

TOWARD ACCESS EQUALITY: BRIDGING THE DIGITAL DIVIDE

Before the Internet era, telephone penetration was the measure of U.S. progress in securing universal access to all its citizens (access to affordable telephone service). The telephone referred to herein was obviously the “landline”, which evolved from analog to digital throughout the second half of the 20th Century. By the mid-1990s, the notion of universal access had included access to computers and modems. Today, it encompasses a spectrum of Information and Communication Technology (ICT) devices, including desktop, laptop, handheld, wearable, and airborne devices, all of which connect to the Internet. And the term we use now to refer to the level of access pertinent to today’s needs is Broadband Access.

In 1995, a report was published by the National Telecommunications and Information Administration (NTIA) revealing that U.S. rural areas and central cities (the densely populated parts of metropolitan areas) have a lower share of universal access than the country’s urban areas. Along with other surveys, the report showed that there is also access inequality among communities of various incomes, races, ages, education level, gender, and places of residence [1]. The term Digital Divide was coined to refer to the economic, social, educational, and knowledge inequalities between those who have access to ICT and those who do not have the same.

Although access to the Internet has been rising globally over the past two decades, current studies show a persisting digital divide, not only in the U.S. but also worldwide. The divide exists in most countries at least, and half the world’s population is without access. There are also inequalities among countries, if compared to each other [2]-[3]. Factors such as economy, infrastructure, technology, telecom market, regulations, computer literacy, and the level of democracy play roles in determining the nature of the divide in a given country. Overall, and over the years, the global divide has remained relatively stable although some unevenness subsided. The variety of development levels, usage, device capabilities, and connection qualities led some researchers to disapprove of the binary nature of the “digital divide” metaphor and replace this term with the multidimensional notion of “digital inequality” [4].

Individuals and communities without access to the Internet, or with limited access, cannot have the same economic, social, and political rights as those who have easy and fast access. Broadband access has become important for selling and buying stuff, applying for jobs, education and research, online banking, accessing healthcare information, government services, engaging in civic activities, entertainment, and for many other aspects of modern life. Probably more than any other event in the last 30+ years, the COVID-19 pandemic has underscored the impact of the digital divide and inequality on humanity [5]. One of the sectors affected is education, from pre-school to higher and graduate education. Virtual education could be widening the digital



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divide since a certain level of income is necessary to acquire ICT devices and subscribe to broadband access. Those who are disadvantaged, in part because of the divide, do not have such an income. They are prone to face the same dilemma in employment, healthcare, in providing for their families, and in other areas.

The technology needed to close the digital divide has been around for many years [6]-[7]. The main challenges are poor infrastructure in areas where access is absent or limited, and in the cost of extending the reach of the Internet to those who cannot afford it. This will remain the case for as long as the same business models, policies, and regulations are in place. Many of the world’s

rural communities have started to pursue solutions that do not rely on traditional service providers. Based on their own resources, they build Community Networks which are playing an important role today in bridging the digital divide. These networks are collectively owned and run by local citizens and/or organizations for the benefit of their respective communities. They are built using commodity wireless hardware (mostly Wi-Fi based), locally-funded fiber links, heterogeneous architectures, and utilizing the open unlicensed spectrum [8]. Despite the fact that some State laws are not friendly to these networks, about three million people have access to the Internet through community networks in the US alone.

On the other hand, rural utility companies in some countries are launching fiber-based broadband local infrastructures of their own. These are proven to be cost-effective and are offering access at reasonable and declining prices [9].

Digital inequality is not limited to rural and remote areas or to developing/poor economies. It exists also in some of the largest growing and emerging economies where adequate infrastructures are not available. Cases in Africa and rural China have been studied in this regard and innovative solutions are possible, whether for green-field scenarios or for others where legacy-copper infrastructures may be upgraded [10].

Regardless of the context within which the digital divide and inequality are discussed, policy changes are instrumental since technologies are readily available and since local, national, and international investments in infrastructures are possible. Several initiatives are living examples in this regard worldwide. Policies that enable and empower community networks and city-based networks, encourage service providers to extend their reach to disadvantaged areas, and provide businesses with incentives to pay for employee’s broadband access have been proposed and can make a lot of difference [11].

Attending to the digital divide and inequality is not only a social, economic, and political necessity; it is a moral responsibility. It is incumbent upon us as individuals, societies, governments, and world organizations to take part in the quest

to close the divide for good. The IEEE Communications Society can take a lead in increasing the awareness of this problem and its impact on humanity. Many of us can take part in proposing technical and economic solutions. We are a community of researchers, engineering practitioners, and professionals of various kinds who are deeply involved in Internet matters. This makes us particularly relevant to turning the COVID-19 crisis to an opportunity to accomplish digital equality!

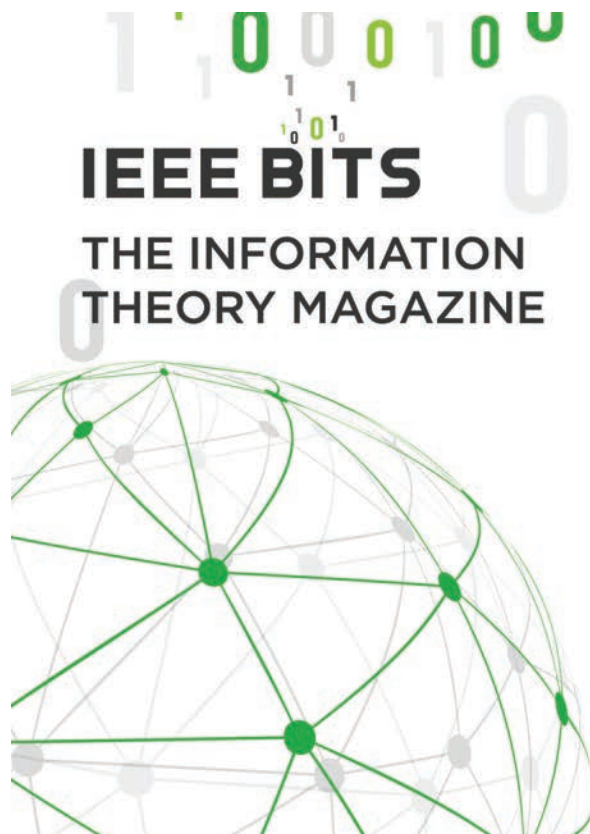
REFERENCES

- [1] "Falling through the Net: A Survey of the "Have Nots" in Rural and Urban America," a report of the United States National Telecommunications and Information Administration (NTIA), Department of Commerce (DoC), Washington, D.C., July 1995.
- [2] K. E. Skouby and I. Williams (Editors), *Handbook on ICT in Developing Countries: 5G Perspective*, River Publishers, 2017, electronic ISBN: 9788793379923, print ISBN: 9788793379916.
- [3] K. E. Skouby et al. (Editors), *Handbook on ICT in Developing Countries: Next Generation ICT Technologies*, River Publishers, 2019, electronic ISBN: 9788770220972, print ISBN: 9788770220989.
- [4] E. J. Schweitzer (Contributor), "Digital divide," Encyclopædia Britannica, November 23, 2015, <https://www.britannica.com/topic/digital-divide>, last accessed on November 15, 2020.
- [5] T. S. El-Bawab, "The Outlook for Networks in the Third Decade of the 21st Century," *IEEE Commun. Mag.*, vol. 58, no. 10, Oct. 2020, pp. 6–7.
- [6] M. Zhang and R. S. Wolff, "Crossing the Digital Divide: Cost-Effective Broadband Wireless Access for Rural and Remote Areas," *IEEE Commun. Mag.*, vol. 42, no. 2, Feb. 2004, pp. 99–105.

- [7] R. Tongia, "Connectivity in Emerging Regions: The Need for Improved Technology and Business Models," *IEEE Commun. Mag.*, vol. 45, no. 1, Jan. 2007, pp. 96–103.
- [8] L. Navarro et al., "Advances in Wireless Community Networks with the Community-Lab Testbed," *IEEE Commun. Mag.*, vol. 54, no. 7, July 2016, pp. 20–27.
- [9] L. Laursen, "Rural CO-OPs Deliver High-Speed Internet: Long-range Wi-Fi and a Cooperative Approach May Help Close the Digital Divide," *IEEE Spectrum*, vol. 56, no. 6, June 2019, p. 8–9.
- [10] M. Ruffini et al., "Connected OFCity Challenge: Addressing the Digital Divide in the Developing World," *J. Opt. Commun. Netw.*, Optical Society of America, vol. 11, no. 7, July 2019, pp. 354–61.
- [11] R. Seamans et al., "Three Policies to Address the Digital Divide," *Forbes*, May 7, 2020, <https://www.forbes.com/sites/washingtonbytes/2020/05/07/three-policies-to-address-the-digital-divide/?sh=5dc986986014>, last accessed on Nov. 20, 2020

BIOGRAPHY

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