compared with others in their own country.[5] Similarly, the Bedouins in Israel and Gypsy-Travelers throughout Europe also have lower levels of connectivity.[6,7] Yet, once online, these communities can access connections with government agencies and other resources, promote their sense of culture and community, and advocate for their rights.[7]

For several decades, the Information and Communication Technologies for Development (ICTD) community has promoted designs that take into account the unique needs of impoverished communities,[8] as well as providing critical perspectives on those efforts.[9,10] The research presented herein contributes to mainstream ICTD scholarship by advocating for greater connectivity and use. Also, this study asserts marginalized communities require more complex solutions for connectivity than those typically offered through market mechanisms. These solutions are most likely to be offered by a different set of organizations, namely nonprofit and social service agencies. This stance provides an implicit critique of the overreliance on for-profit Internet and mobile network service providers to fill these network service gaps.

MARGINALIZATION CAN TRANSCEND POVERTY, IT CAN HAVE ROOTS IN POLITICAL, SOCIAL, AND CULTURAL EXCLUSION.

Specifically, the analysis below examines geographical, national, and organizational factors limiting access for Native American communities in the US, as well as for camp-based refugees in the Middle East and Sub-Saharan Africa. Based on these findings, a framework for comprehensive solutions is proposed.

CASE STUDIES OF MARGINALIZED COMMUNITIES

American Indian and Alaskan Native (AIAN) communities suffer the largest digital divide in the US, with 85 percent of rural Tribal land residents lacking access to modern broadband.[11] Often, people living in these disconnected communities have come to these places through forced relocation programs.

Refugees—defined as people crossing international borders with a well-founded fear of persecution due to race, religion, nationality, or membership in a social or political group, and lacking protections by their nation-state[12]—also have been forced from their lands. Their connectivity is hindered not only by their lack of land rights and transient status, but also by the concomitant economic hardships. According to UNHCR, globally, refugees are 50 percent less likely than the general population to have an Internet-enabled phone. Even more troubling, a full 29 percent of refugee households have no phone at all. While having the resources to connect is a challenge, at least the majority of refugees live in urban areas with available network infrastructure. However, for refugees living in rural areas, 20 percent have no available connectivity.[13]

The first of the following three case studies examines the Southern California Tribal Chairmen's Association (SCTCA), a shared governance association among a group of 19 federally recognized tribes, with reservation lands in Southern California. Another two case studies examine connectivity for camp-based refugees in Jordan and Rwanda. The Jordan case study examines a single camp of 80,000 Syrian refugees; whereas in Rwanda, the case study examines a program influencing connectivity at three camps for Congolese refugees. The analyses rely on both primary and secondary data. The former were collected through firsthand field research conducted between 2015 and 2017, including over 100 hours of observation, participatory design research, and face-to-face and Skype interviews with related organizations. This data was supplemented by secondary data collected from press releases and organizational and governmental reports.

Reservation-based spatial factors for access

For the SCTCA tribes, the Pala Reservation, originally home to the Luiseno (Payómkawichum) tribe, became a combined reservation with the Cupeno (Kuupangaxwichem) as the result of the expulsion of the latter from their homeland. The expulsion resulted from the Supreme Court case *Barker v. Harvey* in 1901.[14] As a result, in 1903, the Indian Bureau, through a band of armed teamsters, forced the Cupenos on a three day journey to Pala, thereby joining the large number of US tribal nations forcibly displaced from their homelands.

For the SCTCA, their land presents two challenges for connectivity. The first is its noncontiguous nature. Interspersed with private, nonreservation land holdings, infrastructure must traverse territory where revenues are not generated. Second, the land consists of deep canyons, which are difficult to serve with the line-of-sight wireless technologies typically used in low population density rural areas.[15]

The SCTCA's digital divide exists despite its location on two San Diego transit corridors, which connect the city of San Diego with the resort community of Temecula, as well as with cities in the neighboring state of Arizona. Mobile carriers provide service to tourists and truckers, with coverage along the roads that cut through the reservations. Although this coverage is a benefit, those reservation households or businesses off the main road are out of reach of the signal. Yet, on most coverage maps, it looks as if the area is completely served. Residents make do, storing emails, social media posts, and search queries until a trip into town brings them within range.

Camp-based spatial factors for access

Similar to the communities of AIAN, refugees' choices of where to live are dictated by the host country government. Some countries allow urban settlement in private accommodations, others require refugees to live in camps, and some allow both.

Identifying land for camps is often a scramble, occurring as refugees flow over the border. In hopes the stay will be temporary, governments tend to select a location that is typically vacant land and close to the border. This not only enables quick settlement, but also facilitates refugees' return to their home country as soon as hostilities end or circumstances change. Frequently, camp land is rural, undesirable (otherwise it would already be settled), and lacks access to infrastructure.

Even for camps relatively close to urban centers, connectivity can be a challenge. For example, the Za'atari camp in Jordan is just 10 km east of the sizable town of Mafraq, and only a 1.5-hour drive from the capital, Amman. Humanitarian organizations providing services arranged for a single, fixed wireless connection into the camp to meet their own needs, however, the camp's roughly 80,000 refugee inhabitants are nearly completely reliant on mobile network service. Unlike food, water, and shelter, communication is not considered an essential need and thus individual refugees have to pay for it themselves.

In 2016, when Za'atari camp was already 4 years old, our detailed tests of its cellular infrastructure found that in some areas the service was poor, both in terms of signal coverage and connection speed. Similar to the Native American reservation lands, signal quality varied significantly, but this was not reflected on carriers' coverage maps.[16] The problem was due in part to some towers serving the camp being located relatively far away, likely designed to serve a small nearby town prior to the refugees' arrival. While extending service from established infrastructure is a reasonable short-term solution, it would seem that, four years on, investment in additional infrastructure would benefit everyone.

National factors in reservation access

In June 2017, the SCTCA's nonprofit tribal ISP, Tribal Digital Village (TDV), attempted to serve a canyon-based cluster of households using new TV white space (TVWS) technology. This innovative wireless technology makes use of the spectrum vacated by the transition from analog to digital television service.

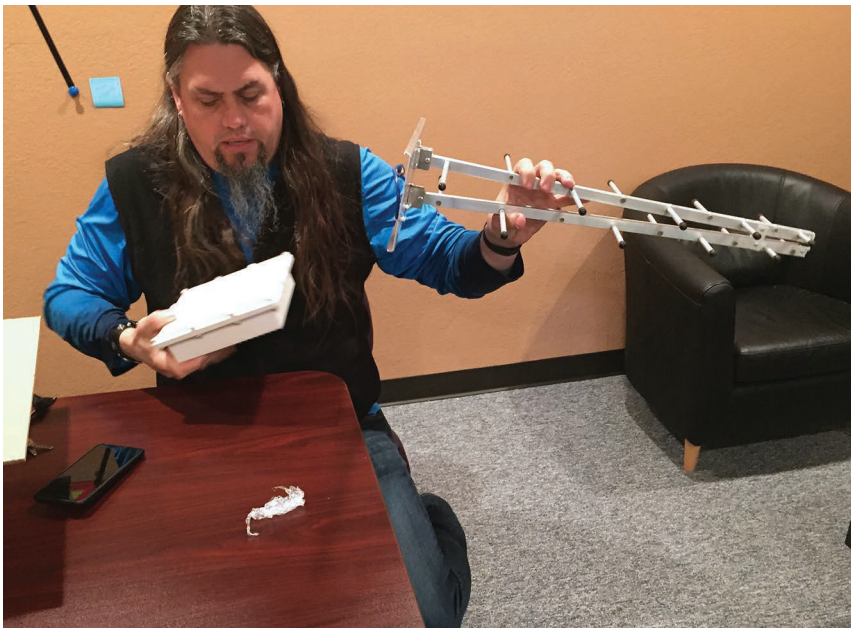

FIGURE 1. Matt Rantanen of Tribal Digital Village (TDV) holds television white space (TVWS) equipment, which is regulated by the US Federal Communications Commission (FCC). The FCC limits both the height above average terrain (HAAT) and power levels at which transmission equipment can be operated, which affect the distance the signals can travel.

TVWS policies of the US Federal Communications Commission (FCC) specify limits to both the height above average terrain (HAAT) at which transmission equipment can be operated, as well as their power levels, which affect the distance the signals can travel (see Figure 1).[17] These constraints, designed to reduce potential interference in more densely populated areas, are problematic for providers serving hilly, rural areas. In hilly terrain, towers are frequently placed in the highest location to maximize coverage. For the SCTCA deployment, conforming to the HAAT requirement meant the TVWS equipment could not be deployed on the existing hilltop towers. Instead, it required either building a new tower at a moderately lower location, at great expense, or using an existing tower at a much lower elevation. The latter was the only financially viable option, but it limited the number of households that could be served, driving up the per-subscriber costs for TDV. The nationally determined, integrated policy and technology design of TVWS was not optimized for service in this terrain.

As a nonprofit organization, TDV relies on US federal grants to help keep costs down as well as to manage network extension, maintenance, and upgrades. However, it is never clear when and under what conditions funding will be available. For example, between 2002 and 2017, the US

Department of Agriculture's Community Connect program budget varied significantly, ranging from a low of $9 million to high of nearly three times as much, at $34.5 million. Similarly, the Rural Broadband Access Loan program budget varied between $4 million and $28.6 million in the same period.[18]

In addition to US government policies, reservation connectivity is also affected by national tribal policies. For the Pala, one potential approach to filling connectivity gaps was to make Wi-Fi available in the parking lot of the tribe's library, a common approach across the US. However, due to the tribe's casino, the reservation has frequent guests, and many began using the free library network. The history of colonization and resulting unease with outsiders has contributed to agitation about providing access for these interlopers. Although configuring the system's access to limit use to tribal members was discussed, in the end, the library decided to discontinue the service. This decision was in line with general library policy, which restricts use of all services to tribal members only.[19]

National factors for camp-based refugees

Residents of Za'atari were fortunate in having access to three separate mobile carriers' voice and data networks, although they were not uniformly of good quality. However, in January 2016, all three carriers' data service suddenly degraded to the point of being unusable, while voice and text service remained. Neither the carriers, the Jordanian government, nor the UN agencies were able or willing to explain this occurrence. Desperate for a solution, the refugees held a meeting with government security officials, to no avail. Because they have been unable to leave the camp over a period of years, refugees had become extremely reliant on apps like WhatsApp, Skype, YouTube, and Facebook to connect with the outside world. The disruption in data networks had cut them off from potentially positive online communication, which can serve to ameliorate the negative effects of separation from those they left behind.[20,21] Camp staff also suffer from the poor quality data connections during their workdays. Within a few kilometers' drive from the camp, where so-called urban refugees reside among Jordanians, data service remains available.

Over time, informal explanations were given. Apparently, data access at all camps had been throttled due to security concerns of the Jordanian government. With limited geographic scope and population, refugee camps allow for targeted surveillance and censorship, exemplifying the interaction between spatial and national political dimensions of marginalization and Internet access.

In addition to security concerns, camp connectivity is also influenced by local and national government fears of permanency and competition for scarce resources. In 2015, the Carnegie Endowment for Peace reported: "Patience and generosity in host communities have worn thin as refugees compete with Jordan's vulnerable populations for scarce resources, employment opportunities, healthcare, shelter, and education."[22] Extending the fixed or mobile network infrastructure, as suggested above, could create a political backlash. Yet, five years later, acceptance of the longer-term nature of the Syrian crisis is growing. The camp now has access to an extensive power grid, resolving a critical problem for broadband connectivity, yet there is still no fixed Internet infrastructure. The politics of information access make lack of Internet connectivity precarious for marginalized communities.

Organizational factors in reservation's access

Connecting marginalized communities to the Internet requires knowledge of the local community along with individual users. Accordingly, SCTCA's TDV consults tribal chairmen on a variety of decisions, including where and to whom new connections should be made. Navigating the complex politics of several tribes, not all of whom get along, is necessary for long-term operations. While technical expertise resides within several, but not all, of the tribal government offices, TDV provides technology and data expertise for a wide range of SCTCA intertribal affairs.

Similarly, knowledge of the local population is crucial. TDV understands the personal circumstances of their customers and is often called upon to help with all manner of household technology problems. They also avoid raising expectations when deploying experimental technologies. In the TVWS deployment, potential service locations were not disclosed until the technology had been fully tested. Once connected, only one of the four households included an avid Internet user. The others embraced a more reclusive lifestyle that, in some ways, was at odds with Internet use, as described by Jeffrey Boase.[23]

As a local ISP, critical skills for TDV staff are persistence and ingenuity. As exemplified in the TVWS deployment, validation of experimental equipment takes time, requiring multiple

interactions with equipment vendors, driving up the cost of installation. Also, the lack of electricity in some of TDV's operating areas requires ingenuity on the part of both staff and customers. The TDV middle mile network, a fixed wireless configuration spanning a series of mountaintop towers, is largely powered by solar systems. Maintaining the distributed network of solar equipment presents regular challenges and, when problems occur, can affect the network's operation and reliability. A customer, also without access, operates his so-called *customer premises equipment* via a generator. These are the challenges and costs of providing service where commercial carriers are reluctant or unwilling to go.

That is not to say commercial carriers are entirely absent. TDV faces competition from satellite and cellular data service providers for customers within reach. When funding for network upgrades is unavailable, TDV might lose customers. However, those who cannot afford the higher price of cellular data remain and muddle through.

Organizational factors in camp-based refugees' access

In Za'atari camp, refugees' Internet access is often bundled into programs for disseminating information or skills training. One such program involved UNHCR's distribution of mobile phone SIM cards, which are necessary for connecting to a carrier's network. In others, Internet access is made available in the camp's computer labs for programs providing skills and livelihood training. However, at any time, these programs could be canceled, due to lack of funds or changing priorities.

The relationship between network connectivity and strategic alignment is also observed in a cash-based assistance program in Rwanda. There, the UN's World Food Program (WFP) and UNHCR in 2014 worked together to introduce a program replacing physical distribution of food with "cash." Instead of physical cash, a mobile handset together with a text-based system were used. The system enabled refugees to purchase food in markets, while also enabling better tracking and reporting on the use of funds.

The program, rolled out in three Congolese camps, provided a mobile phone and SIM card to each household. However, the organizations found its operation rife with challenges. Keeping phones charged and safe, identifying their owners when all households were given the same model, and simply remembering the mobile phone PIN code, all presented operational hurdles.

The organizational network operating the system included UNHCR and WFP, together with a mobile carrier, a text-messaging platform provider, a bank, and an NGO to provide helpdesk services and reporting. Eventually, WFP became dissatisfied with operational challenges and the level of cooperation between the organizations and dissolved the program. In the end, WFP and UNHCR decided to abandon the mobile phone–based program, opting instead for a bank card–based program. Not only did the bank cards provide an easier way for WFP to fulfill their responsibilities, it also provided a better platform through which multiple organizations, including UNHCR, could funnel money to the refugees. In the end, the mobile phones were sacrificed to strategic alignment. This action is likely having a disproportionately negative effect on women, who in low- and middle-income countries are already 10 percent less likely to own a mobile phone and 26 percent less likely to use the mobile Internet than men.[24]

OVERCOMING THE CHALLENGES OF CONNECTING MARGINALIZED COMMUNITIES

The above cases suggest providing consistent and effective network access to marginalized communities requires a broad vision and holistic approach, incorporating technical, organizational, and policy dimensions. The elements of such an approach are depicted in Table 1, and described in detail below.

Technology

No single technical solution can solve the problems of all marginalized communities. Instead, a suite of technologies is needed, meeting the high-level functionalities identified in Table 1. Many have been previously identified in the literature on emergency telecommunications and "computing for all," and are now embedded in field-tested, pre-commercial or even commercially available solutions. Here, discussion of these functionalities focuses on the specific needs of marginalized communities, highlighting their interactions with the organizational and policy dimensions.

The first two technical functionalities, namely decentralized and modular architectures and ease of deployment, are related. Such "democratized architectures"[25] call for decentralized approaches to network structure, favoring local over central traffic management and local caching of content. Such self-contained sub-networks, potentially configured as a mesh, will not meet today's broadband user–based bandwidth specifications, but

TABLE 1. Technical, organizational and policy solutions for connecting marginalized communities.

Domain	Solution characteristics	Problem addressed
A suite of technologies	Decentralized and modular architectures	Serving small areas with the potential to scale
	Ease of deployment	Need for temporary networks
	Minimize need for backhaul	Minimally connected rural areas
	Minimize power consumption	Deployments in areas with minimal or no power infrastructure
	Easily configurable security	Flexible and transparent security functionalities
An NGO federation dedicated to technical and organizational connectivity & platform solutions	Provides both a technical and organizational platform	Strategic alignment
		Intermittent access
	International operations	Economies of scale
		Coordination
	Liaises with local organizations	Embraces local knowledge and unique contexts
	Serves organizations involved in long term development as well as crises	Economies of scale
		Coordination between response and development
Policies	Coordinated technology policymaking	Enhances representation for marginalized people, ensuring their needs are met
		Enhances economies of scale
	Justice and human rights policy frameworks	Intermittent access
	Policies that enhance stability of funding	Intermittent access

for a refugee camp, for example, they can meet local information needs.

Freed from the demands of full integration and thus different from so-called cells on wheels (COWs), such network elements can be designed for ease of deployment, making temporary connections feasible. Modular and easy-to-deploy networks can be used in difficult-to-serve locations, such as the noncontiguous reservation lands and those where traditional line-of-sight solutions cannot work. Once made low-cost and easy to deploy, they can be used in disaster zones and refugee crises, where their temporary nature is an advantage. In these designs, the full cost of deployment, including the need for towers/masts, should be considered.

Relatedly, minimizing the need for backhaul as well as keeping power consumption minimal are crucial for rural and even peri-urban and urban areas, such as the world's slums, that lack access to infrastructure. Certainly, the decentralized designs discussed above can help reduce the need for backhaul. Store-and-forward solutions can also help overcome unreliable backhaul access. Similarly, designs should account for unreliable or nonexistent power systems.

Finally, as security for both people and networks becomes an increasing concern, network technologies should make access control and surveillance easy to manage and transparent. In two situations, namely the Pala library and in Za'atari camp, network access was (nearly) fully discontinued due to a desire to effectively limit network

access and/or use, and in the latter, to engage in surveillance. For many, the concept of enhancing surveillance is contrary to the ethos of an open Internet. However, if coupled with the necessary transparency, such systems can provide an effective alternative to fully blocked access.

Organizational dimensions

Current approaches for providing connectivity tend to extend and further entrench existing "stove pipes." For example, UNHCR's approach calls on technology firms to join as its partners in developing solutions to serve refugees.[13] Similarly, the UN's Emergency Telecommunications Cluster has expanded its mission, calling for efforts to connect affected communities as well as humanitarian organizations. Both efforts are to be commended, however, they narrowly focus on humanitarian operations and rely on market-based solutions, providing subsidies to commercial operators, a strategy that has failed marginalized communities in the past.

If communication is seen as an essential service, why not follow models used for providing food and shelter? Using this logic, connectivity and platform services are best handled by a dedicated nonprofit, nongovernmental agency focused exclusively on connectivity and access platform management. Similar to the aforementioned agencies that effectively cover the world, a federated model, similar to that employed by CARE and Oxfam, provides global coverage and coordination, while continuing to embrace knowledge of the local context.

The primary goal of such an agency or federation would be to serve as technical experts, deploying deep knowledge of a range of solutions, liaising with local agencies or infrastructure providers. Where local agencies or providers are not equipped to provide long-term connectivity, the federated agency could do so. The goal is not only to provide connectivity to the marginalized communities, but also provide a platform for digital services, such as cash-based assistance, for service providers.

The platform function would enable humanitarian agencies to focus on their areas of expertise and would provide marginalized communities with long-term connectivity. The latter would be insulated from changing priorities of local governments, as this new agency's primary goal would be connectivity.

Together, international operations and liaising with local agencies in both humanitarian relief and community development, will enable pooling of demand from disparate marginalized communities. Pooling of demand is critical to generating economies-of-scale, making technologies designed for marginalized communities cost effective.

The concept defined here is not entirely unique. Technology companies such as Facebook are pursuing a platform strategy in their Free Basics program. However, the approach envisioned here provides a neutral and open alternative. Similarly, NetHope, a US-based NGO, operates globally, providing connectivity solutions for large, international humanitarian agencies. Although it has the potential to serve as a technologically neutral alternative, to date, its humanitarian organization membership-based business model prioritizes connectivity for its members, as opposed to marginalized communities. However, NetHope's expanding programs suggest this could be changing.[26]

Policy dimensions

Critical to both the organizational and technical dimensions of this challenge, is establishing a regime of internationally coordinated technology policy, which is necessary for achieving the economies-of-scale and maintaining focus on marginalized communities.

An example is the establishment of the Office of Native Affairs and Policy (ONAP) within the FCC in 2010. A positive first step in amplifying marginalized community perspectives, this office now needs greater representation and voice within FCC policy deliberations. On the international stage, the Dynamic Spectrum Alliance fosters greater collaboration on wireless policy. Now in its sixth year, the agency's annual meetings bring together policymakers from around the globe, including the FCC and International Telecommunications Union (ITU), technology firms such as Facebook and Microsoft, as well as academic and civil society organizations.

While coordinated policymaking can promote economies of scale and lower costs, revenues must also be considered. Funding for marginalized communities' connectivity must come from government grant and foreign aid programs. In the US, the public interest mandate has yet to provide a consistent basis for action,[27] and, in turn, funding.

A potentially more potent and direct framework is a rights-based approach. As asserted by Vint Cerf in 2012, the appropriate right is not Internet access itself, but a more fundamental right to information.[28] The UN's Declaration of Human Rights, Article 19, provides the basis for this, stating: "Everyone has the right to freedom of opinion and expression;

this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers." Underpinned by a justice-based approach,[6] policies designed for a rights-based regime avoid majority versus minority tradeoffs, and instead provide justification for funding and designing technologies that ensure information is equally available to all.

A rights-based approach also supports more consistent sources of funding for connecting marginalized communities. Such large-scale change is needed to overcome the fragmented and program-oriented approach to funding connectivity. Currently, inefficient investments are made in thousands of aid programs and community development organization efforts to provide connectivity as a means of supporting improved healthcare, access to nutritious food, or to enable children to do their homework. Instead, providing consistent funding for connectivity will support technical experts' efforts to efficiently provide service to both communities and their social service providers.

A single policy, organizational design, or technology cannot, alone, solve the complex challenges of connecting marginalized communities. However, a more holistic approach, incorporating all three dimensions, is likely to bring about more scalable and lasting solutions.

Three cases, examining connectivity challenges in diverse contexts, including among Native Americans living in tribal lands, as well as Syrian and Congolese refugee camps in Jordan and Rwanda, respectively, demonstrate the breadth of the problem. Although each context presents unique challenges, this analysis has emphasized their commonalities—principally that regardless of national institutional context, marginalized communities' connectivity problems persist. Emphasizing commonalities—such as the need for technologies that can be easily deployed, sometimes for temporary service, and in locations with limited access to power—can provide the necessary scale for sustainable solutions. Similarly, the cases present both unique and common organizational challenges, such as the fundamental role of connectivity in dependent services.

Finally, policy issues play an important role in insuring efficient and effective approaches. The cases highlight the role of policies in shaping technologies as well as providing stable and sufficient funding. Both domestic and international aid programs impact connectivity. In the former, consistent funding of connectivity in wealthy nations will help insure consistent connectivity, with wide-ranging benefits across a range of public services, including education and healthcare. In the latter, if just a portion of the $1.4 and $2.1 billion US dollars provided to UNHCR and WFP, respectively, in 2017,[29,30] could be earmarked for connectivity-focused goals, we could gain significant ground in keeping marginalized communities connected.

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