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Bridging the digital infrastructure gap: Policy options for connecting Filipinos

Mary Grace Mirandilla-Santos

Information and communications technology (ICT), including the internet, disrupts the public's way of doing business (Albert et al. 2018; Dadios et al. 2018). An integral part of digital infrastructure is the internet, a "network of networks" where a series of connected technologies route data from a sender to its destination. Different network segments (e.g., international link, backbone, middle mile, and last mile) make up the value chain of internet connectivity (Figure 1). The *international link*, consisting of international submarine cable systems, cable landing stations, or satellite facilities, connects the country to internet facilities in other countries. The *backbone* connects a country's major regions, while the *middle mile* connects the backbone to the core networks of internet service providers in the provinces, cities, or municipalities. The *last mile* is the final segment of the network that connects to the end-users.

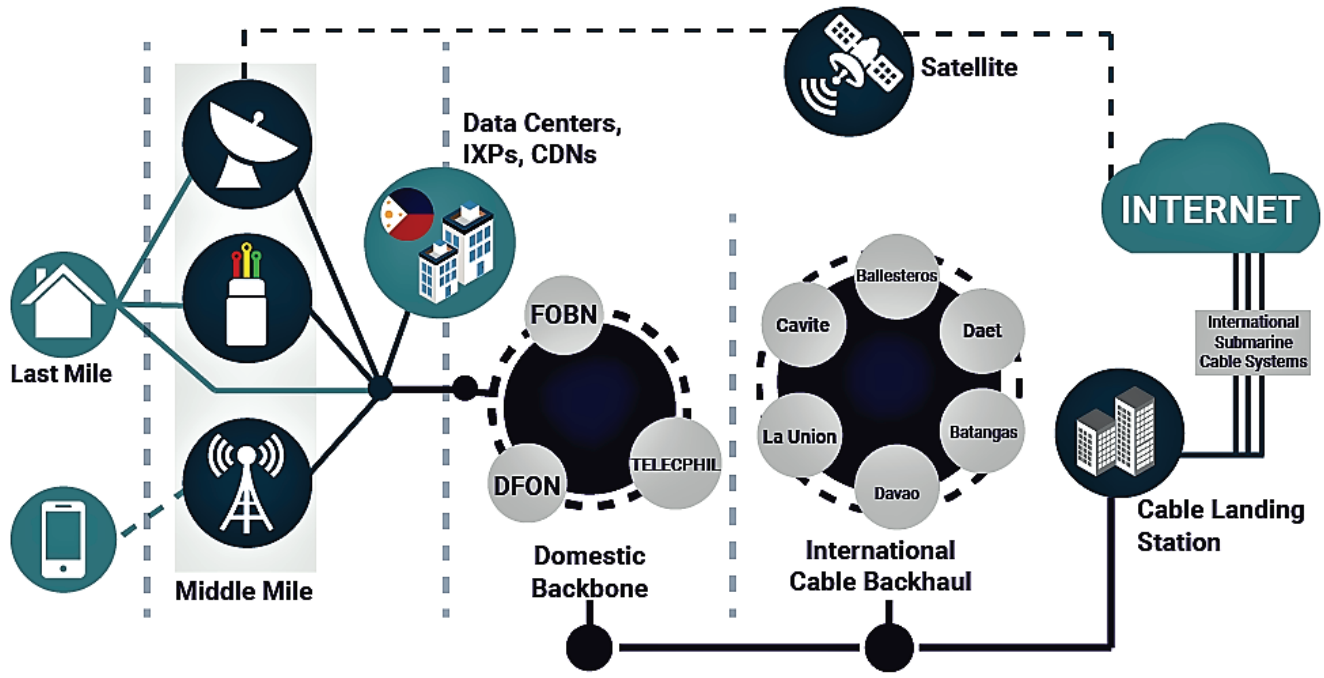
Increasing internet penetration can improve economic growth and income levels (Qiang and Kimura 2009; Ericsson 2014; World Bank 2016). Katz and Callorda (2018) showed that the economic benefits of ICT are maximized once broadband infrastructure reaches critical mass. In developing countries, where mobile broadband is more available, internet penetration contributes 1.5 percent to gross domestic product growth.

Salient Points:

- *Cellular mobile services are Filipinos' top means of connecting to the internet. However, this may be a matter of availability rather than choice, as investments have focused mainly on mobile technology.*
- *The government needs to introduce and enforce a policy that promotes accessibility, affordability, and quality of the internet. Outdated laws have stifled the growth of internet service providers. Hence, the government should remove regulatory barriers and expand market opportunities to enable players to invest, build, and innovate.*
- *Government investment in digital infrastructure must be targeted and limited to network segments and areas where market fails to deliver.*

Access to digital services depends on the reliability, affordability, and security of the digital infrastructure. This became more apparent during the COVID-19 pandemic as inadequate ICT infrastructure has widened the digital divide. The Organisation for Economic Co-operation and Development (2001, p.3) defines digital divide as "the gap between individuals,

Figure 1. How the Philippines connects to the internet



IXPs = internet exchange points; CDNs = content delivery networks; FOBN = fiber optic backbone network; DFON = domestic fiber optic network; TELECPHIL = Telecom Infrastructure Corporation of the Philippines
Source: World Bank (2020, p.32) with author's edits

households, businesses, and geographic areas at different socioeconomic levels with regard to both their opportunities and access to ICT and use of the internet for a wide variety of activities".

Using data from the National ICT Household Survey (NICTHS) conducted by the Department of Information and Communications Technology (DICT) and the Philippine Statistical Research and Training Institute, this *Policy Note* analyzes the infrastructure gap and digital divide from a supply-constrained lens. Specifically, this study looks at the level of access of communities (barangays) and households to ICT infrastructures and services. Finally, it presents policy solutions and recommendations on addressing the issues and challenges that hinder access to reliable and affordable internet connectivity.

Community access to ICT infrastructure

Cellular signal

The NICTHS revealed that cellular signal reaches 92 percent of surveyed barangays[1], with 3G technology still prevalent in rural areas. Despite near-universal access to electricity, some communities have low access to telecommunication towers, fiber optic cable, and free Wi-Fi (Table 1).

Over 90 percent of the barangays reported having a 24/7 electricity supply. Likewise, about 91 percent of them have a cellular signal, with urban barangays having 10 percent more cellular signal coverage than rural communities. The Bangsamoro Autonomous Region

[1] In this paper, the term "barangays" refers to the communities surveyed under the NICTHS, unless otherwise indicated.

Table 1. Access to electricity, ICT services, and digital infrastructure of barangays in the Philippines

ICT Service and Provider	Urban (%)	Rural (%)	Total (%)
Electricity	99.6	97.7	98.5
Cellphone signal	97.8	88.1	92.1
4G signal	82.6	43.8	60.6
3G signal	15.2	40.6	29.6
Telecommunication operator	72.5	42.0	54.5
Telecommunication tower	61.3	18.9	36.3
Internet service provider	92.1	71.1	79.6
Free Wi-Fi (public and private)	23.9	4.1	12.2
Fiber optic cable	53.3	11.9	28.8

ICT = information and communications technology; 4G = fourth generation; 3G = third generation
Source: DICT (2019)

in Muslim Mindanao (BARMM) has the lowest coverage, with only 68.4 percent of barangays being reached by cellular signals. Meanwhile, other regions have at least 80 percent of their barangays with cellular signal coverage.

Telecommunication tower

Cellular mobile services operate on various radio frequencies, such as second generation (2G), third generation (3G), and fourth generation (4G). These frequencies differ in how they provide coverage and capacity (amount of data they can carry). A lower frequency spectrum has a wider coverage area and better in-building penetration, while a higher frequency covers shorter distances, thus, requiring more cell sites to achieve greater coverage.

Although designed primarily for voice communications, the global system for mobile (GSM) communication, or the 2G of mobile technology, was the first to support data services. It can cover large distances and with little degradation of service through obstacles. However, it can provide data speeds of up to 200 kilobits per second (Kbps) only. The 3G was the first mobile technology designed primarily for internet connectivity. It can deliver faster speeds, initially at 300 Kbps but eventually reaching 42 Mbps and beyond. Finally, 4G was the first completely packet-based mobile technology based on the internet protocol. From the outset, 4G, also known as long-term evolution or LTE, was designed to support speeds of up to 100 Mbps. However, increasingly scarce spectrum resources make it difficult to procure enough frequency bands to support today's bandwidth requirements (GSMA 2017).

Depending on the radio frequency spectrum used, the absence or the limited number of telecommunication towers may cause end-users degraded or poor cellular signals.

Only a third (36%) of the barangays have a telecommunication tower (for transmitting cellular signals) located in their community, with each of these barangays having an average of two towers. Urban barangays (61.3%) have three times more telecommunication towers than rural communities (18.9%). Almost all (95%) of these towers are privately owned.

Despite the absence of a telecommunication tower in their vicinity, some barangays have access to a cellular signal. A cell site may be installed in alternative

structures, such as rooftops of tall houses and buildings, to complement the coverage provided by a telecommunication tower. However, this is usually possible in urban areas where such structures are available.

The 4G network signal reaches 61 percent of all barangays, with urban barangays (83%) having about twice as much access as rural communities (44%).

Meanwhile, 3G signal is still prevalent in rural areas. As a result, more rural barangays experience 3G and 2G as the highest signal available in their communities compared to urban areas. The Bicol region (48%) has the highest number of barangays with 3G as the highest cellphone signal available, followed by Zamboanga Peninsula (46%) and Eastern Visayas (44%) (Figure 2).

Free Wi-Fi

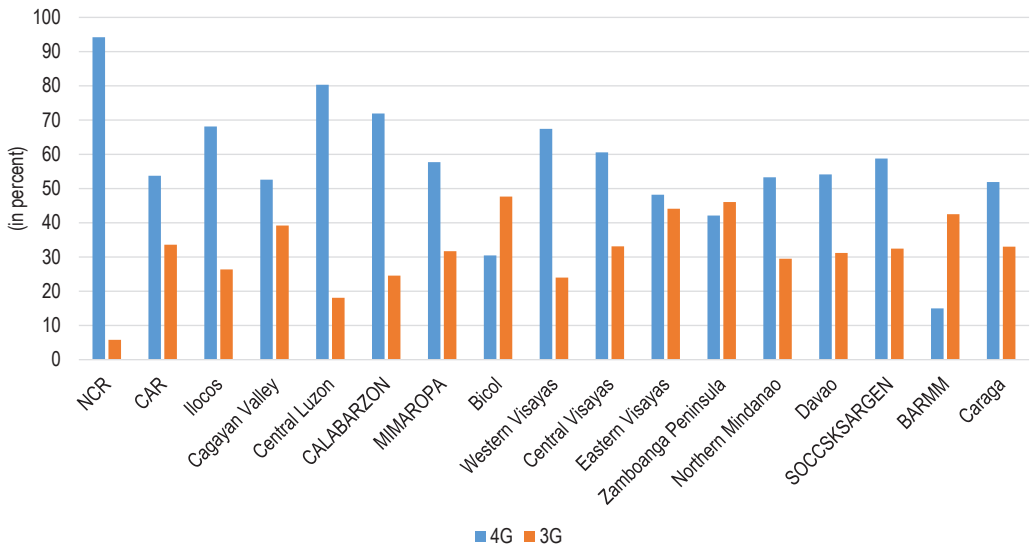
Only 12 percent of all the barangays have access to free Wi-Fi, of which 70 percent is publicly provided, while 32 percent is made available by private entities. In addition, less than 2 percent of the barangays without a telecommunication operator have access to free public Wi-Fi.

These results suggest that the government's Free Wi-Fi for All program is still far from achieving its goal to provide internet access nationwide. The relatively low number of free Wi-Fi sites is a symptom of the larger ICT infrastructure gap. In the past years, service providers reported being unable to deploy their committed sites due to the absence of middle-mile facilities, which brings bandwidth from the nearest backbone facility to the last mile.

Fiber optic cable

About 29 percent of barangays have a fiber optic cable (FOC) network installed in their communities, 53 percent of which are in urban areas, while 12 percent are in rural. FOC is a wired technology that offers the highest bandwidth and reliability. However, fiber is primarily concentrated in urban centers as it is expensive to deploy in areas with lower population density (Mirandilla-Santos et al. 2018).

Figure 2. Highest cellphone signal available in barangays per region



NCR = National Capital Region; CAR = Cordillera Administrative Region; CALABARZON = Cavite, Laguna, Batangas, Rizal, Quezon; MIMAROPA = Mindoro (Occidental and Oriental), Marinduque, Romblon, Palawan; SOCCSKSARGEN = South Cotabato, Cotabato, Sultan Kudarat, Sarangani, General Santos City; BARMM = Bangsamoro Autonomous Region in Muslim Mindanao; 4G = fourth generation; 3G = third generation
Source: DICT (2019)

Aside from telecommunication companies, some cable television operators also offer fiber broadband. However, existing policies, such as the Public Telecommunications Policy Act of 1995 or Republic Act (RA) 7925, restrict non-telecommunication companies from building and operating middle-mile facilities. This has limited the number of market participants that can invest and participate in building the country's broadband network.

Internet service providers

One in five (20%) barangays have no internet service providers (ISPs). All regions, except Ilocos, have more ISPs in urban than in rural areas (Figure 3). Twenty-two (8%) barangays in the National Capital Region (NCR) do not have ISPs.

Globe Telecom and Smart Communications are the only mobile network operators in the country, servicing 65 percent and 52 percent of barangays, respectively. Meanwhile, the Philippine Long Distance Telephone Company operates in 31 percent of barangays, while other ISPs are present in only 6 percent of these communities.[2]

The unavailability of ISPs in 22 barangays in a densely populated metropolitan center like NCR suggests a digital divide even within cities. In addition, income levels in some barangays are likely not sufficient for households to subscribe regularly to broadband services and support an ISP's return on investment (Kenna 2015).

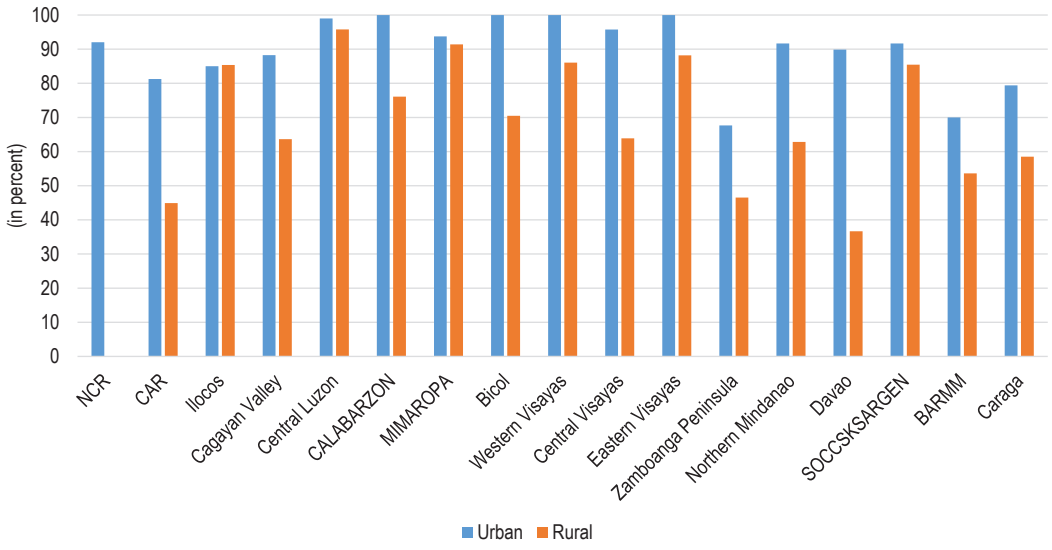
Household access to ICT infrastructure

Electricity

Based on NICTHS data, about 95 percent of households have access to electricity, consistent with the NICTHS results for communities and the 2020 Annual Poverty Indicator Survey of the Philippine Statistics Authority.

[2] The survey question allowed multiple ISPs in the response. "Other" ISPs refer to those other than PLDT, Smart, and Globe.

Figure 3. ISP presence in the barangays per region



ISP = internet service provider; NCR = National Capital Region; CAR = Cordillera Administrative Region; CALABARZON = Cavite, Laguna, Batangas, Rizal, Quezon; MIMAROPA = Mindoro (Occidental and Oriental), Marinduque, Romblon, Palawan; SOCCSKSARGEN = South Cotabato, Cotabato, Sultan Kudarat, Sarangani, General Santos City; BARMM = Bangsamoro Autonomous Region in Muslim Mindanao
Source: DICT (2019)

Computer

Only a quarter (24%) of households own a computer, with laptop (66%) as the most common type used, followed by tablet (39%) and desktop (25%). Of households that do not have a computer, 50 percent do not use computers at all, while 36 percent access computers through computer shops and 11 percent in school or at work.

Cellphone

Similarly, a quarter of households own a communal cellphone, 44 percent of which are urban and 56 percent rural. This supports the NICTHS findings that cellphones are the predominant device used by Filipinos, with 75 percent of individuals owning at least one cellphone and 79 percent having used one in the three months preceding the survey.

Internet

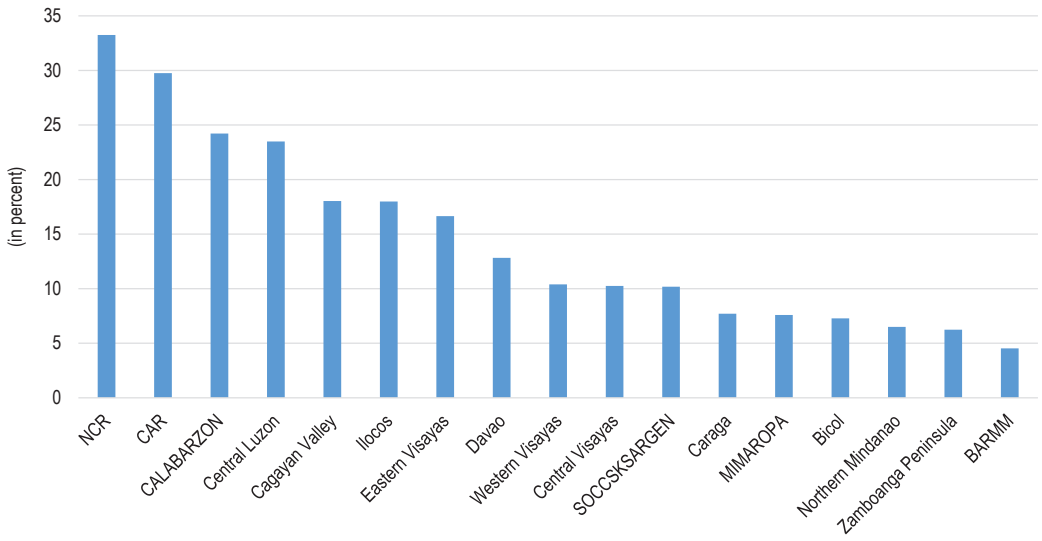
Only 18 percent of households have an internet connection, much lower than data from other reports (e.g., International Telecommunication Union 2018). NCR has the highest proportion of these households at 33 percent, while BARMM has the lowest at 4 percent (Figure 4).

On average, Filipino households spend PHP 1,280.59 monthly on internet connection (Figure 5), with higher spending in urban (PHP 1,406.99) than rural areas (PHP 1,008.33). Comparing the indicative monthly family income of poor to low-income families, Albert et al. (2018) suggested that internet connectivity remains expensive in the Philippines.

The average monthly spending for all types of internet connections is PHP 295. Urban households spend 50 percent higher (PHP 395) than their rural counterparts (PHP 192) for internet subscriptions.

A majority of households that do not have an internet connection cited the high cost of subscription (52%) as the primary barrier to access, followed by high price of

Figure 4. Households with internet connection per region



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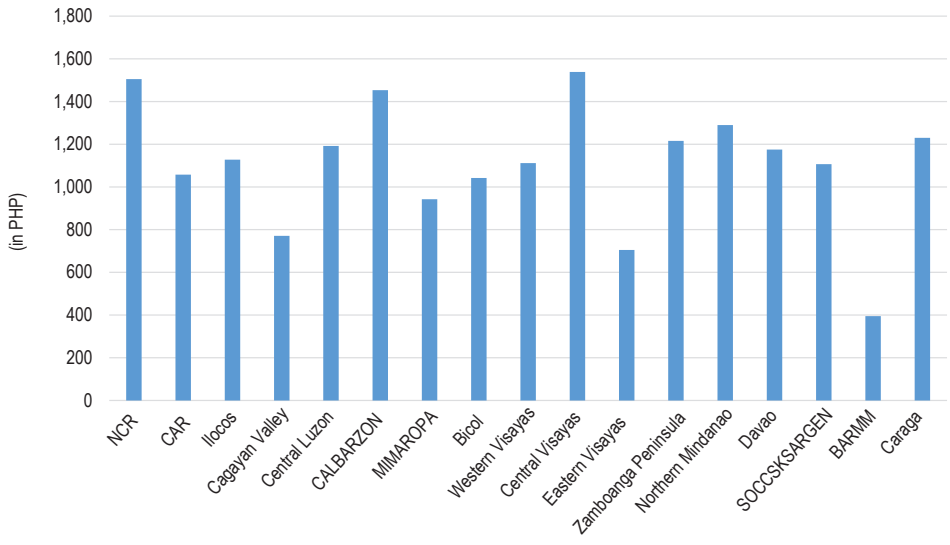
Source: DICT (2019)

Figure 5. Average monthly cost of internet connection at home per region



PHP = Philippine peso; NCR = National Capital Region; CAR = Cordillera Administrative Region; CALABARZON = Cavite, Laguna, Batangas, Rizal, Quezon; MIMAROPA = Mindoro (Occidental and Oriental), Marinduque, Romblon, Palawan; SOCCSKSARGEN = South Cotabato, Cotabato, Sultan Kudarat, Sarangani, General Santos City; BARMM = Bangsamoro Autonomous Region in Muslim Mindanao
Source: DICT (2019)

equipment (33%) and unavailability of internet service in their area (19%). Thus, these results suggest two distinct access barriers: cost and availability.

Individual access

About 47 percent of Filipinos used the internet in the three months preceding the survey through a mobile device (85%), a desktop (30%), and a laptop (19%). This is consistent with NICTHS results indicating the pervasiveness of a cellphone signal. Internet usage among individuals is highest in NCR (66%), Luzon (54%), and urban areas (57%).

Policy recommendations

Despite the widespread cellphone signal coverage and mobile device ownership, internet usage in the country remains low owing to poor and expensive internet connectivity and inadequate digital infrastructure, especially outside NCR.

The NICTHS results reflect the impact of analog-era policies and laws, such as the Public Telecommunications Policy Act, the Radio Control Law, and the Public Service Act. The Radio Control Law requires a legislative franchise for the use of radio spectrum, limiting the providers who can set up wireless internet, while the Public Service Act imposes foreign ownership restrictions on telecommunications. Public policies must reflect the needs and requirements of modern-day digital technologies, such as the internet, which can be put up and used by community networks and non-telco ISPs, if policy allows them to.

Government investment in digital infrastructure must target network segments and areas where the market fails to deliver, as shown in NICTHS findings. The government may also consider investing in areas where the private sector has difficulty competing and making a profit. Moreover, the government may support passive

Photo from DICT - Luzon Cluster 3 (https://www.facebook.com/dictlc3)

infrastructure such as an operator-neutral utility corridor accessible to any service provider.

However, the most critical role of the government is to introduce and enforce policies to address the accessibility, affordability, and quality of the internet. Outdated laws have stifled the growth of ISPs by restricting network-building to enfranchised telecommunication companies only. Therefore, the government should remove regulatory barriers and expand market opportunities to allow players to invest, build, and innovate, regardless of size, ownership, and technology. Since the digital infrastructure is a combination of different technologies, not just mobile, laws must also remove biases for specific technologies. For example, RA 7925 promotes local exchange or landline telephones and allows for cross-subsidy to expand landline installation across the country. This has not changed since 1995 despite the emergence of new digital technologies. Radio spectrum is also assigned only to telcos and mobile network operators.

The NICTHS results should inspire immediate action. Fast-tracking the passage of certain laws pending in Congress, such as the Open Access in Data Transmission Act or House Bill (HB) 8910, can help address the digital infrastructure gap. HB 8910 allows more players to build broadband networks by simplifying the market entry process and promoting infrastructure sharing. The Radio Control Law and the Public Service Act should also be amended to remove or ease market entry restrictions.

The executive and legislative branches should work together to pass these laws with a sense of urgency.

These forward-looking bills can address the demands of the digital age, make the country competitive, and use ICT to achieve economic recovery, coupled with sustained, inclusive wealth creation.

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Contact us

Address: **Research Information Department**
Philippine Institute for Development Studies
18/F Three Cyberpod Centris - North Tower
EDSA corner Quezon Avenue, Quezon City
Telephone: (+63-2) 8877-4000
Email: publications@mail.pids.gov.ph
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Mary Grace Mirandilla-Santos is a consultant at PIDS. She is an independent ICT policy researcher, vice president for policy at the Internet Society Philippines Chapter, and research fellow at LIRNEasia. The author thanks Angelo Gutierrez, Ranna Pintor, and The Asia Foundation-Philippines for their invaluable contribution to this work. The views expressed are those of the author and do not necessarily reflect those of the PIDS or any of the study's sponsors.