AUGUST 2021

DISCUSSION PAPER SERIES NO. 2021-20

Expanded Data Analysis and Policy Research for National ICT Household Survey 2019

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August 2021

Abstract

The National ICT Household Survey (NICTHS), conducted by the Department of Information and Communications Technology (DICT) in partnership with the Philippine Statistical Research and Training Institute (PSRTI), is the first-ever household survey in the country focusing on ICT. The NICTHS is one of the strategies of DICT to jumpstart the generation of official ICT statistics critical for monitoring ICT development, particularly the expansion and diffusion of digital technologies, as well as for national development planning and policy-making. The NICTHS has a wealth of information describing households' ICT equipment and individual uses of ICT (information technology, fixed-line and mobile Internet). This study analyzes the results of the NICTHS to help the government in developing and evaluating ICT policies and strategies, including measures to address issues such as the digital divide, and in assessing ICT developments in the country compared to that of its peers. The study looks into ICT access and use as they pertain to living conditions (and livelihood) of households, skills of individuals (particularly in mobile telephony and the Internet) and the sharing of equipment within a household (including gender issues), that in turn, can provide clues on the potential impact of increased ICT adoption in the country on productivity, growth, jobs, and inclusion.

Keywords: ICT, infrastructure, inclusion, gender

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1. Introduction

The rapid development of information and communications technology (ICT) and other emerging, frontier technologies of the Fourth Industrial Revolution (FIRe) are disrupting the way people do things, especially in interconnecting, in accessing and sharing information, and in doing business (Dadios *et al*. 2018; Albert *et al*. 2018). The Internet, social media, and various ICT tools have provided people with the means to transmit, share and exchange data faster, and easier. Further ICT is considered a vital engine for accelerating economic growth and productivity as it fosters innovation, increases competitiveness. Digital technologies give key support to firms across various economic sectors and drastically changing business models, including the production and consumption of various products and services. Platforms are providing a mechanism for consumers and producers to interact. The nature of work is also drastically changing, not only in terms of effects of technology on jobs, but also in terms of the skills businesses require for its workforces.

Although digital technologies have grown by leaps and bounds, the broader development benefits from using ICT has both been an opportunity and a challenge for developing countries like the Philippines. With robust and broad-based economic growth that the Philippines has had in the past decade prior to the onset of the novel corona virus (COVID-19), the country requires reliable, accessible, and affordable ICT infrastructure to sustain economic activity, encourage investments, and lay the ground for further innovation. There is recognition that amid the new normal, i.e. the way of life in the wake of COVID and the likely post-COVID world, ICT is going to be more mainstreamed.

While a lot of social good and new wealth is being created with expanded use of ICT, there are also other likely unintended consequences, including technological unemployment, the rise of monopolies and oligopolies, increase in income inequality, erosion of privacy, problems on cyber-security and cyber sabotage, data fraud (Albert *et al*. 2018). Policies need to be formulated and implemented to maximize digital dividends of ICT, and ensure that these dividends are shared equitably and made more inclusive, otherwise current inequalities and other socio-economic problems are likely to exacerbate.

With the ever-growing importance of ICT and the need for evidenced-based policies, seven indicators on ICT are among the 232 global indicators for monitoring of the Sustainable Development Goals (SDGs), viz., (i) Proportion of schools with access to the Internet for pedagogical purposes; (ii) Proportion of schools with access to computers for pedagogical

* This research was commissioned by the Department of Information and Communications Technology (DICT). The authors wish to thank the DICT for the opportunity to collaborate and for their inputs to the study.

[1] The first two authors are senior research fellow, the third author is research fellow; the fourth author is a consultant; the fifth author is supervising research specialist; the sixth author is research specialist; the seventh and eighth authors are research analysts, all from the Philippine Institute for Development Studies (PIDS). Views expressed are those of the authors and do not necessarily reflect the position of the PIDS.

purposes; (iii) Proportion of youth/adults with ICT skills, by type of skills; (iv) Proportion of individuals who own a mobile telephone, by sex (v) Percentage of the population covered by a mobile network, broken down by technology; (vii) Fixed Internet broadband subscriptions, broken down by speed; (vii) Proportion of individuals using the Internet (UN 2020).

While the country has adopted the Philippine Digital Transformation 2022 aimed at transforming the government into a digital platform providing transparent and accountable governance, efficient operations, direct citizen engagement, and innovation, there is a general lack of availability of official statistics on ICT that has resulted in an incomplete picture of on the access and use of ICTs, as well as the full impact of the ICT sector in socio-economic development (Astrologo 2018).

Although some questions on ICT are being asked by the Philippine Statistics Authority (PSA) in its household and establishment surveys, hitherto, there has not been a stand-alone census/survey on ICT statistics. Data on access and use of ICT across the population are often scant if not unavailable from official data sources. The scarcity of information has also been the cause for lackluster scores of the country in international benchmarking exercises as these depend mostly on available indicators and data.

Among these seven SDG indicators identified earlier, only one is available, the proportion of population covered by a mobile network, by technology. Even for the Philippine Development Plan (PDP) Results Matrix, of the required 14 indicators, only three are available. For the ITU's Global ICT Development Index, which requires 11 indicators, only five are available. Among the 61 indicators that are considered part of the ITU's Core List of ICT indicators, only 25 are available.

A study commissioned by the International Telecommunication Union (ITU), a specialized agency of the United Nations for ICT, recommended that data gaps on ICT in the Philippines need to be addressed especially at the household level to better track performance of the ICT sector and that measurements and methodologies be developed to establish the linkages of ICT access with socio-economic development.

The National ICT Household Survey (NICTHS) is one of the strategies to jumpstart the generation of official ICT statistics critical for monitoring ICT development, particularly the expansion and diffusion of digital technologies, as well as for national development planning and policy-making. The NICTHS conducted in 2019 by the Department of ICT (DICT) in partnership with the Philippine Statistical Research and Training Institute (PSRTI) is the first-ever household survey in the country focusing on ICT. The survey collected baseline information on the access and usage of ICT products, services and infrastructures by communities, households and individuals. It involved interviewing over 40 thousand households, supplemented by information gathered from barangay/community leaders on the presence of telecommunication services in the surveyed areas.

This study, which aims to extensively analyze the results of the 2019 NICTHS, is important to help the government in developing and evaluating ICT policies and strategies, including measures to address issues such as the digital divide, and in assessing ICT developments in the country compared to that of its peers. The NICTHS has a wealth of information describing households' ICT equipment and individual uses of ICT (information technology, fixed-line and mobile Internet). The study can help describe the impact of ICT on the living conditions (and livelihood) of households, the skills of individuals (particularly in mobile telephony and the

Internet), the ownership of ICT devices, and gender issues, that in turn, can provide clues on the potential impact of increased ICT adoption in the country on productivity, growth, jobs, and inclusion.

In aiming for ICT development and digital transformation in the country, the following are relevant questions and areas of interest for policymakers.

- What is the state of ICT access, use and infrastructure in the community, household and among individual Filipinos?
- Does ICT connectivity promote inclusiveness, e-livelihood and e-entrepreneurship, and online protection in the country?

Given the technology divides across various segments of society, the study can identify policy issues that are most promising for inclusive development especially for the new normal, and for reducing risks that threaten progress. The study is also helpful in identifying the role of government in the era of rapid advances in digital technology (and its use).

This report is structured as follows. The next chapter provides a literature review and discusses the framework for analysis adopted in this study. Empirical findings from the NICTHS are discussed in Chapters 3 to 5. Chapter 3 focuses on how ICT can be used for promoting more innovation and inclusion. The following chapter discusses ICT in the context of Gender, e-Livelihood and e-Entrepreneurship. Chapter 5 discusses digital infrastructure development. The final chapter provides a summary of the study findings, including policy implications, conclusions and ways forward.

1.1. About the 2019 NICTHS

The 2019 NICTHS is the first national ICT survey in the country. It is focused on gathering data on access, and usage of ICT products, services and infrastructures by communities, households and individuals. Specifically, it aims to:

- Gather ICT data at the household and individual level to support the monitoring of performance indicators in the DICT plans, PDP Results Matrix, the SDGs and international benchmarking indices;
- Gather critical data on ICT demand toward improvement of public service delivery, as well as growth of potential markets in the digital economy (i.e., e-commerce);
- Provide a national baseline and regional estimates for core ICT household indicators.

The survey is designed to collect data at the community, household and individual levels. The target respondents are 42,816 households; 2,528 barangays; and a randomly selected household member aged 10 to 74 years old for every selected household.

There are three survey instruments used, namely, Community Questionnaire, Household Questionnaire, Individual Questionnaire. The Community Questionnaire is intended to assess the barangay's current ICT infrastructure and equipment. The Household Questionnaire focuses on the household's ICT access and use. It includes questions on the ICT devices and services that the household has and usage of these devices and services. The Individual Questionnaire is used to capture the individual's knowledge, access and usage of ICT. It also includes questions about access to government websites and participation in e-commerce.

The survey's sampling design is based on the 2013 Master Sample (MS) of the PSA. The MS comprises 2,835 randomly selected geographical areas, called primary sampling units (PSUs), which are either barangays (villages) or combinations of barangays. The MS is intended to represent the total population of the Philippines, and to efficiently serve the needs of all PSA household surveys. The samples of households and persons for all household surveys are selected via a three-stage design: PSUs within the MS, then enumeration areas within the selected PSUs, and finally housing units within the selected enumeration areas. All households in the housing unit are enumerated, except for rare cases when more than 3 households reside in the housing unit, in which case, only a probability sample of three households are enumerated with each of the households in the housing unit given equal chance of being selected. The number of PSUs in the MS was chosen to be large enough to satisfy the needs of household surveys of the PSA such as the Labor Force Survey (LFS), the Family Income and Expenditure Survey and the Annual Poverty Indicator Survey, but this is larger than necessary for other household surveys. The MS was thus designed as a combination of four replicates, each of 709 PSUs, with each replicate being a national sample design. Smaller household surveys can consist of one, two, or three of the replicate samples as desired. The PSUs were selected within a set of strata using probability proportional to estimated size sampling, where the measure of size was the number of households in the PSU according to the 2000 Census of Population and Housing. Within each region, further stratification was performed using geographic groupings such as provinces and highly urbanized independent cities. Within each of these groups formed in a region, further stratification was done using proportions of strong houses and of households in agriculture in the PSUs and a measure of per capita income as stratification factors. Sample households across household surveys and survey rounds follow a rotation scheme, to minimize respondent fatigue. For the quarterly LFS, one rotation of the sample households are dropped every quarter and replaced by a new set of sample households from the respective sample areas. The PSA has re-designed the MS based on data from the latest censuses, and other information gathered by the PSA.[2]

For the NICTHS, sample households from the MS are interviewed using the household questionnaire. For each selected household in the NICTHS, an individual is randomly selected and interviewed using the individual questionnaire. The barangays where the NICTHS sample households reside are respondents of the community questionnaire. The DICT and PSRTI used Computer Aided Personal Interview (CAPI) with computer tablets for the conduct of the NICTHS.

1.2. Availability of Philippine ICT Statistics

Cross-country statistics on the ICT sector are being compiled, chiefly by the International Telecommunication Union (ITU). The ITU global database is a widely and highly referenced source of global and regional time series data such as on computer and Internet access and usage of households; telephony and broadband subscriptions; international bandwidth usage; and cellular and broadband network coverage. In addition, the UNCTAD report on digital economy (2019) suggests that statistical data on ICT employment and e-commerce are also available, though with limitations in some developing countries on the scope and disaggregation. There are also ICT-related statistics being collected by researchers, marketing

[2] This paragraph describing the PSA's Master Sample directly quotes from the technical descriptions in Barcenas (2004) and PSA (2018).

and consulting firms, creative outfits such as We Are Social, and Internet companies themselves such as Google, though data could differ depending on methodology.

However, not all indicators of ICT performance of countries, identified by international organizations like ITU, and the Philippine government itself, are available. Astrologo (2018) reports on the many data gaps in ICT statistics: as of 2017, less than half of the indicators needed for the ITU's Global ICT Development Index (45%) and the ICT core list of indicators (41%), and for monitoring the SDGs (14%) are available for the Philippines (**Table 1.1**). Under the Philippines' ICT-related programs (National Broadband Plan and National Cybersecurity Plan), all indicators are available, possibly identified along with the development of the program. Meanwhile, under the PDP 2017-2022, only three of the 14 indicators are available for monitoring results of national ICT strategies and reforms.

Table 1.1. Availability of ICT Statistics for the Philippines

Statistical Framework	Total No. of Indicators	Available (as of 2017)		Available from NICTHS (2019)	
		No.	%	No.	%
ITU Global ICT Development Index	11	5	45.5	3	27.3
ITU Core List of ICT Indicators	61	25	41.0	17	27.9
Sustainable Development Goals	7	1	14.3	3	42.9
National Broadband Plan	50	50	100.0	-	-
National Cybersecurity Plan	1	1	100.0	-	-
Philippine Development Plan 2017-2022	14	3	21.4	1	7.1

Source: Astrologo (2018); Update by the authors.

With the conduct of the NICTHS, additional ICT indicators have become available. Data for three additional indicators are available for the ITU Global Development Index, particularly, the percentage of households with a computer, the percentage of households with Internet access, and the percentage of individuals using the Internet. The ITU core list of indicators is a major reference used in designing the NICHTS instrument. Hence, data and indicators particularly referring to access and usage of ICT devices and the Internet at the household and individual levels have been collected in the NICTHS. Meanwhile, three available indicators are added to the list of ICT-related indicators in the SDGs (proportion of youth and adults with ICT skills, by type of skill; proportion of individuals who own a mobile telephone, by sex; and proportion of individuals using the Internet). As for the PDP results matrix, the NICTHS results can be used to monitor the indicator-Proportion of households with Internet connection.

The analysis of the NICTHS presented in this study can help provide inputs to the formulation, and implementation of ICT policies that aim for better development outcomes and wider digital dividends for Filipinos.

2. Literature Review and Framework for Analysis

2.1. Significance of ICT

New technologies have introduced radical changes to the industry and society historically. These periods of transformation have been referred to as industrial revolutions. The first three industrial revolutions involved steam and water power, followed by electricity and assembly lines, then computerization and digitization. The fourth industrial revolution, dubbed as Industry 4.0 or FIRe, is well underway, and much of the frontier technologies of the FIRe are on ICT (Dadios *et al*. 2018; Albert *et al*. 2018).

By enhancing economic and social interactions, ICT promotes access to information and opportunities, and improves efficiencies in business and daily life, thereby, increasing productivity and value-added, and enabling growth. According to Qiang *et al*. (2009), for every 10-percent increase in highspeed Internet connections, economic growth increases by 1.3 percent. Spiezia (2013) posits that increased GDP growth and country-specific global competitiveness can be primarily attributed to growth rates in ICT investment.

Technologies of the FIRe, including ICT innovations, are in the process of transforming the economic landscape as new business models, new products and services, and new sources of economic value are emerging (Dadios *et al*. 2018). The results of this transition are already visible across the world: in 2016, the global digital economy was worth $11.5 trillion, or 15 percent of the world's GDP, and it has grown two and a half times faster than the global GDP over the past one and a half decades (Huawei & Oxford Economics 2017). While there are national statistical accounting challenges on measuring the digital economy (IMF 2018; Brynjolfsson et al. 2019; Bukht & Heeks 2017), tracking the growth trajectory of ICT, across various metrics, is essential since it serves as an integral forward-looking barometer of economic growth, productivity and international competitiveness, as well as preparedness for resilience to disruptions such as those produced by the COVID-19 pandemic.

In the digital era, ICT development can be a further driver of the country's economic activities and sustainable development. The ICT sector and ICT-enabled firms make important contributions to economic growth and the labor market. ICT and other emerging technologies of FIRe, most especially automation and robotics, the Internet of things, 3D-printing and big data, are vastly changing the landscape of economic activities (Dadios *et al*. 2018), the nature of work (ADB 2018; WB 2019), and even the data ecosystem (UN 2019; Albert and Martinez 2018).

ICTs are enabling governments to work differently, to transform public services and governance with a transparency and accountability framework, and ultimately to make service delivery more efficient and effective (DICT 2019). The emerging wave of innovations is having an impact of unprecedented speed and scale, providing many opportunities as well as daunting challenges. While advances in ICT and other frontier technologies of the FIRe have generated unparalleled, enormous wealth in record time, but that wealth has also been largely concentrated around a small number of individuals, companies and countries. As regards digital or Internet platforms alone, the total market size of platform companies across the world is estimated at $7.2 trillion, as of 2018 (Dutch Transformation Forum 2018), an increase of 67 percent from an estimated $ 4.3 trillion in 2016 (Evans and Gawer 2016). Nearly half (46%) of the platform companies with a value of +$1 billion are based in the US, while slightly more

than a third (35%) are based in Asia, most of which are in China. These platform companies are dominant in four sectors, namely, Internet Software & Services, Ecommerce & Retail, Social and Search, although in recent years, these platform companies have shifted focus to variegated sectors as well. Platform companies are extremely concentrated around seven 'Super platforms': US-based Apple, Amazon, Microsoft, Google, Facebook and the PRC-based Alibaba and Tencent, which have an aggregate market value of USD 4.9 trillion or 69 percent of the total market value of the 242 platform companies (Dutch Transformation Forum 2018).

Despite the increased inequality that is resulting from ICT use, technology has the potential to create a lot of social good as it provides access to opportunities, especially among the poor and vulnerable. Digital platforms are connecting people to interact either socially or financially, to access huge amounts of available information for their use in daily living, to participate in online learning activities, to buy or sell products and/or services, and to even obtain healthcare through telemedicine, that have become extremely important especially amid the pandemic. With ICT, micro and small firms can connect with potential buyers in another country through the Internet, social media and digital platforms. They can also gain knowledge and skills to trust a new business partner based on information gained from the Internet.

Mobile money is giving an easy and secure alternative to the traditional banking system, thus boosting financial inclusion especially in many developing countries, where the proportion of persons with a bank account has been much lower than half of the population. Digital identification is now allowing people, including those marginalized, to prove who they are, exercise their rights, and avail of essential social services like education, health and social protection. The benefits of ICT products, services and tools are reaching far and wide and potentially unlocking innovative solutions to complex challenges in attaining the SDGs, including goals on food security, to quality healthcare and education for all, to disaster risk management.

But not all have benefited equally from digital dividends: while many in the Philippines are complaining about the slow speed and huge costs of Wi-Fi access, for a substantial portion of the population, there is even no access. There are prevailing disparities within the country when it comes to the penetration, affordability, and performance of digital products and services. The Philippines, like many other developing countries, is working to scale up efforts toward universal broadband access, and give people the skills and resources they need to participate fully in the digital economy. A recent report from Google, Temasek and Bain & Co. (2020) discusses rising investments in some areas in the Internet economy across Southeast Asia, including the Philippines. Specific areas mentioned include digital financial services (as reflected in query volume of Robo-Advisors and Online Wealth Management). The report also discusses how digital investments are also starting to show dividends with the increase in online adoption of e-wallets and e-commerce amid the pandemic, and how likely it is that these e-transactions will be sustained in a post-COVID world. The Philippines will need clear roadmaps to further harness ICT development, otherwise the country may be left behind, especially by its neighbors.

2.2. Conceptual Framework

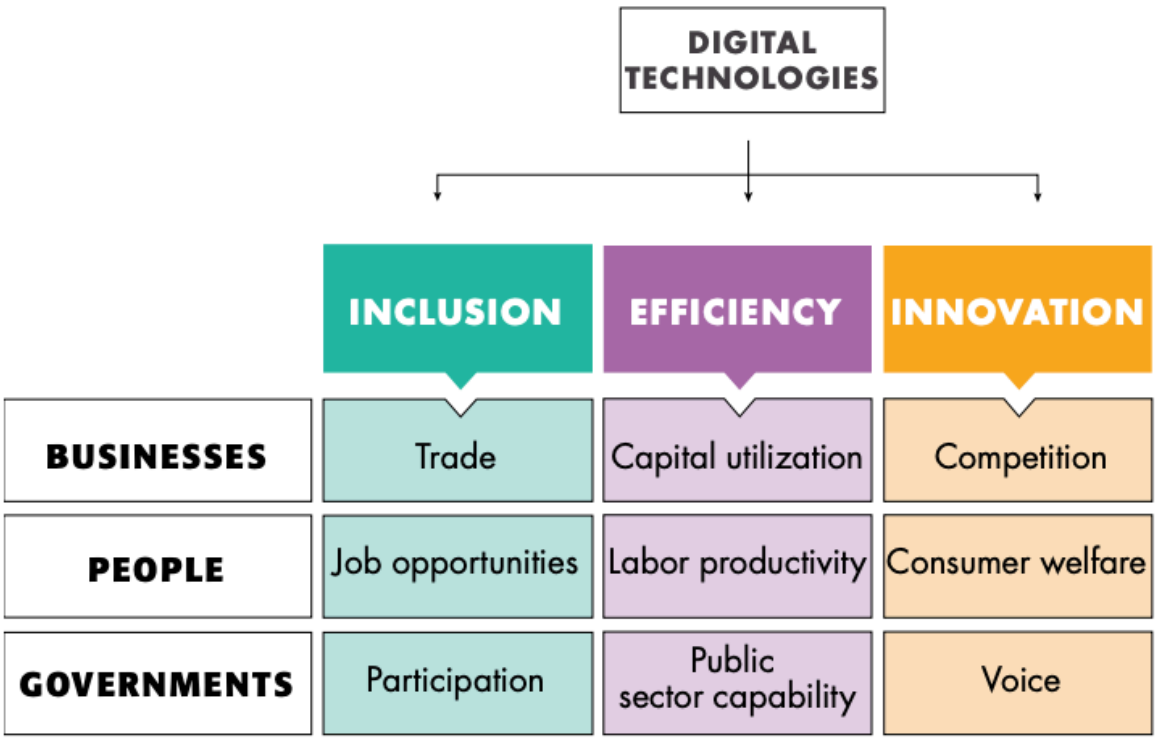
Digital technologies such as the Internet promote inclusion, efficiency and innovation which can then lead to economic growth, more jobs and better services (WB 2016). Technology promotes streamlining of processes, lowering of information barriers, and reduction of search

and information costs. Access to the Internet and digital adoption allows micro, small and medium enterprises (MSMEs) to connect with potential clients in international markets and sustain business relationships with lower transaction costs (Albert *et al*. 2016). E-commerce platforms and Internet-based jobs can provide opportunities for women, persons with disability (PWDs), the poor and vulnerable persons (who are often left behind from development) to become productive members of the workforce and improve their living conditions.

With falling transaction costs, businesses are able to produce efficiently, provide better goods and services, and encourage innovation with increasing competition in the market. Digitalization likewise favors governance, as delivery of public services is made more efficient and innovative with use of ICT.

Access and use of ICT tools have spread rapidly in much of the world, though digital dividends, i.e., the broader development benefits from using ICT—have not been inclusive (WB 2016). While digital technologies have boosted economic growth, expanded opportunities, and improved service delivery, their aggregate impact across the population has been unevenly distributed, with those lagging in reaping benefits typically being the poor, rural population, and other marginalized sectors. Following a framework of analysis based on the 2016 World Development Report of WB (2016), the examination in this study will look principally at ICT access of households and ICT use of individuals within households in as far as they promote inclusion, efficiency and innovation in the economy (**Figure 2.1**).

Figure 2.1. How ICT promotes inclusion, efficiency and innovation among businesses, people and governments



Source: World Development Report (2016), World Bank

But while greater ICT access is important, it, by itself, is not enough. Analog complements are also needed for ICT access, i.e., adapting workers' skills to the demands of the new economy, and ensuring cybersecurity, strengthening regulations and regulatory environments to ensure competition among businesses, and ensuring that institutions are accountable. The study attempts to describe the main policy levers for ICT to promote sustained, accelerated and inclusive economic growth, vis a vis the profile of households and individuals in the country as far as access and use of ICT.

2.3. Obtaining Digital Dividends

Digitalization is bringing about significant gains in wealth, and opportunities for social mobility and interaction. However, if sectors of the society and economy fail to adapt, the impact can be far-reaching and widen further socio-economic divides. Not having access to the Internet brings to a disadvantage a job-seeking person or a small firm looking to expand its network, when a great amount of information is increasingly becoming available online. But digital divides can be more complex and bring more forms of inequality which can invalidate the inclusion impact of ICT and digital technologies.

It has been discussed in several fora and research studies how the FIRe will impact on jobs (see, e.g. Albert *et al*. 2018). There will be new jobs arising from digitalization, but certain jobs are at risk of being displaced because of automation. The latter highlights the importance of acquiring the necessary ICT and digital skills (and measuring these skills). Preparing the workforce with skills and business opportunities towards the digital economy can ease the adverse impact of digitalization on current work. Additionally, findings from the literature indicate that policies that will enhance skills are highly beneficial for firms that are slow to adopt technologies (Sorbe *et al*. 2019).

Digitalization can unfavorably widen income inequality. Berlingieri *et al*. (2017) explains a scenario of an industry that is composed of high-productivity firms that employ new technology and high-skilled workers and can afford to pay high wages, and low productivity firms that continue to use old technology and could afford relatively low wages. On another perspective, if industry becomes skill-biased with the rise of ICT, then the increase in demand for high-skilled works raises the wages of these workers relative to low-skilled workers.

Previous studies have also suggested that the widening productivity divergence between firms can be associated with digitalization (literature review by Sorbe *et al*. 2019). The more productive firms are most likely to adopt digital technologies and gain from these, compared to less productive ones that are inadequately capacitated in adopting advanced and complex technologies. Policy is thus important in this respect, to create an environment wherein less productive firms and small firms are capacitated to effectively adopt digital technologies and catch up with more productive firms.

Indeed, there are benefits to the use of ICT. However, there are also challenges to ensuring that everyone is able to adopt ICT and gain from it. Towards this end, countries including the Philippines have initiated different policies and frameworks in support of increased digitalization.

2.4. Gender Dimensions in ICT

2.4.1. Gaps between women and men in ICT use and skills

ICT could be an enabler of economic empowerment, especially given the narrowing gap in educational attainments between women and men, but aside from divides on access, there are also divides on content (UN Women 2005). Further, we would expect a correlation between the percentage of the population with advance ICT skills who are women and gender equality. However, UNESCO has uncovered a reverse phenomenon, which has been subsequently dubbed as the ICT gender equality paradox (West *et al*. 2019). This paradox may be described as follows: countries that are near in achieving gender equality have the fewest proportion of women who have pursued skills needed for ICT jobs, and conversely, countries with low levels of gender equality have the largest share of women pursuing advanced ICT degrees. This paradox has been observed more generally across science, technology, engineering and mathematics (STEM) disciplines (Stoet and Geary 2020; Stoet and Geary 2018). In the Philippines, Albert *et al*. (2020) suggest that while the gender gap in the total number of people who finished ICT degrees has been minimal, the labor participation of women (70%) with ICT degrees is lower by 23 percentage points compared to men (93%).

Empirical evidence on disparities between men and women lie largely not in ICT use but in skills. According to a study conducted by the OECD (2017), ICT usage of men and women generally does not differ in developed countries. Instead, the disparity lies in ICT specialist skills, of which five percent of male workers in such countries are specialists as compared to about one percent of female workers. Examination of ICT skills per industry shows more variation. Female workers in light manufacturing, chemicals, machinery, construction, and transport tend to have or utilize more ICT skills. On the other hand, male workers have the edge over females in social services, retail, finance, and real estate industries. A reason stated behind this is the different nature of occupations assigned to workers in such industries based on gender (Grundke *et al*. 2017).

Differences between men and women are more pronounced with regard to vital skills that are related or necessary in learning ICT and utilizing digital devices. Studies conducted on 15-year-old students in OECD countries show that women have a relative disadvantage to men in digital literacy. Women are found to particularly underperform compared to their male counterparts in problem solving, and navigation. They also have less interest in ICT-related skills. Research that investigated reading proficiency between men and women showed that although women generally have higher reading proficiency scores than men, the disparity narrows when readings are computer-based as compared to paper based, implying the challenges that women seem to face in this medium. Difficulties in these skills place women at a disadvantage, especially as digitalization requires the combining of such skills to be able to harness ICT.

Data from the OECD Survey of Adult Skills show that while ICT use has no disparity amongst low-skill men and women workers, evidence from countries such as Austria, Japan, Norway, Russia and Singapore show that women are less likely than men to perform well in high function work, which requires a more well-round skill set. Furthermore, older working women are more likely to lack skills needed in a digital environment than their male counterparts. This is attributed to the time and financial incentives needed to capacitate themselves conflicting with unpaid housework and family care responsibilities that continue to serve as a barrier for most women, even to join the labor force (OECD 2018).

Beyond the OECD countries, gender disparities with regard to ICT utilization are also felt, if not more so, across developing nations. Aside from lack of time to reskill in technology due to household work, women in these countries also face less mobility due to violence, supporting infrastructure, and the lack of enabling laws and policies to incentivize them to pursue ICT-related work. This leads to women having less capital, less participation in STEM disciplines, and less access to digital technology than men (Bastagli and Hunt 2020). This is highlighted in the GSMA Mobile Gender Gap Report 2020. The report states that there remains a substantial gender gap in mobile Internet use in low- and middle-income countries, particularly in South Asia (51%) and Sub-Saharan Africa (37%). Women in these countries are eight percent less likely than men to even own a mobile phone and 20 percent less likely to own a smartphone. The lack of access to these devices provide a formidable constraint for women to further utilize ICT in their everyday lives.

2.4.2. Online entrepreneurship and gender issues

What are the characteristics of online entrepreneurs? In a systematic literature review that tackled online entrepreneurship, Anwar and Daniel (2016) identified some characteristics of online workers. They noted that online business owners tend to be more educated than other types of entrepreneurs. This is expected as engagement in online ventures would require a certain level of proficiency with handling technology. These studies have noted the need to develop skills that match the particular needs of several diverse types of online businesses. Moreover, beyond having the proper ICT skills, an important correlate of entrepreneurship is tech-savviness, that is, the desire to use technology as the primary driver of one's enterprise (Dheeriya 2009).

Online entrepreneurs are also shown to be more risk-averse than others. This makes the online nature, as well as the low capital and investment requirements for most online enterprises more enticing than formal jobs and ventures. The remote nature of online business also allows entrepreneurs to preserve social capital, enabling them to move to move to new online ventures without the baggage of previously failed engagements to be tied with their new enterprise (Daniel *et al*. 2014).

Insights from a recent online survey in the Philippines conducted on 855 individuals who were purposively selected show that platform workers in the country are young people. Women respondents in the online survey are also more likely to participate in platform work (Dacuycuy *et al*. 2020). It is noted that flexibility is a major consideration when participating in this economic activity. Some of these workers consider their engagement in platform work as a primary source of income. Most, however, see platform work as a supplementary income source. The same study reported that people with income from other online sources have a higher probability of engaging in online platform work, taking advantage of the similarity in skills needed, as well as the economies of scope.

Dacuycuy *et al*. (2020) likewise found lower probabilities in platform work engagement among those who do not a savings account, suggesting the important role of payment systems in online work engagement. There are also lower chances of engaging in platform work among low-income households and those who lack online training. Also, past experience on the platform is an important factor in the current platform involvement. It was observed that majority of the survey respondents have current platform engagement that are similar to their past platform work. Because firms use experience in online/platform work as a signal of worker productivity, those without experience or people who are just entering the platform work have limited

chances. Literacy and ICT, numeracy, and soft skills are all needed for one to accumulate work experience in this sector (Dacuycuy *et al*. 2020). The findings of this abovementioned study also show that the amount of time dedicated to platform work and household work are positively correlated, though only up to a limited time. It was shown that beyond one to two hours spent on housework, platform work time tends to decline. It was also reported that workers tend to adjust to their non-market work as market works increases.

The relationship between gender and online entrepreneurship is not consistent, and tends to vary depending on the area of study or type of online business. A more concrete connection that can be asserted is that online entrepreneurship has been effective in increasing female participation in the paid labor market due to new technologies that facilitate remote engagement. Despite the intuitive incentive for online enterprises to cater towards homemakers, evidence that supports it is mixed. Dacuycuy and Baje (2020) found, for example, that the flexibility of online platforms, as well as the presence of housework are bigger incentives for women to engage the digital economy than men. The caveat, however, is that online work also contributes to time-related stress and intra-family conflicts, which inhibit women from attempting to enter the sector (Anwar and Daniel 2016). Thus, studies have shown that online entrepreneurs tend to be single or divorced; other studies show that online entrepreneurs are less likely to have children. A possible explanation to this was posited, wherein the constant engagement usually required by online ventures are not conducive to traditional family life.

Data from the Philippines, as mentioned earlier, show that women have a higher probability in engaging in online work. Particularly, women have a higher probability of working in an online platform. This is also evident in younger women, as well as those with no private health insurance. Furthermore, women with no insurance, no savings account and no other online sources of income tend to engage in both platform and non-platform online work. Engagement of women in platform work is expected, as it gives the flexibility needed to do other non-market work.

In comparison, men tend to work exclusively in non-platform work, a trend which is observable also of men from low-income households, and those with no online/platform work experience. Younger men and those with income from other online sources, meanwhile, have a higher chance of working in both platform and non-platform work. The higher probability of men to transition to non-platform work exclusively as compared to women's willingness to engage in both types of online work may be attributable to gendered wage differences in the traditional workspace, incentivizing women to take up more work in the online sector (Dacuycuy *et al*. 2020).

The study further shows that housework has differing effects on women and men's likelihood to engage in platform work. Women engage in this type of work due to the flexibility it offers them to simultaneously accomplish household work and other interests. The presence of housework is not as big a factor for engaging in platform work for men, lending itself to the traditional notion that housework continues to be relegated as a role of the female in the country. It was found that females spend more time in care work than males. This is true both for female primary income workers, who spend two hours more care work than men, as well as female platform workers with no non-platform work.

In the context of social protection, women continue to face challenges due to their low labor force participation rate. Data shows that this gendered disparity also manifests in the online

sector, where a smaller proportion of female platform and non-platform workers contribute to a social security fund in relation to their male counterparts. Another contributor to this issue is the large presence of informal working among women, especially in the non-platform work sector. Apart from the inadequate access to social protection, Dacuycuy *et al*. (2020) reported that on important issue in platform work noted by platform workers is slow connectivity.

In terms of compensation, the hourly rate received by the survey respondents was found to be higher compared to the compensation prevailing in the country. Likewise, there is no gendered difference in the compensation per hour once personal and platform attributes have been controlled for.

2.5. Digital Infrastructure

Digital infrastructure is the foundation of today's digitized economy. But unlike traditional infrastructure like roads and railways, the digital infrastructure is somewhat invisible to those who enjoy it. Not many Internet users are aware that beyond the computers or mobile devices they hold in their hands is a whole range of interconnected networks, facilities, and various resources that span the globe—and even outer space—in order to get the data that they wish to access. This is the *digital infrastructure*.

This study identifies policy solutions that will address the supply-side constraints in the digital infrastructure. One useful way of doing this is to look at the value chain of providing Internet connectivity—from the point where the Internet enters a country (the "first mile" or international connectivity) and passes through the country (the "backbone" and "middle mile") in order to reach the end user (the "last mile"), including the "hidden elements in between" (the "invisible mile") (WB 2016).

The following subsection defines digital infrastructure, the various segments or components of the broadband network value chain, then discusses the Philippine context.

2.5.1. Definition and components

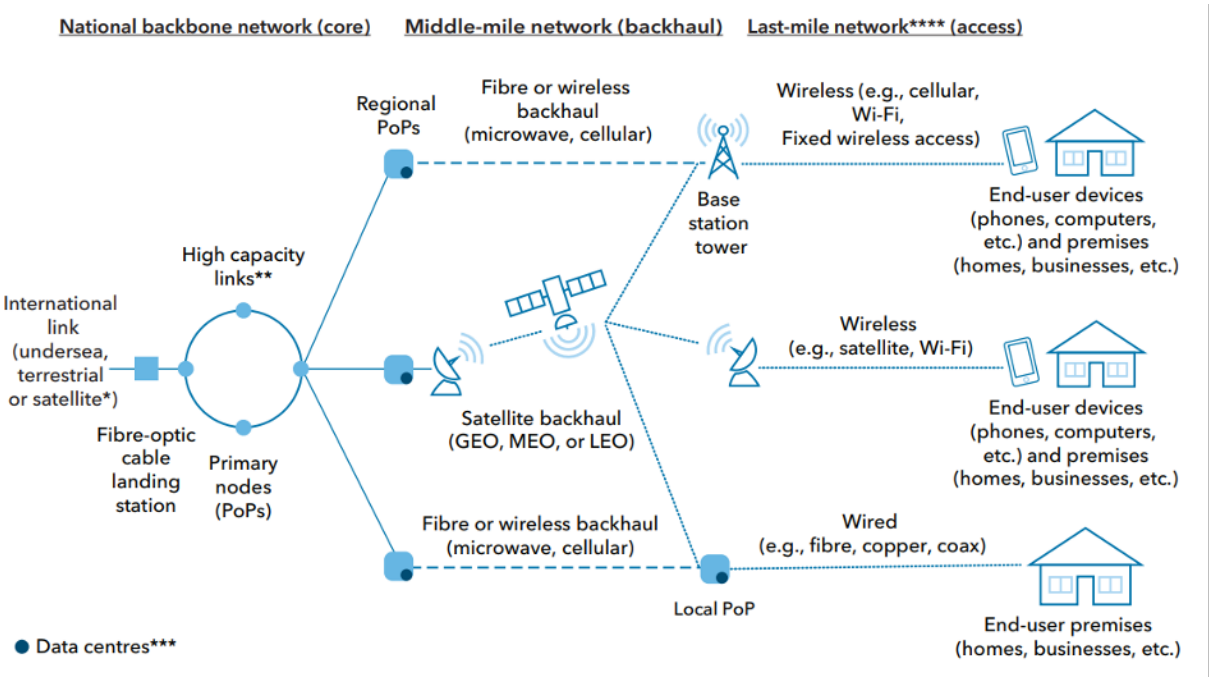
Digital infrastructure is "the physical hardware and associated software that enables end-to-end information and communications system to operate" (ITU 2019a). It includes several components that make up different segments of a network that are connected to each other, in one way or another, to process, store, transmit data. These components include:

- Internet backbone, including national and trans-oceanic fiber cables;
- Fixed broadband infrastructure, such as analog coaxial and fiber optic cable networks;
- Mobile communications infrastructure and networks including fixed wireless access (FWA), transmission towers, radio and optic fiber backhaul networks;
- Broadband communications satellites;
- Data and cloud computing facilities;
- End user equipment such as mobile handsets, PCs, modems and local Wi-Fi and Bluetooth networks;
- Software platforms including computer and mobile device operating systems as well as application programming interfaces; and
- Network edge devices such as sensors, robots, autonomous and semiautonomous vehicles, and other Internet of things facilitating devices and software

Source: ITU. (2019).

A significant part of the digital infrastructure is about connecting to the Internet. The physical Internet is a "network of networks"—a series of connected technologies that route data from a sender to its destination. Understanding what infrastructure makes up the Internet requires understanding what each part of the greater network, called "segments," do and what technologies underlie them. **Figure 2.2** below illustrates the various segments of the network until the Internet reaches the last mile.

Figure 2.2. Network components supporting last mile interventions in developing countries



Source: ITU (2020). *The Last-mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites*. Geneva: International Telecommunication Union.

International Link. The *international link* connects a country, like the Philippines, to the global Internet. It connects to "international networks made up of international submarine cable systems and satellites" (WB 2020a). Most of the Philippines' international connectivity goes through international submarine fiber optic cables, which land in one of several *cable landing stations* located mostly in Luzon and one in Davao in Mindanao.

Table 2.1 lists the international submarine cable systems and landing stations in the Philippines, both existing and planned.

Table 2.1. Submarine Cable Systems and Cable Landing Stations in the Philippines (as of Feb 2021)

Cable System	Route (km)	Landing Station	Host	System Capacity (Gbps)	
				Lit	Design
In service					
1. SEA-ME-WE-3 (Sep 1999)	39,000	Batangas	PLDT	133	1,100
2. EAC-C2C (Nov 2002)	36,500	Cavite & Batangas	Telstra	3,260	30,550
3. AAG (Nov 2009)	20,318	La Union	PLDT	5,162	11,000
4. APCN-2 (Dec 2001)	19,000	Batangas	PLDT	7,360	13,200
5. SJC (Jun 2013)	8,900	Nasugbu	Globe	1,200	28,000
6. ASE (Aug 2012)	7,800	Camarines Norte	PLDT	1,580	4,900
7. TGN-IA (Mar 2009)	6,700	Cagayan	Globe	1,900	9,600
8. SEA-US (Aug 2017)	14,500	Davao	Globe		20,000
Planned					
9. JUPITER (2020)	14,557	Camarines Norte	PLDT		60,000
10. PLCN (no date)	12,791	La Union & Baler	BCDA, DICT		144,000
11. CAP-1 (2022, Q4)	12,000	Ilocos Norte	Amazon, Facebook, China Mobile International (CMI)[3]		108,000
12. ADC (2022, Q4)	9400	Batangas	PLDT		140,000[4]

Source: Telegeography, Submarine Cable Network, and the Philippine National Broadband Plan, with edits from the author.

Alternatively, traffic can be coursed through satellite technology,[5] which can also be used both for international connectivity and for distributing Internet in the country.

A transmitter on the ground beams data to a satellite in orbit, which then reflects the signal back to an earth station located elsewhere in the country or in the world. This earth station is connected to either to the domestic backbone, in which case satellite is used as a middle mile solution, or to a teleport or data center elsewhere in the world, in which case it acts as an international link. In the latter case, satellite technology can be used to deliver international bandwidth directly to distribution networks without connecting to the domestic backbone.

Legacy satellite Internet networks connected to geostationary orbit (GEO) satellites were known for having poor speeds and low capacity. Due to the altitude at which these satellites operate, they had "relatively high latency, with an average round-trip latency of 477 milliseconds." (ITU 2020b, p. 70) Their use of older C-band radio frequencies also limited

[3] The CAP-1 consortium comprises Amazon, Facebook, China Mobile International (CMI).
[4] NEC Corporation (2020)
[5] In mid-February 2021, there were reports that Starlink, a satellite company launching a constellation of low-earth orbit satellites owned by Elon Musk, was in talks with local fiber broadband service provider, Converge ICT, to offer satellite Internet in the Philippines (Camus 2021). Under existing policy, satellite providers need to secure a legislative franchise and certificate of public convenience and necessity from the NTC. Foreign-owned companies can participate in the telecommunications and broadband market but are limited to 40% ownership of equity in a company (Mirandilla-Santos et al. 2018).

their bandwidth and made them prone to interference from cloud cover and rain, a phenomenon known as atmospheric attenuation.

The introduction of *high throughput satellites* (HTS) has increased the bandwidth of satellite connectivity, with satellites operating on the *Ku*- and *Ka*-band frequencies now capable of "data rates of up to 1 terabit per second" (Viasat n.d., as cited in ITU 2020b, p.70). With the advent of high-speed medium-earth (MEO) and low-earth (LEO) orbit satellites, satellite connectivity now has the potential to deliver speeds and latency at par with some terrestrial networks. LEOs orbit between 400 and 900 kilometers above the earth and a target latency of 12-30 milliseconds[6] (Mirandilla-Santos *et al*. 2018).

Recognizing that barriers already exist even at the first mile, the World Bank (WB) recommends to liberalize the market for satellite dishes and eliminate the monopolies entrenched in international gateway and cable landing stations (WB 2016).

In both cases, connectivity, measured in terms of *bandwidth,*[7] is eventually distributed throughout the country by the fiber core network.

National Backbone Network. From the cable landing stations, bandwidth is transported to telcos' transmission centers, located mostly in the National Capital Region (NCR), where it then gets picked up by service providers over domestic backhaul. This backhaul is called the *national backbone* or *core network*. The core is the network of fiber optic cables which transports bandwidth throughout the country before distribution. Currently. the Philippines has three backbone networks operators:

1) PLDT: Domestic Fiber-optic Network (DFON)[8]
2) Globe Telecom: Fiber Optic Backbone Network (FBON), FOBN-2,[9] and TELECPHIL's[10] National Digital Transmission Network (NDTN)
3) National Grid Corporation of the Philippines' (NGCP) private fiber optic network (FON)[11]

With a projected service life for fiber optic cables of 20-25 years, some segments of the three nationwide backbone networks are nearing end of service.[12] Apart from fiber optic cables, both PLDT and Globe also run terrestrial microwave backbone networks nationwide.

[6] For a description of satellites and other emerging Internet technologies, see Mirandilla-Santos et al. (2018, pp.10-23).
[7] Simply put, bandwidth is defined as the maximum amount of data transmitted over an Internet connection in a given amount of time, often expressed in megabits per second (Mbps). Bandwidth is often mistaken for Internet speed, which is the actual performance of an Internet connection experienced by end users (Verizon n.d.)
[8] PLDT's DFON was completed in 1997 and runs 11,100 km. As of 2017, the total length of PLDT's fiber backbone and distribution networks were at 174,000 km. To date, PLDT's fiber network, including fiber to the end users runs 429,270 km. See Annex 5.1 for a more detailed description.
[9] Globe's fiber optic networks span 12,000 km. Its FOBN was built in early 2000 while the network, FOBN2, became operational in 2009. FOBN2 was a $70-million high-capacity transmission system, spanning over 1,900 kilometers and covers most Luzon, Visayas, and Mindanao. See Annex 5.1 for a detailed description.
[10] TELECPHIL is a consortium of seven telcos, including BayanTel, Smart, Globe, Extelcom, Digitel, Eastern Telecommunications, and PT&T, which operates the NDTN that connects Northern Luzon to Southern Mindanao. TELECPHIL'S NDTN was built in 1999 as the second privately-owned nationwide backbone network that runs for 1,400 km from Cagayan in the Northern Philippines to Dumaguete in Negros Oriental. Including terrestrial microwave, the NDTN has a total length of 2,741 km and runs through Isabela, La Union in the north, Batangas in the east, Bicol region in the west and Davao in the south. Telecphil is run by a consortium of telcos, with Bayantel as the majority owner.[10] In 2015, Globe Telecom bought Bayantel.
[11] In 2017, NGCP won a 25-year concessionaire contract with the state-owned National Transmission Corp. (Transco) to operate and maintain the country's power transmission network (Domingo 2018).
[12] In 2019, fiber Internet provider Converge ICT received a $250-million investment from US-based equity firm Warburg Pincus to finance the telco's nationwide expansion, which will reportedly be used to complete the construction of its $1.8-billion national Internet backbone. The Luzon backbone is expected to be completed in Q1 2020 (Cordero 2019).

NGCP's dark fiber network is 6,154 kilometers in length and runs from Luzon to Mindanao. In 2018, the Department of Information and Communications Technology (DICT) signed a tri-partite agreement with the NGCP and Transco to use the transmission grid's dark fiber to implement the infostructure component of the country's National Broadband Plan. The agreement gives the DICT "an indefeasible right of use and/or access in certain spare fiber optic cores, vacant lots, tower space and related facilities of the NGCP" (DICT 2018). The NGCP's FON is envisioned to provide the backbone network to be connected to the government-funded Luzon Bypass Infrastructure (LBI),[13] which will receive the cable capacity from the international submarine cable system called Pacific Light Cable Network (PLCD), partly owned by Facebook and Google, which was originally expected to connect Los Angeles, USA to Hong Kong, People's Republic of China.

Under the DICT's plan, the PLCN submarine cable system will provide the international link, through a 2 Terabit-per-second (Tbps) cable capacity, between the Philippines and the global Internet. The submarine cable is set to land in a government-funded cable landing station in Baler, pass through the LBI, and exit through a cable landing station in Poro Point, Zambales before going out to Hong Kong. However, in February 2020, Google and Facebook submitted new application to the US Federal Communications Commission (FCC) for authorization that will run the network between the US, Taiwan, and the Philippines, dropping the Hong Kong path (Harris 2020). It is not clear whether or not the non-inclusion of Hong Kong has any significant implications for the Philippines.

Once completed, the DICT expects the NGCP fiber optic backbone and the LBI to "save up time, manpower, and resources for the government," which will amount to "approximately 2.6 billion US dollars" (DICT 2018).

Using their respective backbone networks, the telecommunications companies (telcos) distribute bandwidth to their regional *Points of Presence* (PoPs).

Middle Mile. From these PoPs, bandwidth makes its way to distribution networks through the m*iddle mile,* which connects the domestic backbone to the core networks of the telecom company or Internet service providers (ISPs) in provinces and/or to cities and municipalities through Points of Presence (WB 2020a). The middle mile is the bridge connecting individual communities to the greater national (and from there, international) network.

Where core networks normally utilize fiber optic cables, there are several mainstream technologies used for the middle mile. In cases where it is technically and financially feasible, the first mile is connected to communities through a *domestic fiber optic network*, which allows for the greatest speeds and capacities (ITU 2020b). When challenging terrain or long distances make laying fiber optic cables too costly or difficult, bandwidth can instead be distributed using wireless *Microwave* technology. Microwave utilizes radio frequencies to transmit connectivity more affordably than fiber; however, they have lower bandwidth capacity than fiber, require a clear view between each transmitter (called line-of-sight), and can be negatively affected by inclement weather (ITU 2020b). Similarly, satellites can provide the middle mile by connecting the last mile facility to a domestic backbone without the need for terrestrial networks. Thus,

[13] The LBI, together with two submarine cable landing stations, was built for the DICT by the Bases Conversion Development Authority (BCDA), which spent close a P1 billion. The BCDA is set to have access to 25% of the cable capacity of the Facebook cable.

satellite is ideal for connecting islands and geographically isolated areas to the backbone. Satellite technology is also useful for emergencies and disaster response, as the equipment can be put back up immediately post- or even during a calamity, such as a typhoon (Bolledo 2020; Newsbytes.ph 2020).

Network deployments in other countries have also experimented with using cellular technology for the middle mile; however, it is more expensive and has a shorter range than microwave.

Last Mile. From the middle mile, connectivity is brought to the *Last Mile*, which is the segment responsible for distributing bandwidth to end users. The last mile "refers to the towers and cables that provide connections to computers, phones, mobile devices of end users." (WB 2020a, p.31). In the Philippines, the most-used last mile technology among consumers is *Cellular.* Cellular uses base stations (otherwise known as cell sites) to distribute connectivity through 2G, 3G, 4G, and the upcoming 5G technologies. Mobile phones or *Fixed Wireless* devices such as home broadband modems connect to and get connectivity directly from the base station.

Another popular last mile access technology is *Wireless Fidelity or Wi-Fi.* While Wi-Fi is more commonly known as a means of wirelessly distributing a connection throughout a building, it can also be used to deliver connectivity over larger distances, as is the case with the Free Public Wi-Fi Program. Compared to cellular, however, Wi-Fi has a much shorter range and is more prone to being blocked by walls or other structures. On the other hand, cellular can be much more expensive to deploy than Wi-Fi: "putting up a cell tower can be prohibitively expensive," and thus "where microwave can be used across longer distances to connect even isolated communities, the availability of cellular backhaul is limited to the range of the nearest cell tower, which for cost reasons is unlikely to be present in sparsely populated areas" (ITU 2020b, p.74).

Satellite technology can also be used in the last mile using *Very Small Aperture Terminals* (VSATs). A VSAT is a small satellite dish attached to an Internet modem that allows end users to access satellite connectivity directly. Users either connect their computers directly to the modem or use a Wi-Fi access point to distribute connectivity to wireless devices.

VSATs are particularly suited for remote or geographically challenging areas where no other Internet infrastructure is available or commercially viable. Indeed, the "biggest advantage of satellites is their very wide coverage area, with service available wherever there is a line of sight to the satellite from a station located anywhere within the satellite's footprint" (ITU 2020b, p. 71). On the other hand, satellite bandwidth pricing for end users "can be higher compared to the alternatives, and bandwidth availability may be much more limited" (ITU 2020b, p. 71). Commercial efforts are underway to increase the availability and decrease the cost of last mile satellite access, such as SpaceX's Starlink Internet and Amazon's Kuiper.

A small proportion of the population have *Fixed Wired* connections (WB 2020a). These are physical cables connecting premises to a local PoP, which is then connected to the middle mile. Last mile wired technologies include *Fiber,* which is the newest and fastest technology, and the more common *Copper,* which uses legacy landline telephone networks to deliver bandwidth. Another wired technology is *Coaxial,* normally used for Cable TV but also used to provide Internet connectivity by some providers using a standard called Data Over Cable Service Interface Specifications (DOCSIS) (ITU 2020b; AV System 2020).

Other Internet Infrastructure

The first, middle, and last mile segments comprise the separate but connected networks that make up Philippine Internet infrastructure. However, within these networks also reside important components that improve connectivity. These include "*Internet exchange points (IXPs)* that allow exchange of local Internet traffic without leaving the national border; *content delivery networks* (CDNs), geographically distributed servers coordinated for fast delivery of Internet to users); and *data centers* that host servers containing digital content and services" (WB 2020a, p. 31) which may be located in between the backbone and middle mile segments.

IXPs and CDNs in particular are critical to bringing the cost of connectivity down. By ensuring that local traffic remains local, IXPs cut down on the cost of international bandwidth. CDNs, on the other hand, store frequently accessed content on servers that are geographically closer to users, improving access times – faster-loading web pages, videos, and other multimedia (Akamai n.d.).

2.5.2. Why digital infrastructure is important

As the digital economy[14] grows, so does the demand for digital infrastructure.[15] According to the United States Bureau of Economic Analysis, the digital economy includes three parts: (1) the digital-enabling infrastructure which enables the existence and operation of a computer network; (2) the digital transactions using that system; and (3) the content created and accessed by digital economy users (Barefoot et al. 2020, p.7). All online content, services and activities that fuel the digital economy run on digital infrastructure.

The ITU asserts the link between digital infrastructure and development, emphasizing that "the quality, quantity and extent of digital infrastructure plays a decisive role in a nation's capacity to realize the benefits of the digital economy and society" (ITU 2019a, p. 18). Hence, the presence and adequacy of digital infrastructure can determine the fate of the country's overall economic development. This is especially true during the COVID-19 pandemic, where the ability of a country and its people to harness the power of digital platforms and tools has become essential to ensuring economic recovery and resilience.

2.6. Overview of Philippines' Performance in ICT

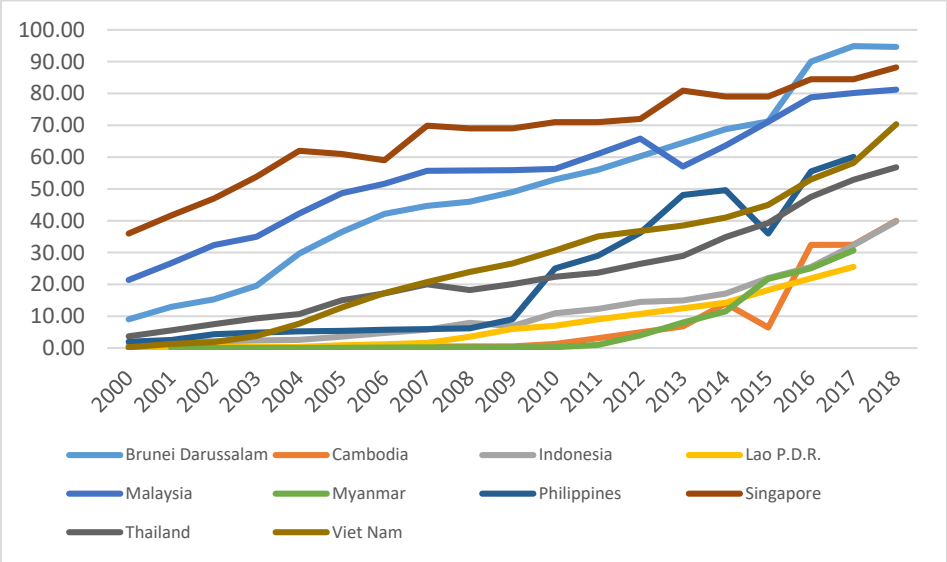
Over the years, the Philippines has seen improvements in ICT adoption, however, there is still a lot of room to elevate its performance, especially when compared to ASEAN countries and the rest of the world.

The ITU estimates that Internet penetration in the country has gone up from two percent in 2000 to 60 percent in 2017 (**Figure 2.3**). There was a steep rise in 2010 when the penetration rate jumped to 25 percent from nine percent in the previous year. But while Internet penetration has risen in the Philippines, the increase relative to the performance of neighboring countries has not been phenomenal. As of 2017, across the Association of Southeast Asian Nations

[14] Digital economy is the "amalgamation of several general purpose technologies and the range of economic and social activities carries out by people over the Internet and information networks" (Dahlman et al. 2016, p.11).
[15] In 2017, the digital economy was estimated to be worth US$11.5 trillion globally or 15.5% of the GDP (Huawei & Oxford Economics 2017).

(ASEAN), Internet access in the Philippines ranks fourth, behind Brunei Darussalam, Singapore, and Malaysia. Viet Nam and Thailand rank fifth and sixth, respectively.

Figure 2.3. Internet Penetration rates (in percent) among ASEAN member states

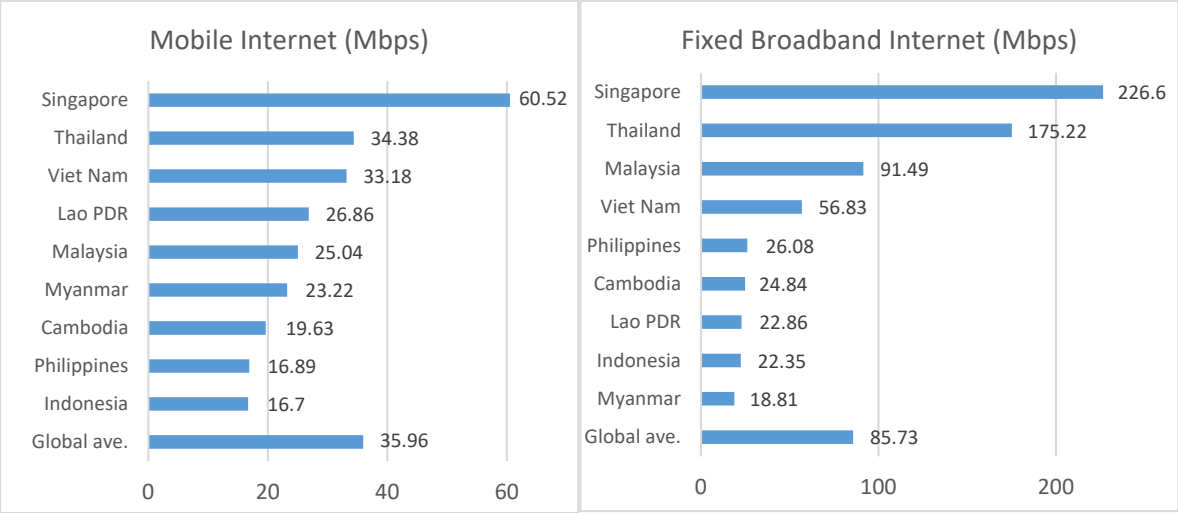


Source: ITU Statistics https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

According to "We are Social", an agency that examines social media data, the Internet penetration in the Philippines has reached 67 percent as of January 2020 (We Are Social and Hootsuite 2020). Also, social media penetration as of January 2020 is at 67 percent. The number of social media users in the Philippines has grown from 67 million in 2018 to 76 million in 2019 and 73 million in 2020. Of the 73 million in 2020, 70 million are on Facebook and 69.3 million used YouTube. However, while penetration rates for Internet and social media are increasing, they also suggest a digital divide: a third of Filipinos are still not using them.

We Are Social also reports that the time spent online daily in the Philippines soared from 9 hours and 29 minutes in 2018 to 10 hours and 2 minutes in 2019, the highest in the world. In 2020, time spent declined to 9 hours and 45 minutes, but this is still the highest figure globally. Ookla Speedtest Global Index reports that fixed broadband Internet speed is 26.08 Mbps as of September 2020, faster than 19 Mbps average in 2019, but is still much less than half of the global average [85.73 Mbps] (**Figure 2.4**). For mobile, the speed has increased from 15.1 Mbps in 2019 to 16.89 in 2020 (September), but this is still much lower than the global average of 35.96 Mbps. In mobile Internet technology, 2G/GSM is the technology largely being used in the Philippines as of 2019. While its ASEAN peers are moving closer to full LTE coverage, the Philippines is catching up together with Brunei Darussalam, Cambodia, Lao PDR, Myanmar and Vietnam (WB 2020).

Figure 2.4. Mobile and Fixed Broadband Internet Speed (Mbps), ASEAN, as of September 2020



Note: No data for Brunei Darussalam for September 2020
Source: Ookla Speedtest Global Index (https://www.speedtest.net/global-index)

According to the ITU (2018b), more than half the world's population now has access to the Internet, but the penetration rate in the least developed countries is only at 15 percent, or 1 in 7 individuals. In a world that is increasingly driven by ICT, this persisting digital divide could exacerbate socio-economic inequalities and create a new class of people left behind.

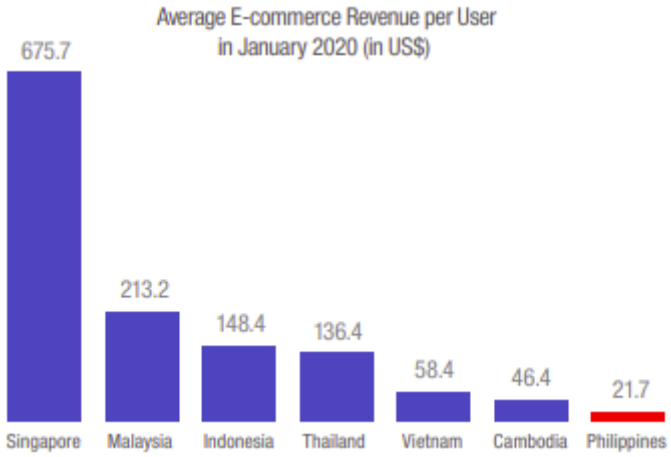
One significant barrier to access to the Internet through mobile or fixed broadband is cost, especially in many developing countries, such as the Philippines where the lack of digital infrastructure as well as regulatory bottlenecks hamper broadband development. According to the ITU (2018b), "Mobile penetration passed the 100 percent mark in 2012 but there is room for growth with 84 percent of homes had a mobile phone (91% in urban areas, 78% in rural areas)." For the Philippines, Internet affordability is a bottleneck to access. The Economist Intelligence Unit (EIU) Affordability Score ranks the Philippines lowest among its ASEAN peers – Thailand, Singapore, Malaysia, Viet Nam, Indonesia [ranked by affordability] (WB 2020). Moreover, the number of cell sites is among the lowest in ASEAN (WB 2020). As of September 2020, the Philippines has around 20,00 cell towers, far lower than Viet Nam's 50,000. This gives a ratio of one tower to 4,000 households, when the ideal ratio is one to 100-200 households (Galvez 2020).

As regards ICT for business, surveys of individuals and establishments indicate increasing e-commerce activities. Surveys conducted by Global Web Index from 2016 to 2020 suggested a large increase in number of Internet users aged 16 to 64 that are engaged in various e-commerce activities. In 2020, the survey indicated that 91 percent of Internet uses searched for an online product or service to buy, and the same percentage visited an online retail store. In addition, 76 percent purchased a product or service online using any device (We are Social and Hootsuite 2020). An increase by around 50-60 percentage points is observed from 2016 to 2020.

Meanwhile, many establishments in the Philippines, small to large, have incorporated e-commerce in their business. It includes setting up social media accounts to promote and even facilitate sale of their products and services. WB (2020) noted, however, that the e-commerce

revenue per user is the lowest in ASEAN (**Figure 2.5**). The Philippines recorded USD 21.70, compared to USD 46.40 in Cambodia and USD 675.70 in Singapore, which is highest in the pack.

Figure 2.5. Average E-commerce Revenue per User in Selected ASEAN countries, January 2020 (in USD)



Source: World Bank (2020), Figure 4.2, page 71 (original source: Statista).

The e-commerce and digital payments sector saw increase in activity during COVID-19 pandemic, when the community quarantine restricted mobility, particularly visits to the supermarket, departments stores, malls, restaurants and other commercial establishments. Consumers had shifted to online activities, such as in purchase and delivery of goods, online streaming for movies and entertainment, and online bank transactions. Google Trends data from January to April 2020 showed increasing interest in delivery and Netflix, and decreasing interest in travel.[16] Moreover, BSP data in the second quarter of 2020 revealed that Instapay and PESONet had a combined 158.6 percent year-on-year increase in transaction value (WB 2020).

In its most recent SEA 2020 report, Google, Temasek and Bain & Co. (2020) point out that Internet usage has further grown in the Philippines; a third (37%) of digital services customers in the country are new to the service (in the midst of the pandemic), of which more than half (54%) are from non-metro areas. Nearly all (95%) of these new digital consumers intend to continue using digital services post-pandemic. Prior to the pandemic, Filipinos spent 4.0 hours online (for personal use), and the hours spent spiked to 5.2 hours at the height of lockdowns - the highest across the entire South East Asia region - and now is currently at 4.9 hours per day. Overall, 2020 gross merchandise value of e-commerce is estimated at USD 7.5B in 2020, having grown at six percent from a year earlier's USD 7.1B. In the 2019 SEA report, Google, Temasek and Bain & Co. (2019) identified six key barriers to growth - Internet Access, Funding, Consumer Trust, Payments, Logistics and Talent – but for 2019, Google, Temasek and Bain & Co. (2020) reports significant progress on most of these barriers (Payments and Consumer Trust, especially), but points out that Talent remains a key bottleneck to ensure the momentum gained in 2020 is sustained.

[16] Based on Google Trends data presented by World Bank (2020).

How does the Philippines' digital infrastructure fare?

Over the past decade, the Philippines has consistently been reported to have poor Internet service. Broadband penetration is lower compared to countries with comparable per capita income (WB 2019b), the average download speed is among the slowest in the region, and the price of broadband is higher than the ASEAN average. According to WB (2020a), the poor state of Internet in the country can be primarily attributed to the inadequacy of the digital infrastructure and weak competition.

The lack of basic infrastructure, particularly for fixed wired broadband networks, is highlighted in various reports.

> In the 2020 **Digital Evolution Scorecard**,[17] the Philippines was categorized under "Watch Out" countries, which are characterized by shortcomings in both existing digital capabilities and momentum for future development." According to the scorecard, those in the Watch Out category should prioritize, first and foremost, "making long-term investments to address basic infrastructure gaps" (Chakravorti et al. 2020).
>
> The **Measuring the Information Society (MIS)** 2018 report noted that the Philippines has a high level of mobile coverage (with 93% of the population covered by 3G, and 80% by LTE/WiMAX), but wired services are relatively underdeveloped, particularly fiber to the premises (FTTP). The MIS 2018 describes the Philippines as "well endowed with international Internet bandwidth," backed by PLDT and Globe's "extensive national fibre optic backbone employing a mix of underground, overhead and submarine cable." This is consistent with UNESCAP's earlier assessment prepared by Ruddy (2013) that the Philippines has excellent international connectivity and relatively strong domestic connectivity.
>
> Similarly, **WB** (2020a, p.34) reports that the "Philippines is much further behind fiber deployment than similar countries with a comparable GDP per capita." Vietnam, for example, which as a lower GDP capita than the Philippines—has 170 percent more fiber connections than what the two dominant Philippine telcos have of all types of fixed broadband subscribers combined (Mirandilla-Santos et al. 2018, p.15).
>
> In the 2020 edition of the **Networked Readiness Index** (Dutta and Lanvin 2020), the Philippines ranked 74th out 130 countries, a drop of three places from its ranking in the previous year. While the Philippines posted improved scores in the three pillars of Impact, People, and Governance, it performed notably worse in the Technology pillar, which corresponds to the level of the country's development in terms of Access, Content, and Future Technologies. Among these sub-pillars, Access covers issues of "communications infrastructure and affordability." The Philippines' low ranking was affected by comparatively low levels of household Internet access, low levels of 4G

[17] The 2020 Digital Evolution Scorecard developed by Tufts University's Fletcher School in partnership with Mastercard analyzes 90 economies based on 160 indicators across four key drivers: Supply Conditions (how developed is the infrastructure?), Demand Conditions (Are consumers willing and able to engage in the digital ecosystem?), Institutional Environment (Do the country's laws (and its government's actions) support or hinder the development of digital technologies?), and Innovation and Change (What is the state of key innovation ecosystem inputs (i.e., talent and capital), processes (i.e., collaborations between universities and industry), and outputs (i.e., new, scalable digital products and services?) (Chakravorti et al. 2020).

mobile network coverage, and the high cost of mobile services (mobile tariffs) especially when compared with neighboring countries (**Table 2.2**).

Table 2.2. Networked Readiness Index 2020 Scores for Select Access Sub-Pillar Indicators of ASEAN Countries

(higher scores are better)

Country	Households with Internet Access	4G Mobile Network Coverage	Mobile Tariffs
Philippines	42.6	80.0	38.6
Malaysia	87.0	93.0	68.4
Indonesia	66.1	92.7	63.6
Thailand	67.6	98.0	60.6
Viet Nam	46.9	93.9	69.3

Source: Dutta and Lanvin (2020).

The Philippines scored much more poorly on cost of mobile services compared to other countries, while also having more limited 4G network coverage.

2.7. Overview of ICT policy environment in the Philippines

Most policies on ICT aim for, first and foremost, universal access, as it is a basic necessity for digital transformation. Aside from coverage, speed and affordability become priorities for policy (ITU 2014; OECD 2020). Additionally, a conducive environment for business that will encourage growth of digital economy firms, new business models (e.g. fintech), e-commerce, entrepreneurship, collaboration, innovation, and competition are being incorporated in regulations supporting digitalization (APEC 2019). Data protection and privacy are also major policies to combat cyberattack and manage digital identity and data use.

Governments, for instance those in APEC, have started transitioning to e-government, i.e. using ICT in public service delivery. There are also best practices in some APEC economies on initiatives toward scoping and measuring the digital economy to help inform policy decision-making. International cooperation on digital rules and standards are also interventions being raised to tackle issues on cross-border operations, entry and investment barriers.

In the Philippines, government strategy towards digital transformation was launched in 2012, chiefly by offices that preceded the DICT. The strategy included the e-Government Master Plan which laid the foundation for the government to provide public services and secure, efficient and seamless exchange of data and information using ICT systems. Among the programs listed under the master plan were e-Government (e-Gov) and the Integrated Government Philippines (IGovPhil). In a continued commitment to progress digitalization in the country, the DICT released a digital transformation strategy for 2020, building up on the learnings and successes of the initial government efforts and new developments in the digital environment.

Promoting digital transformation is now treated as a national strategy and not just a program, with more defined platforms and a framework that includes the interaction and interrelationship between government and society, the economy and technology and their outputs in digital

transformation. The implementation, however, of this program will entail a whole-of-government approach.

The DICT also led the formulation of the National Broadband Plan (NBP) which aims to fast-track the deployment of fiber optic cables and wireless technologies, especially in unserved and underserved areas in the country, and to improve Internet speed and affordability in the country. The NBP strategies include developing responsive policies and regulations to accelerate investments in infrastructure and new technologies, and to stimulate broadband demand" (DICT 2017b).

Other policies and regulations related to ICT include the National Retail Payment System (NRPS) which promotes use of digital technology for finance; E-Commerce Act of 2000 (Republic Act 8792) which facilitates electronic commercial and non-commercial transactions; and the Data Privacy Act of 2012 which ensures security and protection of data in the government and private sector. There is also the Cybercrime Prevention Act of 2012 which covers illegal access to data.

Annex 2.1 presents a summary of published laws, policies and programs related to ICT, covering different strategic domains such as improving Internet access, building ICT structures, efficient service delivery, ICT education, consumer protection, data and information security.

The APEC Digital Readiness Report Card in 2017[18] lists the Philippines as one of the regional leaders in mobile network coverage (RMIT University 2017). However, it lags in Internet access and usage, Internet speed and reliability, and rural inclusion. The country is also assessed to show progress but needs development in terms of the regulatory and political environment, e-Government readiness, finance for startups, skills and education (**Figure 2.6**).

Figure 2.6. APEC Digital Readiness Report Card, Philippines

	People, Skills and Education				Infrastructure and ICT				Institutional and Regulatory			Financial	
Regional Leader / Requires Development / Lagging	A Conducive Skilled Visa Policy Environment for Entrepreneurs	Availability of Expertise and Mentorship	Current Skills Availability	Math and Science Education (Primary and Secondary)	Internet Access and Usage	Internet Speeds and Reliability	Rural Inclusion	Mobile Network Coverage	Regulatory and Political Environment	E-Government Readiness	Laws Relating to ICT including Protection of IP and Data Privacy	Flexible Bank Loans for Start-ups and New Companies	Availability of Venture Capital
Phillipines													

Note: Color legend:

Red Weak; poor quality; limited in scope; insufficient legislative or regulatory frameworks — lagging

Yellow in progress but needs development

Green Strong; high quality; implemented; enacted — regional leader

Source: RMIT University (2017), p.16.

[18] Based on secondary research and opinions of digital entrepreneurs and ecosystem stakeholders, using several indicators for APEC's pillars of connectivity: physical, institutional, people-to-people.

Much work remains to be done but the government through its digital transformation strategy is committed to improving infrastructure and regulatory environment to attain continuous progress towards the country's digital transformation.

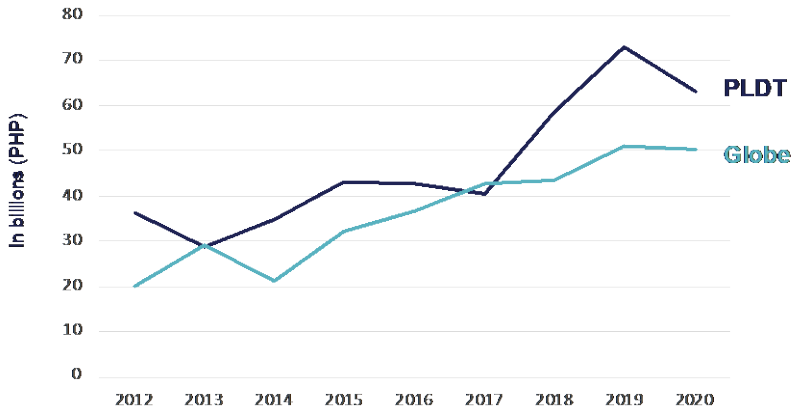
Policy and regulatory environment on the digital infrastructure

To improve the digital infrastructure, it is important to review recent studies[19] on the state of Philippine digital infrastructure, the role of key industry players, other stakeholders and the policy environment. It should be first noted that the Philippines' digital infrastructure is built and operated primarily by the private sector. This is enshrined in law through Republic Act No. 7925 or the Public Telecommunications Policy Act of 1995, which states that "public telecommunications services shall be provided by private enterprises" (Article II Section 4). Hence, investment in the Philippines' telecommunications sector has primarily come from the private sector, which was described as a "national strength" in the latest World Digital Competitiveness Ranking (IMD World Competitiveness Center 2020).

Because the telecom law focuses on PTEs as the network operators, telcos have become the default builders of broadband infrastructure in the Philippines. There are two dominant telcos and broadband providers, particularly of mobile broadband service: PLDT and Globe. Sun Cellular—owned and operated by Digital Telecommunications Philippines, Inc. (Digitel)—was the third mobile network operator from 2003 and saw the first real challenge to PLDT and Globe, after a series of mergers and acquisitions that saw the latter two consolidate the post-liberalization telecommunications market (Aldaba 2011). Even as it disrupted the market with its unprecedented unlimited call and text deals, Sun Cellular was eventually acquired by PLDT in 2011. In 2015, Globe acquired BayanTel, a telco known for competing with PLDT's landline business and also offered DSL services.

PLDT and Globe's capital expenditures (capex) have each risen from just over PHP 36 and 20 billion in 2012, respectively, to a high of PHP 72.8 and 51 billion in 2019, dropping to PHP 63 and 50 billion for 2020 (**Figure 2.7**). The entry of third major player DITO Telecommunity has been widely perceived as the catalyst for increased capital spending from the incumbents (Fitch Ratings 2020).

Figure 2.7. Capex of PLDT and Globe 2012-2020



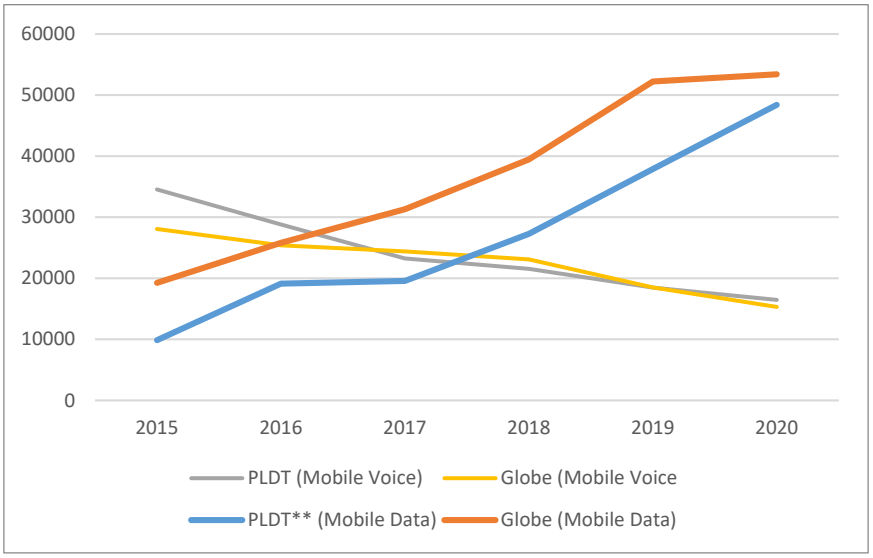
Source: SEC Form 3Q 17-Q reports of PLDT and Globe, 2012-2020.

[19] World Bank (Philippine Economic Update; Brave New Normal); ADB (Thinking Machines); PIDS (RRL on PIDS studies); BBA (Google report).

Despite the huge investment, millions of Filipinos and communities remain unserved and underserved by broadband service providers. While capex has been increasing, especially for mobile broadband services, competition between the only two mobile network operators "has largely focused on increasing market shares" (WB 2020a). One executive described this as an effort to "reclaim the market share it lost to its sole competitor" (Marasigan 2020). Thus, capex may not necessarily be for expanding infrastructure in the countryside where return on investment is not guaranteed.[20]

Both telcos have very profitable businesses in a highly concentrated market (WB 2020a). In the fixed service market, Globe has 32 percent share, while PLDT has 48 percent. In the mobile service market, Globe has 58 percent, while PLDT has 42 percent (WB 2020a). PLDT and Globe were ranked first and fourth, respectively for cash dividend yield in 2020 among all entities listed on the Philippine Stock Exchange, attesting to their profitability (PESOLAB 2021). Going by their respective revenue to capex ratios over the past years, it seems the incumbents have room to invest more. While mobile voice revenues have been falling since 2015, mobile data revenues have been going up (see **Figure 2.8**).

Figure 2.8. Mobile Voice and Mobile Data Revenues, 3Q 2015-2020



Source: SEC Form 3Q 17-Q reports of PLDT and Globe, 2012-2020.

Prior to the passage of RA 7925, the Philippine government had invested significantly in the telecommunications infrastructure through the Telecommunications Office (TelOf) under the then Department of Transportation and Communications (DOTC), which operated and maintained the country's state-funded telephone access program, as mandated in Republic Act 6849 or the Municipal Telephone Act of 1989 (Official Gazette of the Republic of the Philippines (1990).

In the 1980s, the Philippines implemented several telecommunications projects under the country's National Telecommunications Development Master Plan: the National Telephone

[20] Previous agreements to deploy free public Wi-Fi in the rural areas between the Philippine government and the two largest telcos, for example, was reportedly unsuccessful, "as the companies did not foresee a major return on investment in remote communities" (UNDP 2018).

Program (NTP), the Regional Telecommunications Development Project (RTDP), and the *Telepono sa Barangay* (TSB).

As the country's universal access program. the NTP aimed to build an integrated telephone network in Regions III, IV and V, which consisted of telephone exchanges, transmission links, a telegraph system, subscriber cables, and telephone sets. The project was implemented from 1990 to 1997 and cost PHP 1.16 billion (JICA 2002a).

The RTDP Northern Luzon was implemented in Regions I and II: Phase 1 was carried out in 1981-1987 and Phase 2 in 1988-1995. Phase 2 alone cost PHP 136.56 million (JICA 2002b). A succeeding project was implemented in Region III in 1993-2000 for a total loan of PHP 242 million (JICA 2003). Both were financed through ODA loans from the Japan International Cooperation Agency (JICA).

In the middle of the RTDP, the scope was revised because the liberalization of the country's telecommunications sector brought in new market players that competed with PLDT, which was a telecom monopoly for several decades until the late 1980s. In the end, the facility use rate of the RTDP was lower than that of private telcos that began operating in the covered project areas and because of the spread of cellular mobile telephone system (CMTS) usage. Hence, market competition and the emergence of a better technology overtook the project areas and landline facilities. In an independent evaluation, it was concluded that "even without the [RTDP]…it is possible that private service providers…would have filled in the perceived demand-supply gap" (JICA 2003, p.18).

The *Telepono sa Barangay Projects* had a net loan commitment of about USD 45 million.[21] The project targeted to establish telephone lines in 3,319 barangays in 14 municipalities with local, national and international telephone services. Every barangay would be provided with three payphones using phonecard for outgoing calls and one plain ordinary telephone system (POTS) for incoming calls. The government had planned to invite private telcos to take over the program, but no company wanted to touch it due to its unprofitability and huge capital requirements (Yao-Endriga 2000a, 2000b). In 2004, the TSB loan was closed with incomplete outputs (NEDA 2018). The Mindanao Telecommunications System Project had a loan commitment of USD111 million.[22]

The NTP, RTDP, and the Municipal Telephone Project did not result in the long-term improvement of telephone services, as the market soon overtook the government initiatives. The Philippine government continued paying for the loans until 2011 (Bagayaua-Mendoza 2008).

In April 2007, the Philippine government signed an agreement with the Chinese government for a contract with Zhong Xing Telecommunication Equipment (ZTE) Company to connect all government offices to the Internet. The national broadband network (NBN) project, which would cost USD 329 million, was to be funded by a loan from the Export-Import Bank of China (Philippine Daily Inquirer 2018). After top government officials were implicated in alleged

[21] The TSB Phase 1 cost USD 22.73 million and Phase 2 cost USD 22.66 million and was financed by the Export Development Corporation (EDC) and the Credit Commercial de France.
[22] Financing for the Mindanao Telecommunication Development Project was by the EDC (USD 99.45 million) and Italy II (Mediocreditor Centrale) (USD 11.58 million). See Commission on Audit (2009).

corruption over the proposed project, the contract was cancelled in October 2007 (ABS-CBN News 2016).

Before 2016, publicly funded broadband infrastructure was practically non-existent. Recognizing the growing role of ICT in economic development and nation-building, the Department of Information and Communications Technology (DICT) was created in May 2016. Since then, the DICT has been investing in the Free Public Wi-Fi Program and, since 2017, the Philippine Integrated Infostructure (PII) under the National Broadband Plan. According to the DICT, the PII aims to "provide a demand responsive core and aggregation network for national government agencies (NGAs), local government units (LGUs), public elementary and secondary schools, state colleges and universities (SUCs), public hospitals and rural health units (RHUs), among others located in the identified growth centers" (DICT 2017b, p. vii).

Funding for the free Wi-Fi program was bolstered when President Duterte mentioned the free public Wi-Fi project in his first state of the nation address (SONA) in 2016 and by the passage of RA 10929 or the Free Internet Access in Public Places Act in 2017.

The government, through the DICT, has allocated a total of P33 billion for the two flagship programs—which includes budget for personnel, maintenance and operation, and capital outlay for the NBP and Free Public Wi-Fi program—from 2015 to 2020 (**Table 2.3**).

Table 2.3. DICT Budget for Free Public Wi-Fi and the National Broadband Infrastructure, 2015-2020 (in PHP)

DICT Budget	2020	2019	2018	2017	2016	2015
Operations (including Free Wi-Fi)	4,983,017,000	5,781,337,000	4,018,542,000	172,850,000	239,343,000	
Free Wi-Fi in Public Places	50,000,000	1,166,401,000	1,362,700,000	1,758,161,000	1,651,760,000	1,408,000,000
Free Wi-Fi in SUCs	50,000,000	279,895,000	327,000,000			
Subtotal 1 (Free Public Wi-Fi Program)	**5,083,017,000**	**7,227,633,000**	**5,708,242,000**	**1,931,011,000**	**1,891,103,000**	**1,408,000,000**
ICT Systems and Infostructure Development, Management, and Advisory	1,935,928,000	3,507,847,000	2,923,746,000			
National Broadband Plan	296,461,000	1,043,329,000	50,621,000			
Subtotal 2 (PII)	**2,232,389,000**	**4,551,176,000**	**2,974,367,000**			
Subtotal 3 (Free Public Wi-Fi and PII)	**7,315,406,000**	**11,778,809,000**	**8,682,609,000**	**1,931,011,000**	**1,891,103,000**	**1,408,000,000**
Total (2015-2020)	**33,006,938,000**					

Source: Department of Budget and Management. National Expenditure Program, 2015-2020.

The key barrier to expanding the country's digital infrastructure is the existing archaic laws—designed for analog communication and broadcast services—that are being applied to digital connectivity. RA 7925, for example, provides that a public telecommunication entity (PTE) or a telco can build and operate a "network." While the law refers to telecommunications networks,[23] RA 7925 has been interpreted to mean that only a telco is allowed to build *any type* of network. Hence, the Philippines' digital infrastructure has been dependent on telcos, as other non-telco entities, such as Internet service providers (ISPs) and VAS providers, are only allowed to deploy facilities to connect their subscribers in the access network. This arrangement has resulted in a handful of telcos thriving and dominating the market, while the ISP industry remains small and restricted, with non-telco ISPs having very limited participation in expanding the country's digital infrastructure.

Licensing. Compared to its Asian neighbors, the Philippines has a multiple-step licensing process, which involve Congress passing a law for a telecom franchise as the first step to allowing market entry for a service provider and the industry regulator carrying out a quasi-judicial process[24] before it awards a provisional authority for an entity to operate a network. The whole process can take between 1 and 5 years. In Asia Pacific, the Philippines is the only economy that requires a franchise from Congress as part of licensing network operators. **Table 2.4** lists the licensing approaches in select Asia Pacific countries.

Table 2.4. Licensing of ISPs in Select Asia Pacific Countries

COUNTRY	LICENSING
Cambodia	License from Telecommunication Regulator of Cambodia (TRC)
Indonesia	License from Indonesian Telecommunications Regulatory Authority (BRTI)
Malaysia	License from Malaysian Communications and Multimedia Commission (MCMC)
Philippines	**Telco franchise law** passed by Congress; **PA/CPCN** issued by National Telecommunications Commission
Thailand	License from National Broadcasting and Telecommunications Commission (NBTC)
Singapore	License from Infocomm Media Development Authority (IMDA)
South Korea	Registration with Korea Communications Commission (KCC)
Japan	Registration with Ministry of Internal Affairs and Communications (MIAC) (If installing cable facilities); Notification to MIAC prior to providing telecoms services, including Internet

Source: Better Broadband Alliance, 2019; cited in World Bank, 2020a.

Foreign ownership. The Philippines has one of the most restrictive policy environments when it comes to foreign ownership in the telecommunications and broadband sectors. Among ASEAN countries, the Philippines sets the lowest ceiling for foreign ownership of a telco and

[23] RA 7925 identifies the following telecommunications service providers: local exchange operator (primarily voice-to-voice service), inter-exchange carrier (connects local exchanges within the Philippines to engage in national long distance services), international carrier (primarily transmission and switching of telecom service between the Philippines and any other point in the world), mobile radio service (mobile radio telephone system), and radio paging services (voice or data messages).

[24] The NTC is responsible for the regulation and quasi-judicial functions relative to the supervision, adjudication, and control of the country's radio communications, telecommunications, and broadcast, including cable television (CATV) facilities and services (DBM 2012, p.722).

ISP to 40 percent, compared to Indonesia's 67 percent, Thailand's 49 percent, and Vietnam's 53 percent (Rivas 2021).

Shared infrastructure policy. The country does not have a policy on sharing passive infrastructure such as dark fiber, ducts, and poles. In 2018, however, the DICT issued guidelines for common tower sharing. There is also no policy on cross-sector infrastructure sharing or coordinated buildout with other network infrastructure, such as with roads, bridges, water, and electricity systems.

Spectrum management. The main spectrum management policy of the country is Act 3846 or the Radio Control Law of 1931. It limits the installation and operation of a radio station to entities with a legislative franchise. This limits the use of wireless Internet technologies, especially in rural communities where wired networks absent or have limited reach. In terms of spectrum licensing, RA 7925 provides that an open tender may be carried out when the demand is higher than the supply. No bidding has ever been conducted in the country since 1995. In 2018, the NTC carried out a special process to select a third major telecom player who was assigned mainly 4G and 5G spectrum.

3. ICT Development for Promoting a More Innovative and Inclusive Society

3.1. Introduction

An estimated 4.66 billion people, equivalent to almost 60 percent of world population, are using the Internet as of January 2021 (Statista.com). The Internet and digitalization are firing up economies towards further growth. There is no stopping the rise of these technologies, but behind this pleasant scenario are disparities in connectivity, adoption, as well as the production of technologies. Digital divide remains, as most of the growth in connectivity is happening in developed countries (UNCTAD 2019). While, less developed countries (including some developing ones) are managing with poor, high-cost connectivity. Moreover, as regards digital platforms[25], which own high market capitalization value, about half of platform companies with a value of +$1 billion are based in the US, while a third are based in Asia, mostly in China (Albert 2020; Dutch Transformation Forum 2018). UNCTAD (2019) also reports that within countries, connectivity gaps are observed in terms of gender, income level, education, and geographical location. For instance, there are evidences of urban-rural and gender divides, especially in less developed and developing countries.

Digital divide means there are people and sectors that are left behind, unreached, 'excluded', and are deprived of the convenience, efficiency, productivity and growth brought by ICT and digitalization[26]. They are missing access to information and ICT-enabled services such as e-commerce, e-education, e-finance, and other digital platforms. A major purpose for digitalizing service is for its providers, e.g. education institutions, teachers; medical institutions and professionals, to reach the last-mile consumer, e.g. students; patients, especially those located in remote, unserved and underserved areas. In the same manner, ICT is being used in finance to serve the segments of the population that are not able to participate in the financial system (digital financial inclusion). The COVID-19 pandemic also revealed a significant contribution of these platforms in providing services amid restrictions in mobility and gathering of crowds. According to the e-conomy SEA 2020 report of Google, Temasek and Bain & Co. (2020), Internet usage in Southeast Asian countries has risen amid the pandemic, especially during the lockdown, with the Philippines continuing to have the highest usage, increasing to 5.3 and 4.9 hours on average spent online each day (during the hard lockdown, and after).

Despite the rising use of the Internet in the Philippines, the country ranks 101st rank out of 176 countries in ITU's ICT Development Index as of 2017, faring lower than the performance of its ASEAN peers. The country's performance in the index is an indication of the level of progress in ICT development, particularly in aspects of access, use and skills.

Using the 2019 NICTHS survey results, this section presents a micro-level inspection of the country's ICT development status by looking at the household's and individual's access, digital skills, and usage of digitalized services. It also provides some insights on how the country can improve and thereby harness and advance inclusion and innovation through ICT.

[25] Digital platforms are digital matchmakers; they can be defined as "digital intermediary and infrastructure that brings together various parties through the Internet to interact, thereby matching supply and demand in a multi-sided market" (Albert 2020, p. 15).
[26] Digitalization is the "incorporation of data and the Internet into production processes and products, new forms of household and government consumption, fixed-capital formation, cross-border flows, and finance" (IMF 2018, p.6).

Being inclusive and innovative with ICT

An inclusive society is characterized by participation, equity, and sustainable growth (Pacetti 2016). People are able to participate in economic as well as civic activities – as a worker, entrepreneur, consumer, and citizen. There is equal access to public goods, services and infrastructure for all segments of the society including the poor and marginalized. Economic opportunities are available and are yielding growths in income especially for the poor. Wealth is not only improving but more so, sustained and inter-generational. Meanwhile, an innovative society is one where new, creative ideas and methods drive growth. Innovative behavior favors development by improving productivity and competitiveness, service delivery, and overall well-being. When inclusive, technology reaches the remote and disconnected segments of the society, allowing them to participate in and benefit from innovation and advances in technology.

With ICT, society can be more innovative and inclusive. A significant contribution of ICT is that it breaks down information barriers (WB 2016) such as cost, lack of awareness about sources of information, and lack of access points. The use of technology reduces search and transaction costs, and makes it possible to manage access to an enormous amount of information from different sources through use of platforms.

ICT and digital technologies support participation and equity by facilitating universal access to information. In government, the use of online platform expands the reach of public service including the remote areas. Similarly, businesses are able to reach out to existing and potential clients and partners, distant or not. Information about opportunities are more widely available and equally accessible to job seekers through websites, online platforms and other services in the Internet. E-commerce, e-gov and business websites are some examples of how a vast amount of information is made available and accessible in a manageable way by use of technology.

Another contribution of ICT is that it supports new technology and encourages further innovation. ICT is supporting the growing digital economy, which includes the new business models such as the sharing economy, gig economy, digital finance, e-learning, etc. These are technologies that promote efficiency and inclusion. These platforms provide convenient, cost-effective, systematized delivery of services. They also provide jobs and incomes that were previously not available, untapped, or thought to be unlikely. Flexibility and opportunity for new and incremental income have become available and accessible with continuous innovation along with ICT.

Certainly, the status of ICT development matters a lot for these digital dividends or benefits to reach all segments of society. ICT has to be available and accessible widely, supported by infrastructure and institutions. Moreover, digital skills are as important in using ICT and exploiting its applications.

3.2. Access to ICT

Access is important to achieve inclusion through ICT. The SDGs have highlighted the importance of enhancing the use of ICT especially in the achievement of three goals:

- Goal 5 – Achieve gender equality and empower all women and girls;

- Goal 9 – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation; and
- Goal 17 – Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Access to ICT device (mobile or cellphone, computer) and the Internet are fundamental to gaining digital benefits.

The 2019 NICTHS results reveal that 24 percent of households own a computer[27]. A majority of these households, 64 percent, live in the urban areas (**Table 3.1**). Across regions, Region IV-A (43%), NCR (37%) and CAR (30%) have the most households with computer. Meanwhile, ownership is lowest in BARMM at eight percent, the only region with ownership lower than 10 percent.

Table 3.1. Proportion (%) of households by computer ownership, and alternative ways to access computer, by Region, Urban and Rural

Region /Area	With Computer	Without Computer	Total		If Without Computer, Alternative Ways to Access (multiple response)					
					Does not use other computers	School/ Work	Relatives/ Friends/ Neighbors	Barangay/ Community Computers (free-use)	Computer shops	Others
Region										
NCR	37.1	62.9	100.0		44.1	12.2	3.9	0.2	48.2	3.4
CAR	30.0	70.0	100.0		49.9	17.0	1.6	6.3	28.0	2.4
REGION I	23.3	76.7	100.0		56.1	5.1	7.0	0.2	36.2	4.9
REGION II	17.2	82.8	100.0		47.0	5.9	3.8	4.2	44.3	2.1
REGION III	23.2	76.8	100.0		62.6	6.3	5.5	1.0	32.8	0.3
REGION IV-A	42.7	57.3	100.0		36.1	16.5	6.5	0.1	50.3	4.0
REGION IV-B	14.4	85.6	100.0		50.5	30.3	3.7	0.6	23.7	5.3
REGION V	15.8	84.2	100.0		59.5	6.4	1.2	0.3	16.7	18.6
REGION VI	16.5	83.5	100.0		54.7	13.0	11.1	0.8	29.2	0.0
REGION VII	16.3	83.7	100.0		57.3	3.3	2.8	1.0	38.4	0.2
REGION VIII	14.2	85.8	100.0		57.6	13.8	1.8	0.3	27.4	6.6
REGION IX	11.4	88.6	100.0		51.7	13.4	2.1	4.3	35.6	1.4
REGION X	14.4	85.6	100.0		43.9	21.9	10.1	3.8	38.1	2.5
REGION XI	16.7	83.3	100.0		67.6	7.8	1.6	0.5	25.2	2.4
REGION XII	15.3	84.7	100.0		56.8	9.3	2.5	0.2	38.8	1.1
BARMM	8.5	91.5	100.0		55.8	9.4	9.2	6.3	27.8	0.1
CARAGA	16.0	84.0	100.0		70.8	12.1	1.0	0.5	22.5	0.2

[27] Defined in the 2019 NICTHS as desktop, laptop, tablet, etc., which can be used by any household member at any time.

Region /Area	With Computer	Without Computer	Total		If Without Computer, Alternative Ways to Access (multiple response)					
					Does not use other computers	School/ Work	Relatives/ Friends/ Neighbors	Barangay/ Community Computers (free-use)	Computer shops	Others
Area Classification										
Urban	30.0	70.0	100.0		46.7	11.9	5.6	1.1	43.4	2.9
Rural	17.3	82.7	100.0		59.1	10.5	4.2	1.3	28.6	3.2
Total	***23.8***	***76.2***	***100.0***		***53.3***	***11.2***	***4.9***	***1.2***	***35.6***	***3.1***

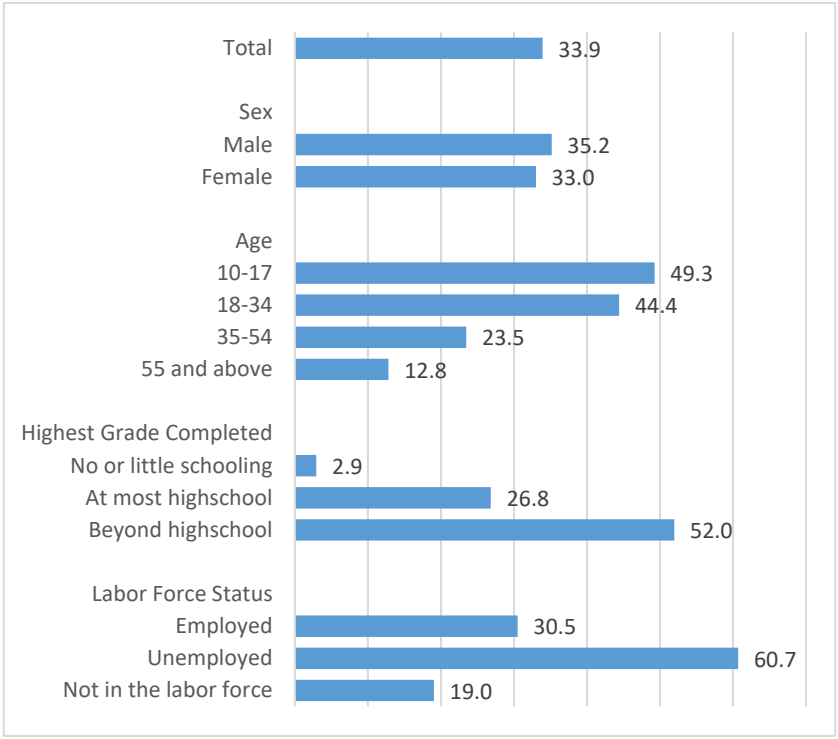
Source: 2019 NICTHS, DICT and PSRTI

About half of households that do not own a computer find alternative ways to access them. Most households (or 36%) turn to computer shops, while others get access through school/workplace (11%) and relatives, friends or neighbors (5%). There is also a small percentage that use free-to-use computers available in their barangay (1%). The survey results also indicate that around half of households without a computer do not use one or do not have ways for access.

Consistently, at the individual level, use of computer is as low as ownership of computer. Only about a third (34%) of individuals used a computer in the three-month reference period of the survey (**Figure 3.1**). In terms of magnitude of users, there are more women than men (56% versus 44%), but usage relative to population is higher among men than women though only at a small margin (35% of males, 33% of females). High usage is observed among individuals aged 10-17 years old (49%), and lowest among older population, 55 and above (13%). Interestingly, and perhaps surprisingly, at first glance, three-fifths of the unemployed (61%) used a computer, while among their employed[28] counterparts, only three tenths (30%) used a computer. This may be on account of the higher educational attainment of the unemployed that has been observed in various examinations of the labor force (Albert *et al*. 2015), as unemployment in the Philippines is not a concern of the middle class and not the poor since the poor cannot afford to stay unemployed. Computer usage is observed in half (52%) of individuals who studied beyond high school[29]; about a quarter (27%) for those that reached at most high school[30], and less than a twentieth (3%) for those with no or little schooling[31].

[28] Employer, Employee, Own-account worker/Self-employed, Member of Producers' Cooperatives, Contributing Family Worker, Worker not classified by status
[29] Post-secondary, College, Post-Baccalaureate.
[30] Elementary, K-12 program, ALS.
[31] No schooling, Pre-school.

Figure 3.1. Proportion (%) of Individuals that used a computer in the last 3 months, by individual characteristics



Notes: No or little schooling: No schooling, Pre-school; At most high school: Elementary, High School, K-12 program, ALS; Beyond high school: Post-secondary, College, Post-Baccalaureate. Employed: Employer, Employee, Own-account worker/Self-employed, Member of Producers' Cooperatives, Contributing Family Worker, Worker not classified by status; Not in the labor force: Student, Retired, Homemaker/Housewife, Person with Disability (PWD).
Source: 2019 NICTHS, DICT and PSRTI

Meanwhile, ownership and use of cellphone are much higher: 75 percent of individuals own at least one cellphone, and 79 percent used one in the last three months (**Table 3.2**); this is partly on account of household ownership of cellphones referring to joint use. The proportions of ownership are slightly higher among women than among men: around 8 in 10 women (77%), and 7 in 10 men (72%). A similar pattern is seen in use of cellphone: 81 percent among women, and 77 percent among men (See further discussions in the next chapter). Across age groups, highest grade completed, and labor force status, the proportions owning cellphones are over 60 percent, except for individuals with no or little schooling (46%) and with age 55 years old and above (59%). Generally, the same pattern is observed in use of cellphone.

Table 3.2. Proportion (%) of individuals that own at least one cellphone and used a cellphone in the last 3 months, by individual characteristics

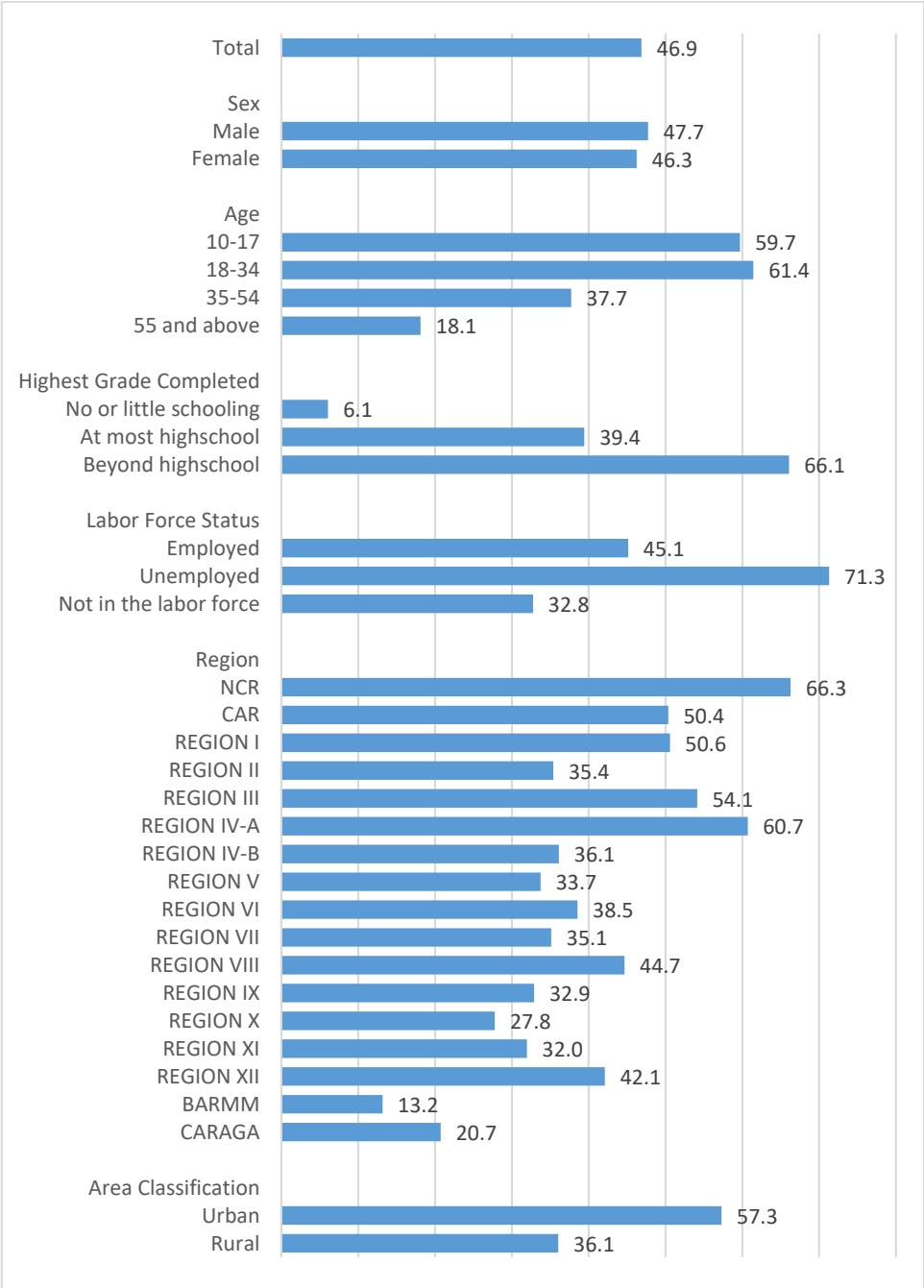
	Own at least one cellphone	Used a cellphone (in the last 3 months)
Total	75.3	79.0
Sex		
Male	72.5	76.6
Female	77.4	80.8

	Own at least one cellphone	Used a cellphone (in the last 3 months)
Age Group		
10-17	61.9	73.2
18-34	87.6	88.9
35-54	79.6	81.6
55 and above	58.9	61.0
Highest Grade Completed		
No or little schooling	45.7	43.9
At most high school	68.5	73.4
Beyond high school	92.8	93.7
Labor Force Status		
Employed	79.5	81.1
Unemployed	82.0	86.1
Not in the labor force	74.3	76.5

Notes: No or little schooling: No schooling, Pre-school; At most high school: Elementary, High School, K-12 program, ALS; Beyond high school: Post-secondary, College, Post-Baccalaureate. Employed: Employer, Employee, Own-account worker/Self-employed, Member of Producers' Cooperatives, Contributing Family Worker, Worker not classified by status; Not in the labor force: Student, Retired, Homemaker/Housewife, Person with Disability (PWD).
Source: 2019 NICTHS, DICT and PSRTI

As for connectivity, half (47%) of individuals used the Internet in the last three months (**Figure 3.2**). The proportion of Internet users is higher among residents in urban areas (57%) than in rural areas (36%). Across regions, Internet penetration is highest in NCR, Region IV-A and III (over 60%); and lowest for residents in BARMM and CARAGA (13-20%). Internet use by men is quite close to that of women: 48 percent and 46 percent, respectively. Among age groups, usage is highest among the younger population – 10 to 34 years old; and lowest among the older population – 55 years old and above. Education correlates with Internet use: i.e., the proportion of Internet users is higher for those who have higher education attainments (of high school to post-baccalaureate), compared to who had no or little schooling. The proportion of Internet users is high among both the employed and the unemployed, but the figure is a lot higher (around 25 percentage points) among the unemployed. Among those not in the labor force, only a third (33%) use the Internet. Results of the 2019 NICTHS also indicate that half of students used the Internet; while for PWDs, only around one in ten used the Internet.

Figure 3.2. Proportion (%) of individuals that used the Internet in the last 3 months, by individual characteristics



Notes: No or little schooling: No schooling, Pre-school; At most high school: Elementary, High School, K-12 program, ALS; Beyond high school: Post-secondary, College, Post-Baccalaureate. Employed: Employer, Employee, Own-account worker/Self-employed, Member of Producers' Cooperatives, Contributing Family Worker, Worker not classified by status; Not in the labor force: Student, Retired, Homemaker/Housewife, Person with Disability (PWD).
Source: 2019 NICTHS, DICT and PSRTI

Among mobile technologies, 4G/LTE is the highest cellular network signal received by majority of households (68%) in the barangay where they reside **(Table 3.3**). The other technologies, 3G and 2G, are available for 24 percent and seven percent of households,

respectively. In urban areas, 84 percent of households have access to 4G, while those in the rural areas, only half have access to the same cellular network signal. Among regions, nearly all households in NCR receive 4G signal. The adjacent regions, Regions III and IV-A, follow NCR in terms of 4G coverage (81% and 79%, respectively). In BARMM, majority of households are still connected to 2G (44%); and in Region V, 3G is the highest network signal available (50%).

Meanwhile, Internet connection at home is rather low. Approximately one in five households (18%) have Internet connection at home which can be accessed by any member at any time. The proportion is quite similar in urban areas (24%), and lower in rural areas (11%). Across regions, NCR and CAR had the most households with Internet connection at home. They are followed by Region IV-A and III. Households without Internet connection are mostly in BARMM at 95 percent, followed by Regions IX, X, IV-B and V (all over 90%) (**Table 3.3**). The survey results also suggested that some households who do not have Internet connection at home have members with individual/personal connection (9%), and have access to the Internet elsewhere (5%). The NICTHS also revealed that there are households that do not have Internet connection at home because of lack of knowledge or information: households report either they do not know how to use the Internet (16%), or do not know what the Internet is (6%). Based on the individual survey, lack of awareness about the internet is observed mostly in older adults.

Table 3.3. Home and mobile connectivity (% of households)

	With Internet connection at home	Ave. monthly spending for Internet connection at home (PHP)	Highest cellphone network signal available at the barangay		
			2G (E or G)	3G (H or 3G+ or H+)	4G (LTE or 4G+ or LTE-A)
Total	17.7	1,280.59	7.3	24.5	68.2
Region					
NCR	33.2	1,505.08	0.0	4.2	95.8
CAR	29.8	1,057.47	5.4	29.4	65.2
REGION I	18.0	1,127.49	4.7	23.6	71.7
REGION II	18.0	770.86	4.4	42.3	53.2
REGION III	23.5	1,192.08	2.3	16.2	81.5
REGION IV-A	24.2	1,453.23	3.3	18.1	78.6
REGION IV-B	7.6	942.62	10.2	37.0	52.8
REGION V	7.3	1,042.11	23.0	49.7	27.3
REGION VI	10.4	1,111.66	10.8	23.6	65.6
REGION VII	10.3	1,538.36	7.9	31.8	60.3
REGION VIII	16.6	704.95	7.1	40.1	52.8
REGION IX	6.2	1,215.73	10.3	40.5	49.2
REGION X	6.5	1,289.88	19.7	28.2	52.1
REGION XI	12.8	1,175.20	11.5	28.0	60.5
REGION XII	10.2	1,106.63	5.2	32.5	62.3
BARMM	4.5	395.25	44.3	35.7	19.9
CARAGA	7.7	1,229.97	12.9	30.8	56.3

	With Internet connection at home	Ave. monthly spending for Internet connection at home (PHP)	Highest cellphone network signal available at the barangay		
			2G (E or G)	3G (H or 3G+ or H+)	4G (LTE or 4G+ or LTE-A)
Area Classification					
Urban	23.6	1,406.99	2.0	13.8	84.2
Rural	11.4	1,008.33	13.4	37.0	49.6

Source: 2019 NICTHS, DICT and PSRTI

On average, Filipino households reported to have spent PHP1,280.59 monthly on home Internet subscription. Families in urban areas spent more than those in the rural areas (PHP 1,406.99 and PHP 1,008.33 per month, respectively). Across regions, average monthly spending was highest in NCR and Region IV-A. The average spending is above PHP 1,000 for all regions except for BARMM and Region II (**Table 3.3**). Connectivity is not only about accessibility, openness and security, it also has to be affordable (WB 2016). Comparing with the indicative monthly family income of Filipino poor to low income families of five at 2017 prices (Albert *et al.* 2018),[32] the average spending on home Internet connection is estimated at around 13 percent of monthly family income of the poor and a maximum of about seven percent of monthly family income of the low-income class.

The 2019 NICTHS results also indicate that among ICT devices used to access the Internet, cellphones are most commonly used (85%). Aside from cellphones, half of individuals aged 10-17 years old use the desktop computer. Looking closely at ownership of ICT devices, more than half of households do not have a communal cellphone and computer (**Table 3.4**). Assuming that an easily-accessible cellphone is an alternative to a computer, this somehow describes the situation for households when blended learning was implemented in the basic education system during the community quarantine implemented amid the COVID-19 pandemic. Moreover, the survey indicates high cellphone ownership among the school-aged, but it is unclear whether they own/use a smart phone, which is more appropriate for online classes.

Table 3.4. Device ownership of the household (%)

Household shared devices	
Has Communal Cellphone & Computer	5.0
Has Communal Cellphone, No Computer	19.1
Has Computer, No Communal Cellphone	18.8
No Computer, No Communal Cellphone	57.2

Source: 2019 NICTHS, DICT and PSRTI

A nationally representative survey conducted by the Social Weather Stations (SWS) on November 21-25 2020 provides further insights on the use of devices particularly during the

[32] Indicative range of monthly family incomes (for a family of 5) in the Philippines at 2017 prices:
Poor (less than official poverty threshold): Less than PHP 9,520;
Low-income class, but not poor (between poverty line and twice the poverty line): Between PHP 9,520 and PHP 19,040 (Albert *et al.* 2018).

pandemic. The SWS survey revealed that 58 percent of enrolled school-aged Filipinos (5-20 years old) used devices for remote learning (SWS 2021). Among those who purchased or rented the device, majority used smartphone (79%), and the rest used desktop/laptop (13%), TV (5%), and tablet (3%). Majority of these families already owned a device (27%), while the others purchased (12%), borrowed (10%), given (9%), or rented (0.3%). Additionally, there were 42 percent that did use devices for distance learning.

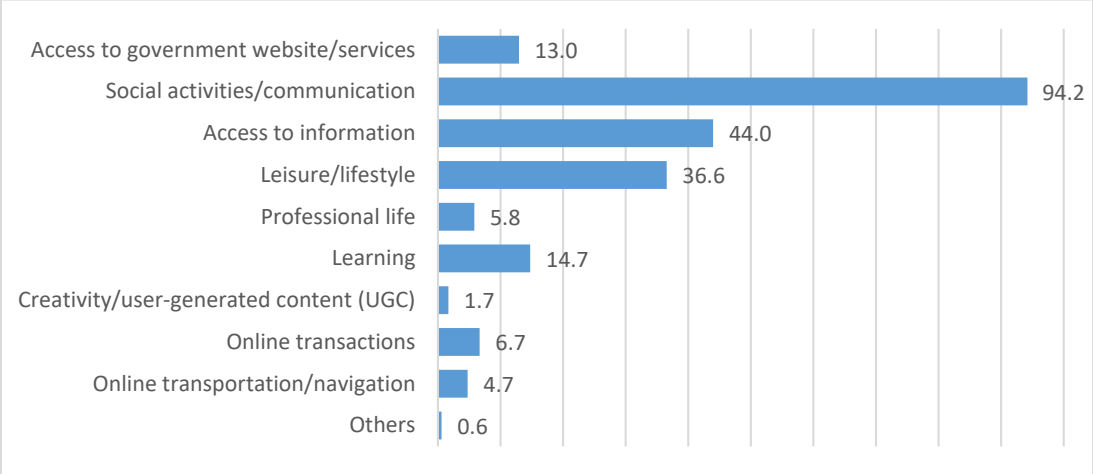
Aside from e-education, there was an increased need for remote access to other services during the community quarantine. Services like telemedicine also require device to connect to the Internet or communicate with a professional. To carry out payments, remittances, and other financial activities online (digital finance), the use of ICT devices and connectivity is likewise needed.

3.3. Digital Skills

The advent of new technology demands new skills. In this era of digitalization and FIRe, digital skills are inevitable in work or business and even in daily life. Anyone who is not skill-ready for digitalization will be left behind; and they may find new opportunities and potential benefits difficult to come by, compared to those who are already armed with digital skills. As WB (2016) puts it, automation without skills creates inequality.

The 2019 NICTHS results reveal that households mostly use their Internet connection at home for social media and communication with family and friends (90%), followed by Entertainment such as movies and games (67%), Studies (school, projects, research) (66%), and Work or business (52%). At the individual level, the top Internet activity is social activities and communication, which is performed by 94 percent of Internet users (**Figure 3.3**). This is consistent with findings that the Philippines is the social media capital of the world, with nearly 4 hours spent on the social media platforms (We Are Social and Hootsuite 2020). Coming in at far second rank in Internet activity to social activities and communication is access to information, which involves use of online search engines, reading general information, and downloading of files/software (44%). Third highest activity is online gaming, downloading music and streaming, which are under the leisure and lifestyle category (37%). Overall, the results indicate that Filipinos are knowledgeable about using ICT in communications, accessing information, creating content, learning (academic research, online course, etc.), and e-commerce/financial transactions.

Figure 3.3. Internet users' online activities in the last 3 months (% of individuals)



Source: 2019 NICTHS, DICT and PSRTI

Looking closely at specific digital skills, Communication and Entertainment/Gaming are what most individuals have capabilities in (**Table 3.5**). Furthermore, the older adult males and females are into communications, and the working age female and young males are into entertainment/gaming. As for other skills, the working-age population possess skills in Data management and analysis, and Use of modelling, simulation and rendering software, more than the youth. Between sexes, females dominate males in skills related to communication, sending emails, creating documents, encoding, file management. On the other hand, males dominate females in skills that are rather intermediate such as data management and analysis, use of modeling and simulation software, and basic arithmetic formula in spreadsheets. Meanwhile, across regions, the same trend in the proportions per digital skill is observed in general (Annex 3.1). However, the data also indicate that BARMM, and to some extent, Region X, have the least ICT-skilled population, especially in the more intermediate ICT activities.

Table 3.5. Digital skills by sex and age group (% of individuals)

	Male						Female						Total				
Digital Skill	**10-14**	**15-24**	**25-64**	**65 and above**	**All Ages**		**10-14**	**15-24**	**25-64**	**65 and above**	**All Ages**		**10-14**	**15-24**	**25-64**	**65 and above**	**All Ages**
Communication	48.2	63.0	76.9	86.5	65.7		55.4	66.8	79.3	84.9	71.6		51.8	65.0	78.4	85.3	69.0
Entertainment and Gaming	81.3	74.4	67.1	51.9	72.8		56.7	53.8	59.0	34.1	56.2		69.2	63.8	62.1	38.9	63.4
Distance/Online/Computer-aided Learning	21.5	22.2	18.5	15.6	20.7		27.3	29.0	18.1	12.0	23.2		24.3	25.7	18.3	13.0	22.1
Using copy and paste tools to duplicate/move information (files/folder)	10.7	23.2	25.5	10.3	21.7		17.6	31.4	20.5	6.1	23.8		14.1	27.4	22.4	7.2	22.9
Transferring files between a computer and other devices	4.7	22.4	24.0	20.9	19.8		10.9	24.4	20.3	3.0	20.1		7.7	23.4	21.7	7.8	20.0
Sending emails (plain text)	3.6	19.6	35.4	22.5	22.5		4.8	25.2	27.5	22.9	23.5		4.2	22.5	30.5	22.8	23.1
Sending emails with attached files (document, picture, video)	3.2	22.2	32.8	22.3	22.7		9.6	28.0	23.6	6.6	23.0		6.3	25.2	27.1	10.8	22.8
Data encoding	11.0	21.1	22.2	17.2	19.7		14.6	29.6	20.8	12.5	23.0		12.7	25.5	21.3	13.8	21.5
Finding, downloading, installing and/or configuring software	4.1	10.1	9.7	8.0	8.8		6.9	14.7	8.5	1.1	10.4		5.4	12.5	9.0	3.0	9.7
Running software program	0.7	3.0	8.1	1.4	4.4		1.5	5.6	4.9	1.1	4.6		1.1	4.4	6.1	1.2	4.5
Using basic arithmetic formula in a spreadsheet	1.8	5.3	11.6	10.9	7.1		2.0	6.0	7.1	0.0	5.8		1.9	5.7	8.8	3.0	6.4
Creating documents using a word processing software	8.9	17.4	19.7	14.7	16.7		19.2	23.7	15.4	4.0	18.7		14.0	20.7	17.0	6.9	17.8
Creating electronic presentations with software	2.1	8.6	10.9	7.9	8.2		3.4	10.5	7.7	0.0	8.0		2.7	9.6	8.9	2.2	8.1
Data management and analysis	0.8	4.2	7.3	7.4	4.8		0.9	3.9	5.1	0.1	4.0		0.8	4.1	5.9	2.1	4.3
Using modelling, simulation and rendering software	0.8	2.7	5.4	0.4	3.3		1.0	1.9	1.5	0.0	1.6		0.9	2.3	3.0	0.1	2.3
Others	3.2	2.0	1.2	4.3	1.9		2.4	2.2	1.0	2.4	1.7		2.8	2.1	1.1	2.9	1.8

Source: 2019 NICTHS, DICT and PSRTI

Table 3.6. Proportion (%) of youths and adults with ICT skills, by type of skill and sex (SDG 4.4.1), ASEAN countries

	Brunei Darussalam (2018)			Malaysia (2018)			Singapore (2018)	Thailand (2018)			Philippines (2019)		
ICT skill	**Both Sexes**	**Female**	**Male**	**Both Sexes**	**Female**	**Male**	**Both Sexes**	**Both Sexes**	**Female**	**Male**	**Both Sexes**	**Female**	**Male**
Using basic arithmetic formula in a spreadsheet	42.4	42.4	42.4	25.9	24.6	27.2	40.7	15.1	16.5	13.6	7.2	6.4	8.2
Using copy and paste tools to duplicate or move information within a document	59.5	59.5	59.5	57.4	56.0	58.8	53.9	19.8	21.1	18.3	24.5	24.8	24.1
Sending e-mails with attached files	56.5	56.5	56.5	43.8	40.8	46.5	59.4	14.7	15.7	13.5	25.8	25.0	26.9
Creating electronic presentations with presentation software	37.5	37.5	37.5	24.2	20.6	27.5	39.7	8.5	9.1	7.9	9.1	8.7	9.6
Finding, downloading, installing and configuring software	42.6	42.6	42.6	34.7	33.4	35.9	54.9	4.6	4.5	4.6	10.5	11.0	9.9
Transferring files between a computer and other devices	52.4	52.4	52.4	43.4	40.6	46.0	47.0	11.3	11.5	11.0	22.2	21.6	23.1

Notes: Three ICT skills listed in SDG 4.4.1 are not included in this table as data is not available for the Philippines.
Data covers youth and adults *(PH: 15 years old and above)*
Source: Global SDG Indicators Database (https://unstats.un.org/sdgs/indicators/database/), except for Philippines-2019 NICTHS (DICT and PSRTI)

The digital skills listed in the 2019 NICTHS captures six of the nine ICT skills identified for monitoring the SDG Indicator on digital skills, Indicator 4.4.1, i.e., Proportion of youth and adults with ICT skills, by sex and type of skill. [33] The six digital skills are:

- Using basic arithmetic formula in a spreadsheet
- Using copy and paste tools to duplicate or move information within a document
- Sending e-mails with attached files
- Creating electronic presentations with presentation software
- Finding, downloading, installing and configuring software
- Transferring files between a computer and other devices

The 2019 NICTHS results indicate that close to half of the youth (aged 15-24) have at least one ICT skill identified in the SDG 4.4.1 (**Table 3.7**). They compose the majority of the population with such skills, followed closely by the working-age population. As for the older adult population (65 and above), fewer people are ICT-skilled. Meanwhile, between sexes, generally more females are skilled (41% versus 38%), but there appear differences with age. Among the youth (and even younger ones), more females are skilled, while among the working-age and older adults, more males are skilled. It appears that while in school, females tend to acquire skills more than males; but in a working environment, the males acquire skills more than females (especially since males participate in the labor market more than females).

Table 3.7. Proportion (%) of individuals that have at least one of six ICT skills identified for measuring SDG Indicator 4.4.1

	Age Group				
Sex	10-14	15-24	25-64	65 and above	Total
Male	16.1	40.7	45.2	30.8	37.8
Female	30.4	52.3	37.4	13.4	41.4
Total	23.1	46.7	40.3	18.0	39.8

Source: 2019 NICTHS, DICT and PSRTI

Comparing the results per skill with the 2018 ASEAN data in the Global SDG Indicators Database of the UN Statistics Division, we see that the Philippines has one of the lower proportions of ICT-skilled youth and adult population (**Table 3.6**). It fares a little bit better than Thailand (2018 data) in all digital skills, except on "Using basic arithmetic formula in a spreadsheet". A gender analysis reveals that the proportion of digital skills among men and women in the Philippines differ across skills; while, in Malaysia the proportions are higher for men, and in Thailand, higher for women, regardless of digital skill.

3.4. Consumption of digitalized services in business and government

Engagement of people as a consumer and user of ICT-enabled services shows behavior towards opportunities brought by ICT in both the government and private sectors. One useful information from the 2019 NICTHS is the type of e-commerce transactions done by Internet users through website/social media/mobile application. The survey results indicate that purchase of goods/services online is the most performed online activity in the last 12 months

[33] This indicator is under the 4.4. target: By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship (UN 2020, p.5).

(20%) (**Table 3.8**). Relatively, a smaller proportion of individuals do other activities such as online payment of bills, online banking, online booking of delivery services, transportation, accommodation, online selling of goods/services, and stock trading/online investment. Ranking of e-commerce activities do not appear to differ between urban and rural dwellers, but the proportions indicate that there are more Internet users in urban areas versus rural areas that engage in the listed online activities.

Table 3.8. Proportion (%) of Internet users by e-commerce transactions done in the last 12 months

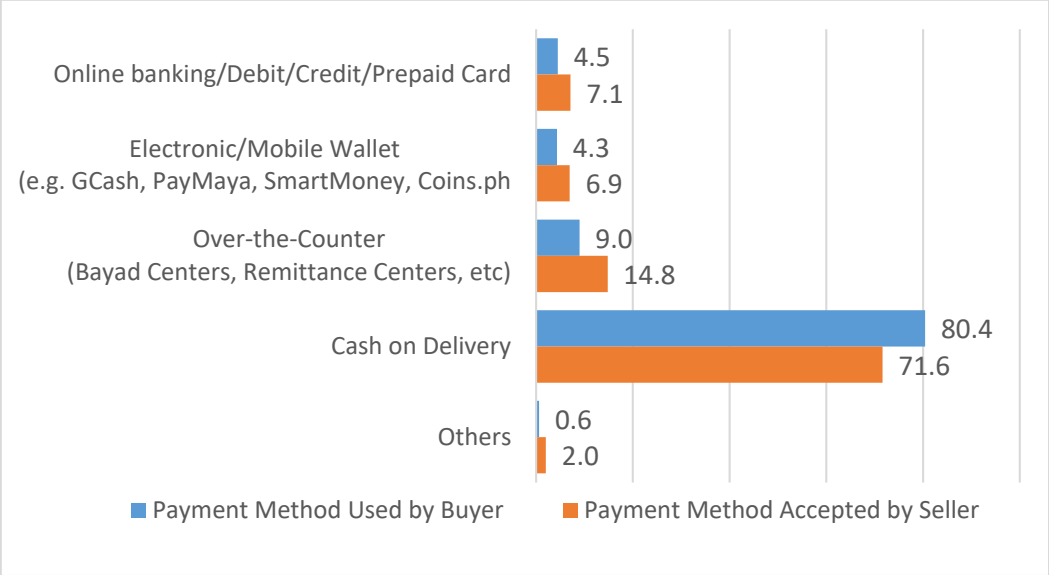
Types of e-commerce transactions done in the last 12 months*	Urban	Rural	Total
Payment of bills online (electricity, water, Internet, credit card)	7.7	3.7	6.2
Online banking (checked account balance, transferred/received funds)	6.8	4.6	5.9
Online booking of delivery services (delivery of food, gadgets, packages, *etc*.)	6.0	3.2	4.9
Online booking of transportation services (flights, car)	3.7	1.3	2.8
Online booking of accommodation services (booked hotels, airbnb)	1.8	1.4	1.6
Purchase of goods/services online	23.5	15.9	20.6
Stock trading and online investments	0.3	0.2	0.3
Selling of goods/services online	3.9	3.4	3.7
Others	0.3	1.6	0.8

*Through website/social media/mobile application.
Source: 2019 NICTHS, DICT and PSRTI

The survey results also reveal that a high percentage of Internet users (74%) did not have any e-commerce-related activity in the last 12 months. As pointed out earlier, this validates the finding from We Are Social and Hootsuite (2020) that most Internet users spend their time in activities related to communications/social and gaming/entertainment. The low e-commerce activities may be associated with appreciation, exposure, as well as trust. The survey data indicate that those who do not buy or sell online are not interested in the platform and lack knowledge or skills in performing such transactions. Trust concerns related to warranty, return/refund, scamming and product quality, are also reasons for not shopping online, validating results from the Global Findex database 2017 report that trust is a major barrier to use of digital payments in the Philippines (Demirgüç-Kunt *et a*l. 2018). Nonetheless, there is still high hope for increased e-commerce activities, especially that it has become an income source. More than half of online sellers recommend selling online as it is a good source of income. Based on the 2019 NICTHS, those who depend on online selling as primary source of income earn an average of PHP 10,368.72 per month; and those who depend on it as incremental income earn PHP 5,737.49.

Meanwhile, online shopping payments are largely done through Cash on Delivery (**Figure 3.4**), again consistent with the Global Findex database 2017 report *(*Demirgüç-Kunt *et al*. 2018*).* Among online buyers, 80 percent pay in cash, and among online sellers, 72 percent of payments were received in cash. Over-the-counter payments are done as well, but electronic payments are the least used among payment modes.

Figure 3.4. Payment methods used in online purchase and selling (% of individuals)

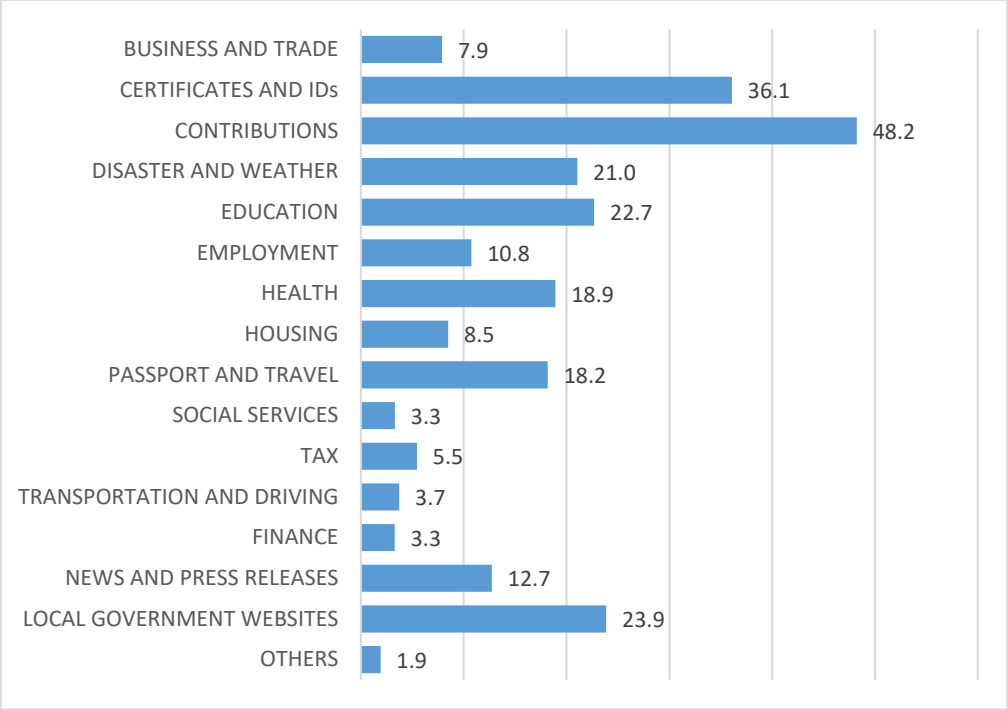


Source: 2019 NICTHS, DICT and PSRTI

The 2019 NICTHS results indicate that majority of individuals (42%) do not use electronic payments (online banking or electronic money) in online purchases because of security concerns, particularly, in giving personal and card details. The same is true across age groups or sex. However, for those with little or no schooling, lack of awareness about electronic payment is a major reason for not using such platform (77%).

In the area of public service delivery, innovations have been and are continuously being developed to respond better to the needs of the people. For instance, websites have been used to give access to information and encourage interaction. The survey results indicate that websites are available in major services-related government agencies, and are being accessed. Most people visit the websites whose services are related to contributions, e.g. Social Security System (SSS), Government Service and Insurance System (GSIS), PhilHealth, Pag-Ibig (48% of individuals) (**Figure 3.5**). It is followed by services related to application/issuance of certificates and IDs (36%). Many Internet users also visited websites pertaining to local government (24%), education (19%), disaster and weather (21%), health (19%), and passport and travel (18%). The lowest website visits are in finance and social services-related websites (both at 3%).

Figure 3.5. Government websites/services accessed in the last 3 months (% of individuals)



Source: 2019 NICTHS, DICT and PSRTI

Efforts have also been made to improve digital inclusion of the people. For one, the Free Public Internet Access Program (Free Wi-Fi for All)[34] was created to provide free Internet access in public places including local government offices. DICT reported that the program has deployed 7,556 active live sites as of December 2020 (DICT 2021). What the 2019 NICTHS has captured is that merely 15 percent of individuals live in a barangay with Free Wi-Fi (offered by public or public entities and does not specify if under the Free Wi-Fi for All program).

Meanwhile, there are barangays that offer free-to-use equipment. It is found that half (47%) of individuals live in a barangay with free-to-use computers (desktop, laptop, tablet). For households and individuals that do not have easy access to a device and the Internet, these government programs can help bridge the gap in connectivity. Connecting to the Internet and devices have costs. Based on the 2019 NICTHS, households spend on average of PHP 1,280 for monthly Internet connection at home. In the November 2020 Social Weather Survey, families with enrolled students spent an average of PHP 8,687 for the device they used in distance learning, such as smartphone, desktop, laptop or tablet (SWS 2021). The efforts being done by the government can be further strengthened to increase coverage of Free Wi-Fi points and availability of free-to-use ICT equipment.

Linked to accessing digitalized services are concerns over being protected online. Cybersecurity refers to protection from unauthorized access and illegal use of networks, devices and data, and the assurance of the confidentiality and integrity of information (CISA 2019). It involves prevention, detection and response to cyberattacks ("Cybersecurity" 2021). Malicious online attempts include theft of personal information and identity to make unauthorized transactions, and attack on information systems to erase and alter files or steal

[34] The program is established under the Free Internet Access in Public Places Act (RA 10929).

confidential data. Cyberattacks target adults and children, businesses/organizations, and potentially national security when it reaches the information systems of transportation, communication, power, etc. There has been increased online activities since the COVID-19 pandemic – financial and commercial transactions, social media usage and electronic communications, online gaming, which warrant greater vigilance against malicious and unlawful online attempts that compromise safety especially of vulnerable groups including the youth and children.

The 2019 NICTHS contains some information about awareness of cybersecurity and data privacy, and experience in cyber incidents. The results indicate that less than half of Filipinos (44%) have heard of cybersecurity and data privacy, and reporting of cyber incidents by victims is extremely low. About one in four Filipinos (24%) reported themselves being a victim of a cyber incident (text scam/SMS fraud, hacking, phishing, cyber bullying/libel). Text scam/SMS fraud was the most reported cyber incident. Of the victims, only three percent reported the incident to authorities. Majority of the victims (80%) reported the incident to the concerned company (e.g. bank, social media platform, telco), approached their family, friends, teachers/school officials. Meanwhile, a fewer proportion reported the incident to the barangay (5%), the police (6%), and a government agency/official (12%). Given these results, there is cause to increase awareness about the Cybersecurity law as well as the Data Privacy Act, to encourage victims to report incidents to the proper authorities, and prepare the concerned government authorities to respond to these incidents especially with the current surge of online activities.

3.5. Summary

The 2019 NICTHS results reveal that the wide gaps in ICT access are more evident in some sectors than others. As regards gender, men and women have minor disparities in both use of devices and access to the Internet (though women may not be harnessing ICT for economic empowerment as is to be shown in the next chapter). Both the employed and unemployed are connected, though the latter are more active (likely because the unemployed tend to have a higher educational attainment). Meanwhile, significant disparities are observed in terms of geographical location, age and education. Households living in rural areas and the less or non-metropolitan regions have lower device ownership, Internet access, as well as quality of connectivity (cellular network signal), which will be discussed in a later chapter in more detail. The older adults and the less-schooled have lower device ownership and are less connected.

A major proportion of Filipinos, regardless of sex, age or location, are active in communication, entertainment and gaming, more than any other digital activity or skill. The NICTHS results reveal that about four in ten individuals have at least one of six ICT skills monitored for SDG Indicator 4.4.1. Generally, more women are ICT-skilled than men, but when age is considered, the pattern changes. Among the young, the proportion of digitally skilled females are higher; while among adults (working-age and older), the proportion for ICT-skilled males are higher. It appears that among the school-age population, females tend to acquire ICT skills more than males; but in a working environment, more males have ICT skills (especially as males are more active in the labor market). Exploring the NICTHS data further suggests that women dominate men in digital skills such as communications, and file creation and management; while, more men are skilled in activities related to using modeling and simulation software, and data management and analysis.

The survey results also reveal that Internet users access digital services that are available in government and the private sector. However, there seems to be low activity in areas that the government and private sector are advocating, such as e-commerce and digital finance (electronic payments, online banking, etc.), at least prior to the pandemic. Purchase of goods/services online is the most identified e-commerce activity, but payments are largely done in cash. Concerns such as security and lack of awareness are bottlenecks to the use of digital services.

These findings from the NICTHS help identify which groups, sectors and segments of the society need further targeting and attention in policymaking particularly to improve connectivity, digital skills, and digital transformation, and ensure that digital dividends get to be more inclusive.

4. ICT, Gender, e-Livelihood and e-Entrepreneurship

4.1. Introduction

ICT is permeating almost all aspects of life, providing quicker ways for people to access information and interact with one another.[35] More and more people are going online to conduct their social and economic activities. One of the benefits of the rise of digital platforms such as social media and online work platforms is that it allows a vast number of people to gain livelihood and work opportunities beyond the traditional market instruments.

It is important to examine whether ICT is an equalizing or a polarizing variable in many facets of life. This chapter examines the gender dimensions in ICT use and online entrepreneurship, making use of results of the 2019 NICTHS. This survey, the first of its kind in the country, provides nationally representative data for analyzing ICT usage as well as online entrepreneurship among individuals and households. In particular, we examine the usage of ICT devices (like cellular phones and computers, and the Internet) by each of the sexes. We also analyzed online entrepreneurship of women and men, though limited to engaging in online selling as this is the only information that the NICTHS offers. Notwithstanding the data constraints, the chapter provides a correlational analysis which offers important, albeit initial, insights with respect to differences in online economic activities of Filipino women and men. The research questions this analysis aims to examine include: (i) Are there gender disparities in ICT use and online entrepreneurship? (ii) What are the characteristics of individuals engaging in online entrepreneurship? (iii) What facilitates the growth of online entrepreneurship among men and women?

The objectives of the analysis are to – 1) examine gender dimensions of ICT use and e-entrepreneurship, 2) describe the characteristics of men and women doing online entrepreneurship, and 3) provide policy recommendations about improving gender equality in ICT use and online entrepreneurship.

4.2. ICT Usage of Women and Men

The NICTHS shows that women are slightly at an advantage in several aspects of ICT use (**Figure 4.1**). There are relatively more women (81%) than men (7%) who use the cellular phone. A simple t-test shows that the observed gap is statistically significant. There are also slightly more women (51%) than men (47%) who are aware that they can conduct business transactions online. There is also a higher proportion of women (11% of women Internet users) than men (9%) who have set up their online buying/selling account, and who purchase goods and services online as well.

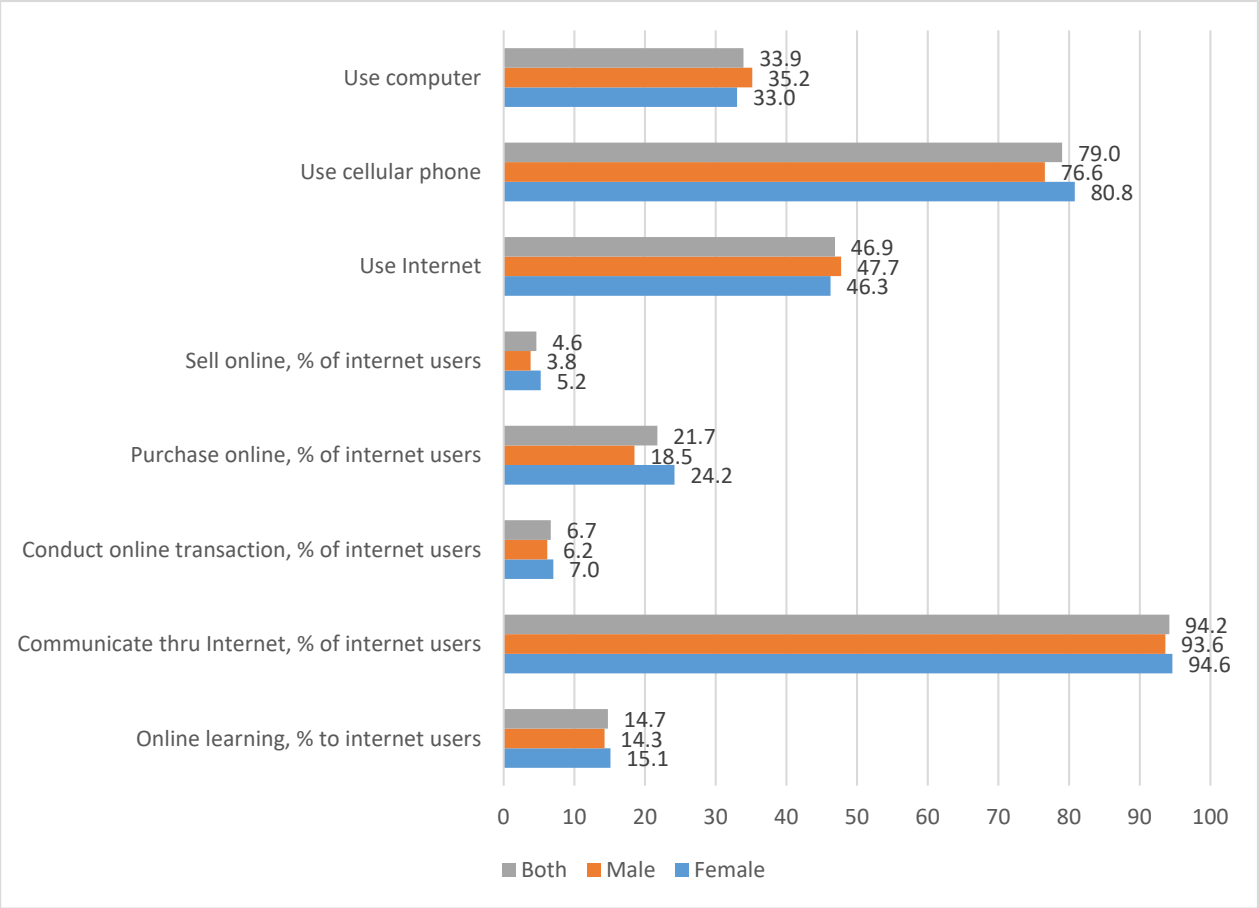
In other aspects, women's performance is at par with that of men. Based on percentage to total, there are no disparities between men and women in terms of Internet and computer usage, with the observed gap being statistically not significant Women are at par with men in having an online bank account and in using electronic wallets. Regarding earnings, male online sellers earned more than female online sellers in 2019 – PHP 10,898 per month on the average

[35] https://itchronicles.com/information-and-communication-technology/the-importance-of-information-and-communication-technology-ict/#:~:text=Importance%20of%20ICT&text=of%20some%20kind.-,ICT%20permeates%20all%20aspects%20of%20life%2C%20providing%20newer%2C%20better%2C,has%20an%20immense%20economic%20significance.

compared to PHP 6,041 for women. Whether this difference is attributable to sex has not been established because other possibly confounding factors have not been controlled for.

Relatively more women (5%) than men (4%) do engage in online selling. And there is a slightly higher proportion of women (93% compared to 89% for men) online sellers who have confidence in online selling that they positively recommend it to others. More women (79%) than men (63%) perceive that online selling is a good income source. Many of them (73% of women online sellers while 65% of male online sellers) also do recommend that online selling offers fast transaction.

Figure 4.1. ICT usage (in %), by sex



Source: 2019 NICTHS, DICT and PSRTI

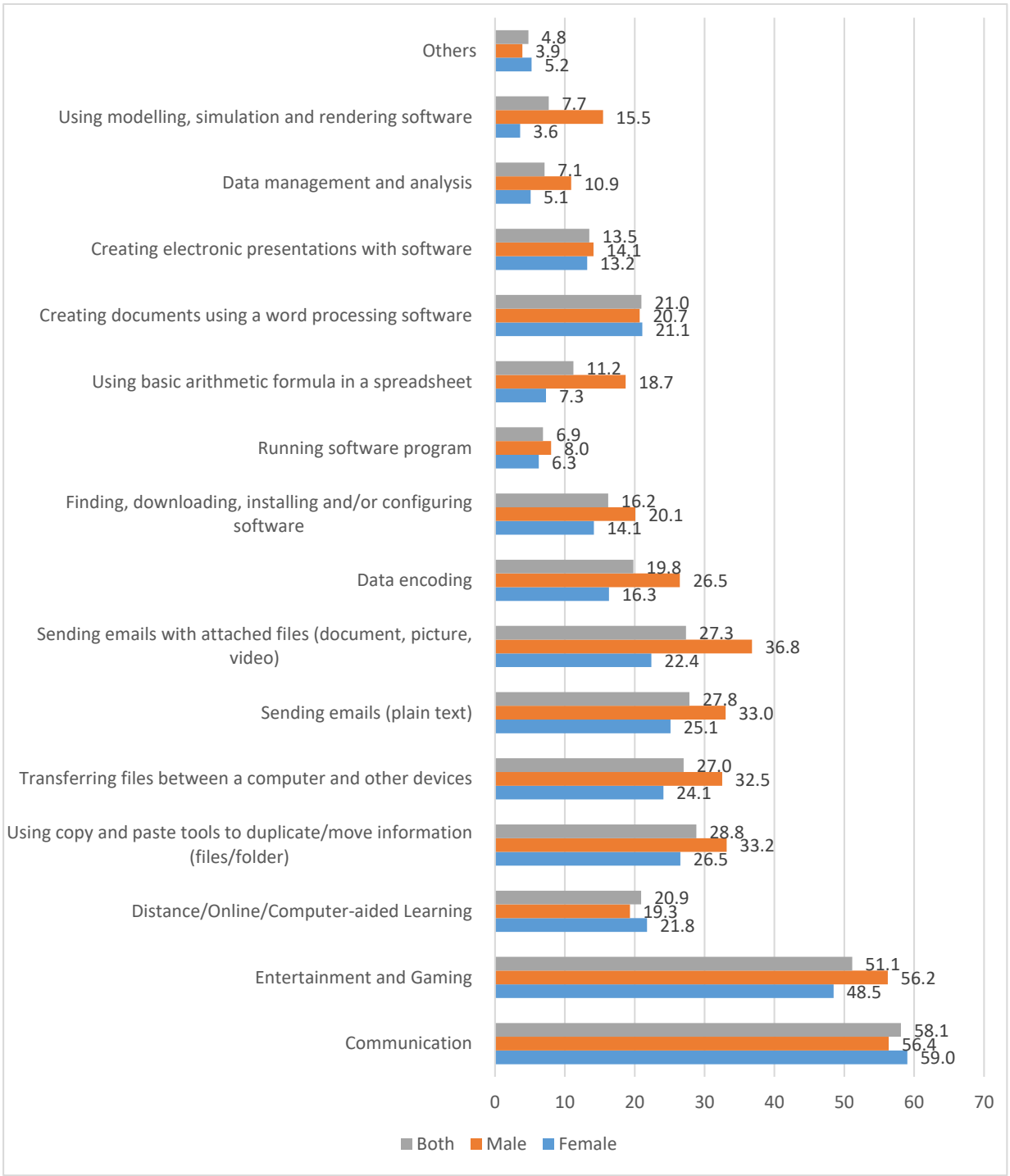
4.3. Characteristics of online sellers

As much as one in four women online sellers (25%) are employed, and this is consistent with the finding that online selling is a supplementary income source for many women. The group of homemakers and self-employed comprises 36 percent of all women online sellers. Interestingly, even those who report themselves to be unemployed conduct online entrepreneurship.[36] Both men and women who are conducting online work, online selling in particular, are mostly college educated ones.

[36] Per the Philippine Statistics Authority (PSA), being employed refers to working or having a job for at least 1 hour within the reference week; online selling for at least one hour would therefore qualify the individual as employed.

If we isolate online sellers as a group and compare it with the general population attributes in terms of digital skills (**Figure 4.2**), we noted that there is higher rate of the following computer activities or abilities among online sellers compared to the general population: transferring files between computer and other devices (27% versus 20%), sending emails with attached files (27% versus 23%), and using copy and paste tools to duplicate or move information (29% versus 23%). There is a lower proportion of individuals who are into online gaming and entertainment among online sellers (51% compared to 63% for the general population).

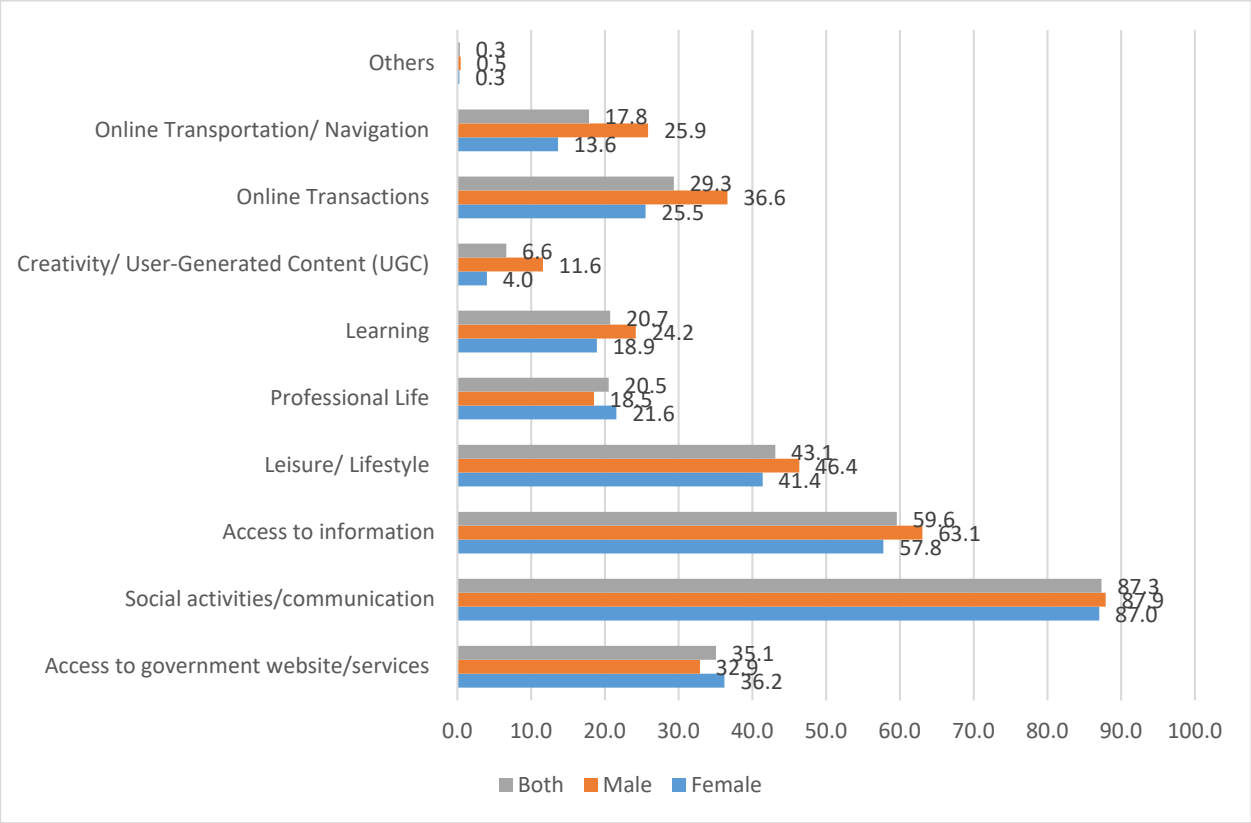
Figure 4.2. Purposes of computer usage of online sellers only (%), by sex



Source: 2019 NICTHS, DICT and PSRTI

As regards Internet usage (**Figure 4.3**), we observe a significantly higher proportion of those doing online transactions among online sellers (29%) when compared to the general population (7%). This is also the case for accessing information online (60% among online sellers compared to 44%), accessing government website (35% versus 13%), conducting professional life activities (20% compared to 6%). Online sellers are likely to be technology-savvy as there is significantly higher proportion of them who purchase goods online (62%) compared to that of the general population (26%). Likewise, the proportion of online sellers is also higher than the corresponding shares of the general population who use the Internet for paying bills (19% versus 6%), and online banking (23% versus 6%).

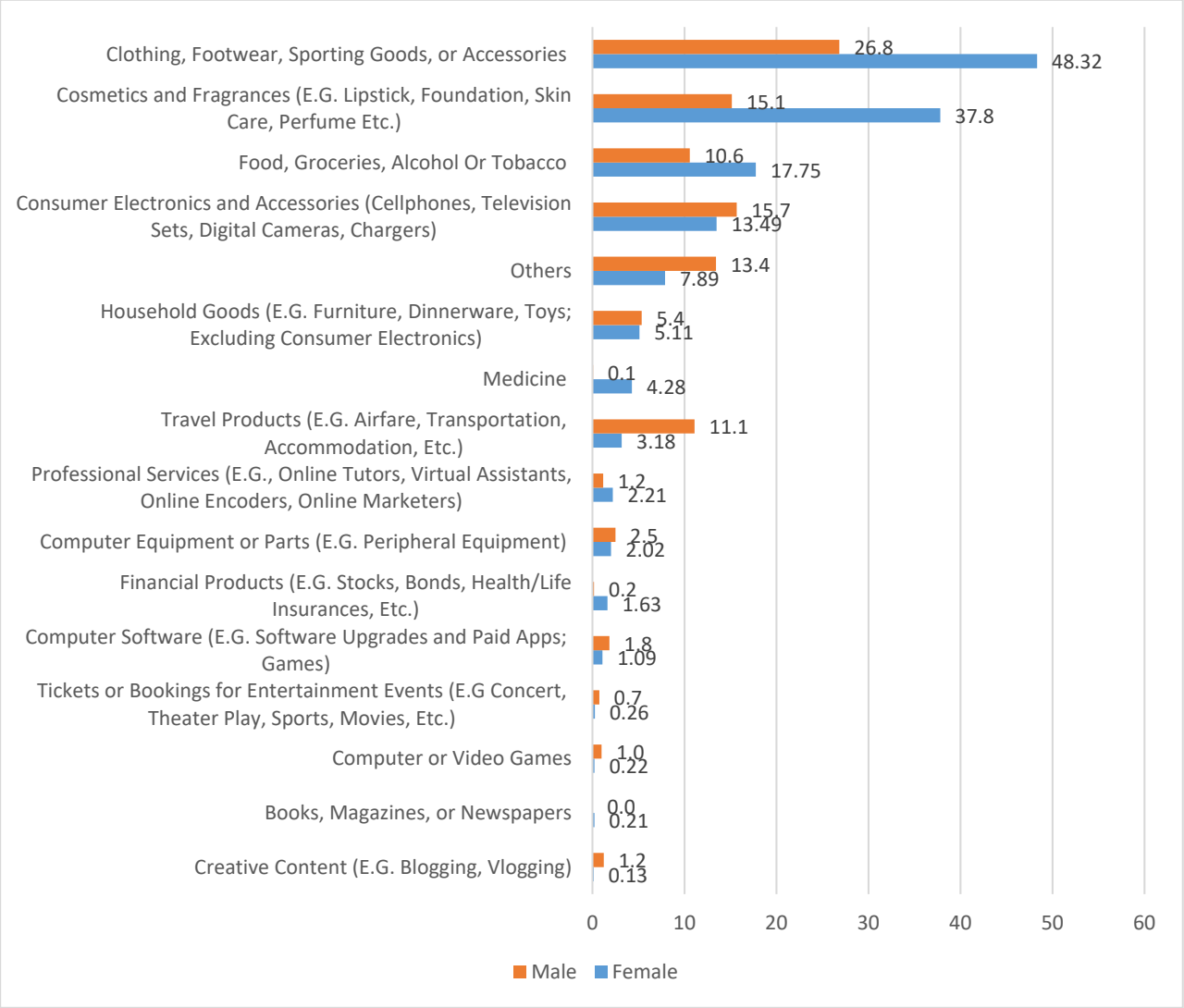
Figure 4.3. Purposes of Internet usage of online sellers only (%), by sex



Source: 2019 NICTHS, DICT and PSRTI

The most common products being sold in online platforms by women are clothing, footwear, sporting goods and accessories with half (48%) of women online sellers selling these (**Figure 4.4**). Another popular merchandise category among women is cosmetics and fragrances with 38 percent. For men, the most popular goods being sold are also clothing and footwear (27%), followed by consumer electronics and accessories (16%).

Figure 4.4. Products sold by online sellers by sex, 2019



Source: 2019 NICTHS, DICT and PSRTI

4.4. Correlates of online entrepreneurship among women and men

We conducted a simple logit regression to examine the correlates of online selling. The results (**Table 4.1**), which are limited to analysis of individual person characteristics, show that online entrepreneurship, which is narrowly defined as engaging in online selling, is significantly more likely among women, married, and more educated individuals, *ceteris paribus*. There is a non-linear relationship between online selling and age all factors being equal: as a person become older, there is greater chance of engagement in this activity but this relationship reverses among very old persons. Holding other factors constant, there is also a higher chance that someone pursues online entrepreneurship among those who have completed an ICT course compared to those who did not complete an ICT course. The econometric results also show that *ceteris paribus*, there is lower chance for individuals in the rural areas to engage in online selling compared to those in urban areas.

Table 4.1. Regression results for engaging in online entrepreneurship (Dependent variable = engaging in online selling, 1, otherwise, 0) on individual and household demographic characteristics [Model 1]

Correlates	Coef.		Std. Err.	Z	P>Z	[95% Conf. Interval]	
Female	0.382	***	0.002	162.940	0.000	0.377	0.387
Age	0.028	***	0.001	50.440	0.000	0.027	0.029
Age squared	-0.001	***	0.000	-91.410	0.000	-0.001	-0.001
Married	0.090	***	0.003	31.990	0.000	0.085	0.096
Household head	0.108	***	0.004	30.130	0.000	0.101	0.115
Completed an ICT course	0.856	***	0.003	251.900	0.000	0.850	0.863
Finished basic education only (include K-12)	-0.166	***	0.006	-28.830	0.000	-0.178	-0.155
Finished at least college	0.343	***	0.006	60.310	0.000	0.332	0.354
Household Variables							
Has access to internet	0.455	***	0.002	201.950	0.000	0.451	0.460
Urban area	0.147	***	0.002	64.310	0.000	0.142	0.151
_cons	-3.781	***	0.010	-364.480	0.000	-3.802	-3.761
Number of observations	9,775						
Prob > chi2	0						
Pseudo R2	0.037						

Source: 2019 NICTHS, DICT and PSRTI; Authors' computation

We also tested the correlation between some labor force characteristics and online selling (**Table 4.2**). Our analysis indicates that being an own-account worker or self-employed has a higher likelihood of doing online selling compared to being employed. Interestingly, this is also the case for being unemployed and being a student. These results suggest that students and unemployed are less time-constrained to do online selling work. Own-account workers or self-employed persons are also likely to have greater flexibility making online entrepreneurship more attractive. We also found a greater likelihood among members in producers' cooperatives

for doing online selling job compared to employed persons. People in urban areas have a higher likelihood of engaging in online selling that those in the rural areas.

Table 4.2. Regression results for engaging in online entrepreneurship (Dependent variable = engaging in online selling, 1, otherwise, 0) on individual and household demographic characteristics [Model 2]

Correlates	Coef.		Std. Err.	Z	P>z	[95% Conf. Interval]	
Female	0.451	***	0.002	188.780	0.000	0.446	0.455
Age	0.041	***	0.001	59.660	0.000	0.040	0.043
Age squared	-0.001	***	0.000	-100.400	0.000	-0.001	-0.001
Married	0.118	***	0.003	39.280	0.000	0.112	0.123
Household head	0.024	***	0.004	6.680	0.000	0.017	0.032
Completed an ICT course	0.970	***	0.003	278.530	0.000	0.963	0.976
Finished basic education only (include K-12)	-0.103	***	0.006	-17.710	0.000	-0.115	-0.092
Finished at least college	0.465	***	0.006	80.270	0.000	0.454	0.477
Household Variables							
Has access to internet	0.451	***	0.002	198.020	0.000	0.447	0.456
Urban area	0.193	***	0.002	83.490	0.000	0.188	0.197
Labor Variables (Basis Category is Employed Worker)							
Contributing family worker	-0.897	***	0.022	-41.670	0.000	-0.939	-0.854
Employer	-0.881	***	0.018	-49.920	0.000	-0.915	-0.846
Homemaker/Housewife	-0.179	***	0.004	-43.420	0.000	-0.187	-0.171
Member of producers' cooperatives	1.153	***	0.006	191.620	0.000	1.141	1.165
Own-account worker/Self-employed	0.994	***	0.003	308.800	0.000	0.988	1.000
Student	0.706	***	0.006	118.100	0.000	0.694	0.717
Unemployed	0.257	***	0.004	66.880	0.000	0.249	0.264
Worker not classified by status	-0.498	***	0.005	-96.060	0.000	-0.508	-0.487
_cons	-4.341	***	0.013	-326.040	0.000	-4.367	-4.315
Number of observations	9732						
Prob > chi2	0						
Pseudo R2	0.061						

Source: 2019 NICTHS, DICT and PSRTI; Authors' computation

4.5. Summary

Data from the NICTHS show that there are no large disparities in ICT access at the individual person level, consistent with the literature. There are even aspects where women are at an advantage over their male counterpart such as in the use of cellular phone. which is the main

instrument for accessing the Internet. Women also report great confidence with online selling as an additional source of livelihood.

The survey data also shows that men outperform women in monthly earnings from online selling activities, though there can be other factors associated with the difference. A recent study by Dacuycuy *et al*. (2020) noted that there is difference between the earnings of men and women in platform work when personal attributes and other characteristics are controlled for. Clearly, policies and programs must be developed to improve ICT access so that more people, both women and men, can benefit from ICT for accessing welfare-enhancing information, and for improving their livelihood (and consequently socio-economic mobility).

Addressing gaps in education and training is an essential step towards improving people's ability to harness the gains from ICT, but there will be a need for behavioral research to gain insights on ICT skills gaps between women and men, and particularly investigate why women may not be harnessing ICT for economic empowerment, e.g., whether this is largely stemming from the persisting expectation for women to carry the burden of unpaid home care, and if so, what interventions could address this issue on time-use. Re-skilling or training older people on the use of ICT and how ICT can aid them in their daily living and economic activities is also an important step for bridging the gap in ICT use between the youth and elderly population. In a broader scale, enhancing skills and capacities of individuals in using online platforms for conducting transactions (i.e., bank transactions, online payment, online booking) is a necessary step so that more people can benefit from it. More in-depth analyses and research are needed to examine why there is a very low incidence of using online platforms for these transactions. The constraints may very well be connected with the usual issues in accessing formal financial institutions. Policies will thus be needed for government to move toward full digitalization of processes, including financial transactions, and prepare everyone, both women and men, the young and the elderly, as this transformation results.

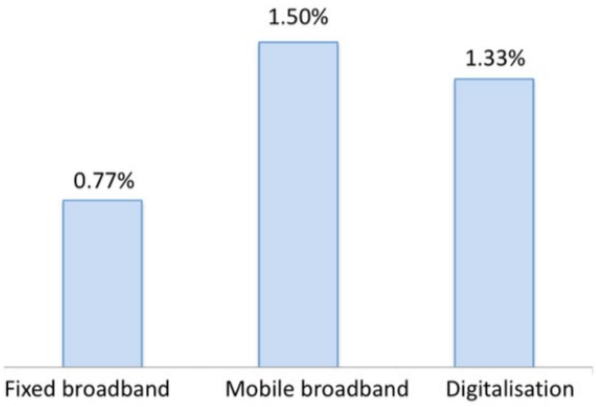
5. Digital Infrastructure Development

5.1. Introduction

The link between Internet penetration and economic growth has long been established: a 2009 report from WB (Qiang and Kimura 2009) estimated that between 2000 and 2006, countries with a 10-percent increase in broadband penetration experienced a 1.35 percentage point increase in GDP. At the micro-level, an Ericsson (2014) study found that introducing entry-level broadband connection of 0.5 Mbps was enough to increase household income in less developed countries by US$800 per year.

More recently, an ITU study prepared by Katz and Callorda (2018) showed that the economic impact of ICT penetration is maximized once broadband infrastructure reaches critical mass. Thus, in developing countries with significant mobile broadband penetration, broadband connectivity was seen to contribute as much as 1.5 percent to GDP growth. On the other hand, in developed countries, the economic impact of fixed broadband, which is more accessible in higher income countries, is higher compared to less developed countries. (Katz and Callorda 2018[37]) The study's findings also imply that in order to unleash the economic impact of technology, emerging economies must strive "to dramatically increase their penetration of broadband" (Katz and Callorda 2018, p. 3). **Figure 5.1** illustrates a comparison of the economic impacts of broadband and digitalization with a 10 percent increase in penetration for the period 2004-2015.

Figure 5.1. Economic impacts of broadband and digitalization due to a 10 percent increase in penetration: 2004-2015



Source: Katz and Callorda (2018, p.51)

Since Internet access is a key determinant of economic development and higher income level, countries must strive to increase their Internet penetration rate and access to digital infrastructure, which will allow digitalization. However, merely having access to fast and reliable connectivity is not enough to drive a country's digitization.[38] The Internet must also be ubiquitous, affordable, and usable, and citizens must be equipped with the right skills to take advantage of Internet-enabled goods and services (El-Darwiche *et al*. 2012). Affordability is

[37] The study created a database of 140 countries containing data between 2004 and 2017.
[38] "Digitization" is the use of digital products and services. It encompasses the infrastructure of digital services, connectivity of devices, the digital transformation of households and production, the development of digital industries, and the availability of digital factors of production (Katz and Callorda 2018, p.1).

particularly crucial for the digitalization process in developing countries, as "[…t]he existence of affordable network links is the basis for launching new applications, services and pervasive information exchange." (Katz *et al*. 2013, p. 8).

Access to reliable and affordable connectivity is at the heart of the digital divide, which refers to "the gap between the individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities and access to ICTs and to their use of the Internet for a wide variety of activities" (OECD, 2001, p. 3). The urban-rural digital divide is pervasive globally, even in the United States[39] and the European Union,[40] where the rural segment of the population still lacks the infrastructure for a decent broadband connection. Wealth is also a factor in the digital divide, with lower income people using mobile devices to access the Internet, if at all.[41]

The novel coronavirus (COVID-19) pandemic, which forced almost all countries to go on lockdown and impose mobility restrictions, became a catalyst to increase broadband penetration. The public health crises emphasized the importance of digitalization to support resilience (WB 2020b). From institutional connectivity—i.e., Internet access in offices and schools—and shared access in commercial establishments and public places, connectivity has shifted to individualized connectivity, where Internet is accessed primarily in homes and by the individual. This allowed people to continue doing everyday activities, such as work from home, online learning (Li and Lalani 2020), finance (Euart *et al*. 2020), doing business (Kane *et al*. 2020), and government transactions, while preventing the spread of the virus. Even in countries that were once laggards in digitalization, Internet connection that was viewed as a "nice-to-have" in pre-pandemic days, instantly became an essential infrastructure (ITU 2020a).

However, not all countries are able to cope with the huge demand for Internet-enabled activities when the pandemic struck. In the Philippines, businesses lamented the unreliable—and sometimes absent—Internet connection of their employees at home. Citing poor Internet service and unstable electricity supplies Some business process outsourcing (BPO) industry players,[42] found the work-from home infrastructure in the Philippines is not best environment for contact center work (Quimba and Calizo 2018).[43]

Going forward, the WB has suggested that innovative solutions should be used to support the re- opening of the economy. It is forecasted that the shift to digital platforms, such as for e-commerce, financial services, digital public service and social protection delivery, are likely to continue after the lockdown. Therefore, "widely reliable and affordable access to Internet will be critical to ensure business continuity" (WB 2020b, p. 3). Albert (2020) also points out the need for measuring in particular the platform economy.

The critical importance of digital content and services for citizens and economies, and of interconnecting players within the digital value chain, underscores the urgent need to have access to reliable, secure, and affordable digital infrastructure. Otherwise, the absence, or

[39] In a 2019 Pew Research survey, it was found that rural Americans generally remain less likely than urban or suburban adults to have a home broadband or own a smartphone. (Perrin, 2019)
[40] In 2020, EU Commission President Ursula van der Leyen stated in her State of the Union speech that 40% of people in the rural areas of the EU still do not have access to fast broadband connections. (von der Leyen, 2020)
[41] Anderson & Kumar (2019)
[42] According to HSBC Holdings economist Noelan Arbis, the call center segment of BPOs in the Philippines alone accounted for 8% of GDP and directly employed 1.3 million people as of June 2020. See Einhorn & Alegado (2020).
[43] See also Dancel (2020) and Einhorn & Alegado (2020)

inadequacy, of infrastructure that responds to social and economic demands will have a negative impact on the whole digital ecosystem (ITU 2020a).

In the review of the literature (Chapter 2), we provided some definitions of technical terms on the digital infrastructure, and a profile of the Philippine digital infrastructure. The heart of the discussion is in the next section on the NICTHS results.

5.2. NICTHS results on the digital infrastructure

In order to identify the digital infrastructure gap in the Philippines, mapping the key elements of the network is crucial. This entails "identifying sources of **backhaul capacity**, such as fiber-optic cable routes and PoPs, in order to understand the amount of capacity that will be available for the access network – and its cost" (ITU 2020b, p.22).

The NICTHS is a welcome source of data on the availability of broadband infrastructure and access to ICT services at the community, household, and individual levels. As an initial effort, the NICTHS captures access of barangays to key ICT infrastructure, which can be used to validate reports on capital expenditure for the expansion and improvement of broadband networks. However, it is not expected that the NICTHS can provide information on international links, backbone and middle mile, as such infrastructure segments cannot be identified by survey respondents. The NICTHS provides, for the first time, a glimpse into the access network. Of particular importance is the availability of ICT infrastructure at the barangay and of Internet connections at home, which is essential in the context of the pandemic and is crucial for the push toward universal access and digitalization.

Below are the highlights of the NICTHS results as they pertain to digital infrastructure:

5.2.1. Community Survey

Access to digital and related infrastructure among surveyed barangays

Among barangays where households were interviewed for the NICTHS[44], only one out of twenty (5%) reported having access to *all* broadband infrastructure and services (Table 5.1). These broadband infrastructure and services include ISP, fiber optic cable, free public/private Wi-Fi, public/private telecom tower). Of the barangays that reported having access to all, 89 percent are urban barangays, while 11 percent are rural barangays.

Table 5.1. Proportion (%) of surveyed barangays with electricity, ICT infrastructure, and service providers

	Urban	Rural	Total
Electricity	99.6	97.7	98.5
Free-to-air Digital TV signal	50.6	34.2	40.9
Cellphone signal	97.8	88.1	92.0
4G Signal	82.6	43.8	60.6
3G Signal	15.2	40.6	29.6
Telecom company	72.5	42.0	54.5

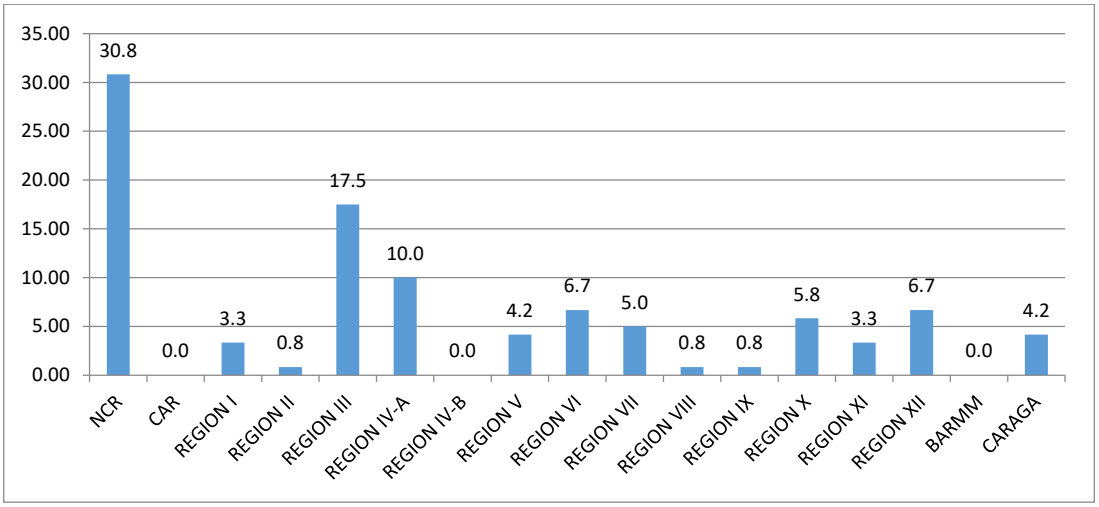
[44] The qualified respondent for the NICTHS community survey is preferably one responsible in approving or managing permits related to ICT infrastructure and services in the barangay. If no records in the barangay exist (like permits for installation of fiber optic cables) to answer the question, the answer will be dependent on the best knowledge of the respondent.

	Urban	Rural	Total
Telco tower	61.3	18.9	36.3
Internet service provider	92.1	71.1	79.6
Free Wi-Fi	23.9	4.1	12.2
Fiber optic cable	53.3	11.9	28.8

Source: 2019 NICTHS, DICT and PSRTI

By region, NCR has the highest reported access to all broadband infrastructure at 31 percent. Three regions, viz., Cordillera Administrative Region (CAR), Region IV-B (MIMAROPA), and the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) reported zero complete presence of all broadband infrastructure and services (**Figure 5.2**).

Figure 5.2. Proportion (%) of surveyed barangays with presence of all broadband infrastructure

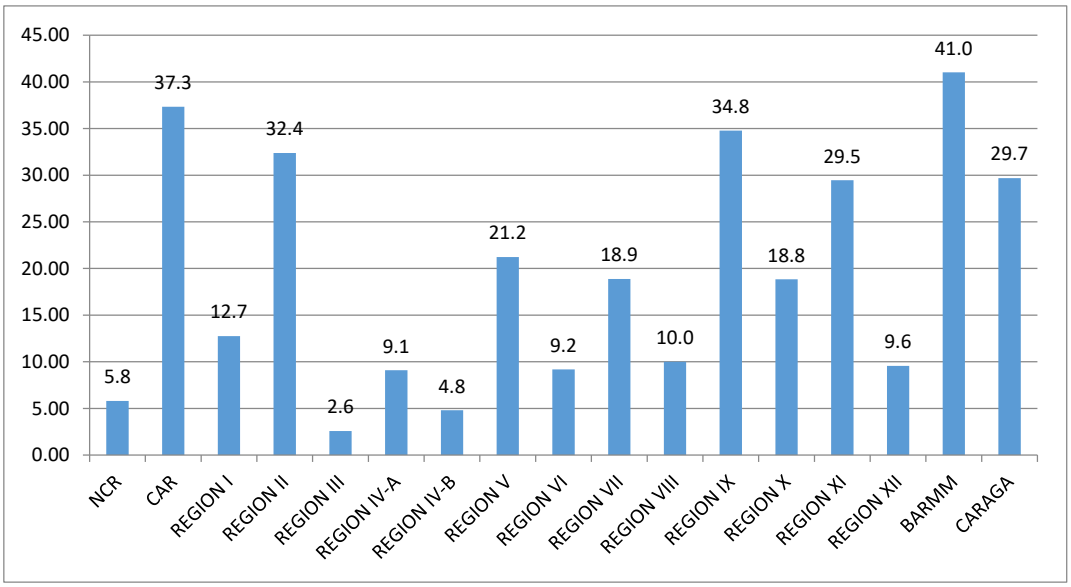


Source: 2019 NICTHS, DICT and PSRTI

Barangays with all broadband infrastructure and service, *except* for free public/private Wi-Fi, is reported at 13 percent of all surveyed barangays. Of the barangays that reported, 86 percent are urban barangays and 14 percent are rural barangays.

On the other hand, 17 percent of all barangays reported not having all of the broadband infrastructure and services. This is highest in BARMM with 41 percent of barangays and lowest in Region III (Central Luzon) at three percent (**Figure 5.3**).

Figure 5.3. Proportion (%) of surveyed barangays with absence of all broadband infrastructure

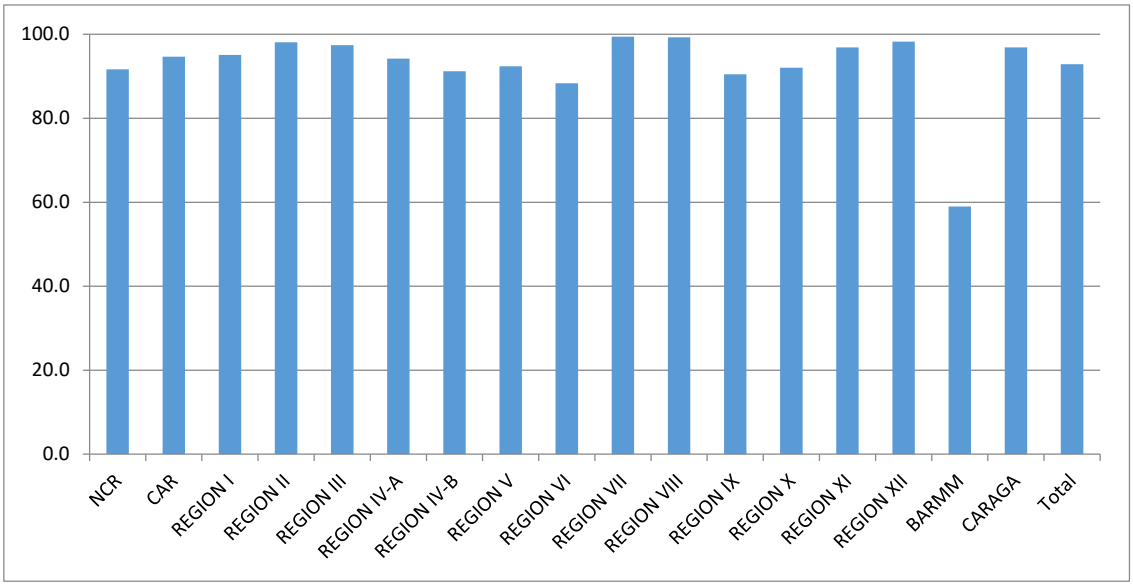


Source: 2019 NICTHS, DICT and PSRTI

Near universal access to electricity

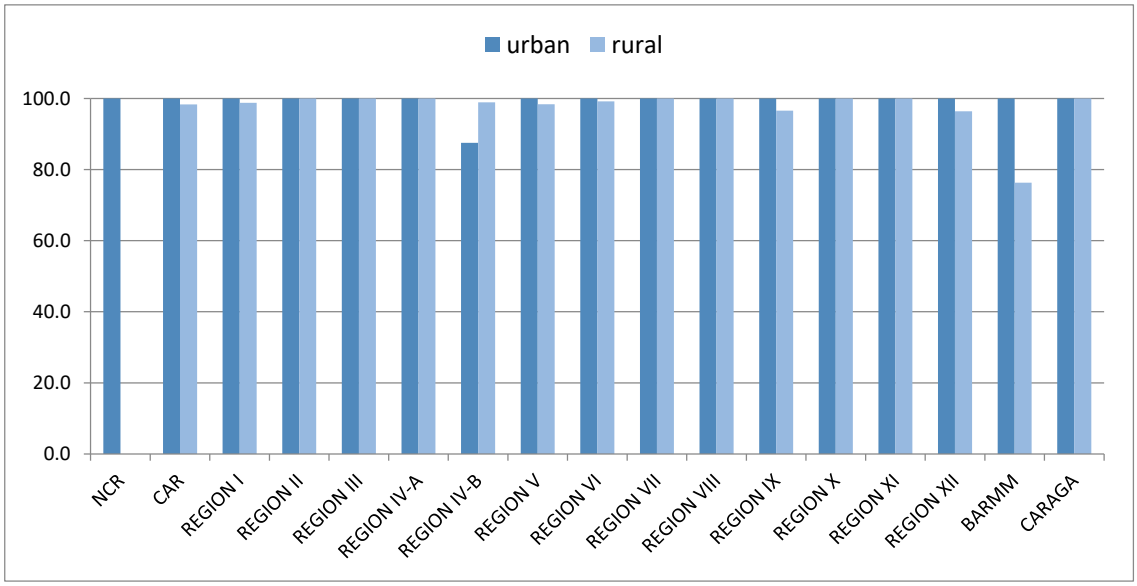
There is near universal access to electricity in the country. This means, there are electricity sources in the barangays that can power digital infrastructure. More than 90 percent of the surveyed barangays reported 24/7 electricity availability (**Figure 5.4**). Urban barangays in all regions except Region IVB (87%) have 100 percent access to electricity. Rural barangays also have 96-100 percent access to electricity, except for BARMM, where only 76 percent of rural barangays surveyed have electricity (**Figure 5.5**).

Figure 5.4. Proportion (%) of surveyed barangays reported having 24/7 electricity



Source: 2019 NICTHS, DICT and PSRTI

Figure 5.5. Proportion (%) of barangays with access to electricity, urban and rural



Source: 2019 NICTHS, DICT and PSRTI

About 91 percent of surveyed barangays with access to electricity also have access to cellular signal, but access varies considerably across regions, and gaps can be observed between urban and rural areas, in favor of urban locales (Table 5.2). Although access is reported to be relatively high across the country, only half (54%) of barangays with electricity reported having **a telco** operating in their area, and four-fifths (79%) having **ISP/s** in their community.

Table 5.2. Proportion (%) of barangays with electricity that reported having cellphone signal

Region	Urban	Rural	Total
NCR	100.0	-	100.0
CAR	96.9	86.4	88.7
REGION I	85.0	89.0	88.2
REGION II	100.0	90.9	92.4
REGION III	99.0	94.7	96.9
REGION IV-A	97.3	89.1	94.2
REGION IV-B	87.5	96.8	94.4
REGION V	100.0	84.4	87.0
REGION VI	98.4	91.8	94.1
REGION VII	100.0	98.6	99.3
REGION VIII	100.0	97.2	97.5
REGION IX	88.2	75.9	80.4
REGION X	98.3	80.8	88.4
REGION XI	92.8	75.0	84.5
REGION XII	100.0	94.5	97.4
BARMM	85.0	48.5	54.7
CARAGA	97.1	77.7	82.8
Total	**97.4**	**86.4**	**90.9**

Source: 2019 NICTHS, DICT and PSRTI

However, the availability of electricity is not synonymous to reliability of electricity. There are regions in the country with dirty electricity that affects the functioning of broadband equipment. Unreliable electricity also increases the cost of operating broadband networks in those areas because of the need to install equipment that will "filter and smooth" electricity, especially for remote site electronics (Galla 2021). Outdoor equipment, such as cable TV line extenders and outdoor optical line terminal (OLT), are prone to breakage due to voltage fluctuations (Dabao 2021).

Limited free-to-air digital TV coverage

Free-to-air (FTA) digital TV coverage remains limited, with only 41 percent of all barangays reached and 7 of the total 17 regions having over 50 percent access to FTA digital TV signal. Free-to-air Digital TV[45] signal only reaches 41 percent of all barangays surveyed. Half of the urban barangays and about 1/3 of rural barangays are reached by digital TV signal. Notably, digital TV signal coverage in NCR is only at 54 percent whereas in Region I, 76 percent of its barangays (90% urban, 73% rural) have digital TV signal.[46] Other regions with more than 50 percent of barangays surveyed with digital TV signal include CAR, Regions III, IV-A, V, and VII. Less than 50 percent of surveyed barangays in Regions II, VIII, IX, X, XI and CARAGA have access to FTA digital TV, and less than 20 percent of surveyed barangays in IV-B, VI, XII and BARMM (**Table 5.3**).

Table 5.3. Regions by proportion (%) of surveyed barangays with free-to-air digital TV signal

Region	% of barangays with FTA Digital TV signal
NCR, CAR, I, III, IV-A, V, VII	>50%
II, VIII, IX, X, XI, CARAGA	50% -20%
IV-B, VI, XII, BARMM	<20%

Source: 2019 NICTHS, DICT and PSRTI

This suggests that a number of TV networks nationwide have not shifted to digital signal and may have implications on the NTC's target for the analog switch off in 2023. Globally, the Philippines is part of the remaining 21 percent of countries that have yet to complete digital terrestrial television broadcasting (DTTB) migration (DICT 2019).

For all barangays surveyed, 41 percent of those with access to electricity also have FTA digital TV signal (**Table 5.4**). However, more barangays that have access to electricity have a cellular signal, a telco, and an ISP operating in their locality compared to those with access to FTA digital TV.

[45] Digital TV allows for higher quality, lower cost, and better compression in broadcasting (DICT 2019)
[46] Analog switch off date is Dec 31, 2023, 95% penetration of the TV Households in each service area is considered sufficient for ASO (DICT 2017).

Table 5.4. Proportion (%) of surveyed barangays with electricity that reported having digital TV signal

Region	Urban	Rural	Total
NCR	54.3	-	54.3
CAR	50.0	61.0	58.7
REGION I	90.0	72.0	75.5
REGION II	41.2	22.7	25.7
REGION III	56.6	45.3	51.0
REGION IV-A	65.3	58.7	62.8
REGION IV-B	18.8	18.3	18.4
REGION V	83.3	50.0	55.5
REGION VI	19.0	12.3	14.6
REGION VII	64.8	48.6	56.6
REGION VIII	50.0	20.8	24.0
REGION IX	64.7	34.5	45.7
REGION X	61.7	28.2	42.8
REGION XI	37.7	26.7	32.6
REGION XII	15.0	16.4	15.7
BARMM	35.0	4.12	9.4
CARAGA	52.9	42.6	45.3
Total	50.6	34.1	40.8

Source: 2019 NICTHS, DICT and PSRTI

Cellular, 4G and 3G signal coverage

Cellular signal reaches 92 percent of all barangays, with urban barangays having 10 percent more access to a cellular signal than rural barangays. Almost all or 98 percent of urban barangays and 88 percent rural barangays have cellular signal coverage. BARMM has the lowest cellular signal coverage of 68 percent.

4G signal can be accessed in 60 percent of all barangays. But urban barangays have about twice as much access to a 4G signal compared to rural communities. For all barangays, about **61 percent can access 4G signal**: 83 percent of urban barangays and 44 of rural barangays.

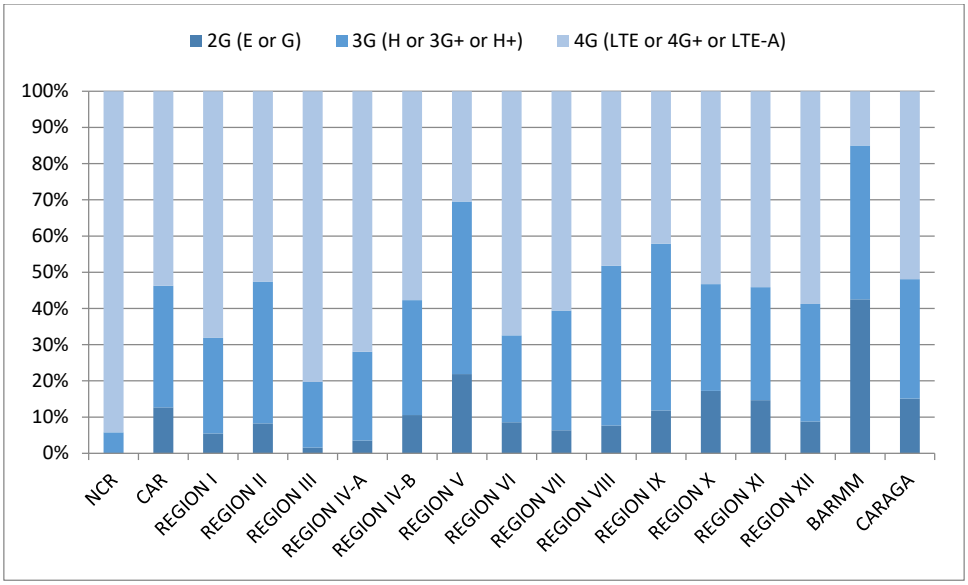
In contrast, mobile network operator (MNO) Globe Telecom reported nearing 95 percent 4G/LTE coverage of cities and municipalities as early as 2018 (Globe Newsroom 2018; Smart Corporate Newsroom 2020b). Opensignal, a mobile network analytics company, reported that in 2020, Smart Communications was the first to breach 80 percent 4G availability[47] nationwide (Open Signal 2020). ProjectBASS—a volunteer, non-profit group that measures mobile broadband and Wi-Fi quality of service through crowdsourced data—also recorded 80 percent of unique cell site IDs with 4G signal, up by about five percent from a year ago.

[47] Opensignal defines 4G availability as the proportion of time Opensignal users with a 4G device have a 4G connection. 4G availability is not a measure of coverage or the geographic extent of a network.

Since a city or municipality can have hundreds of barangays, the MNOs' reporting of network buildup (Newsbytes.PH 2020) that is focused on city and municipality "coverage" do not give a clear picture on access. It would help inform policy and regulation if the government and telcos would have the same definition for coverage and measure for service availability.

Among the communities surveyed, 94 percent of all NCR barangays can access 4G signal. BARMM rural barangays have the highest 2G signal access, at 51 percent. Region V barangays have the highest 3G signal, 50 percent in rural and 37 percent in the urban communities surveyed (**Figure 5.6**).

Figure 5.6. Distribution of surveyed barangays (%) by highest cellular signal available, per region



Source: 2019 NICTHS, DICT and PSRTI

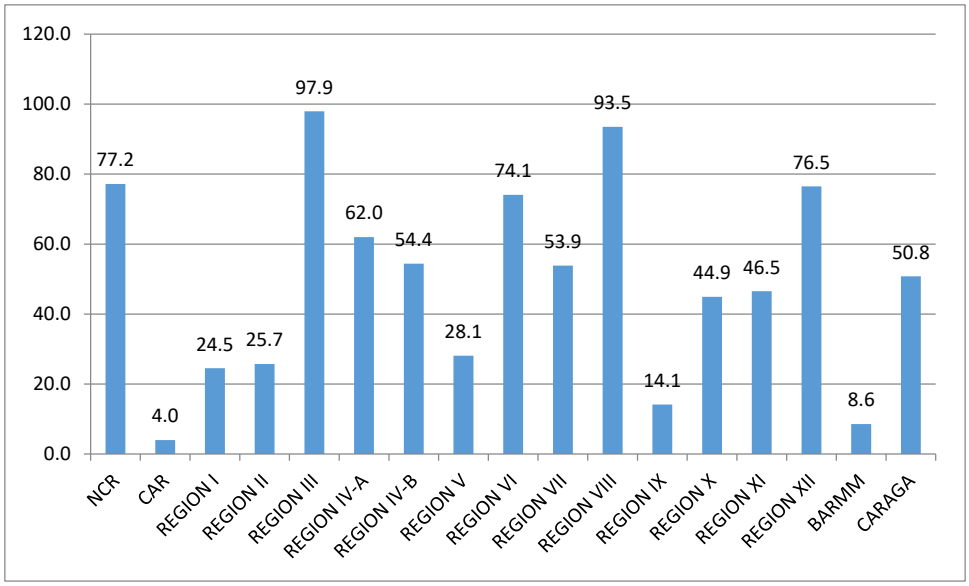
For surveyed barangays with a telco tower, those in BARMM recorded the lowest 4G signal coverage, at 41 percent of urban barangays and eight percent of rural barangays, and the highest in 2G signal, at 51 percent in rural barangays. The Bicol Region has the highest 3G signal, at 38 percent in urban and 50 percent in rural barangays.

There is still significant access to 3G signal in the rural areas. As expected, there are more rural areas that reported having 3G and 2G signals as the highest cellular signal available in their area relative to urban barangays – 41 percent of rural barangays have 3G signal (15% in urban) and 16 percent have 2G signal coverage (2% in urban).

Presence of Telcos

Telecommunication companies or "telcos" (landline, Internet, cellular) are present in just 54 percent of interviewed barangays in the country. Over 70 percent of urban barangays reported having telecom operators operating in their area, while 42 percent of rural barangays reported the same. There are regions with very limited telco presence. For example, only four percent of total barangays in CAR, nine percent in BARMM and 14 percent in Region IX have telecom operators (**Figure 5.7**).

Figure 5.7. Proportion (%) of barangays with telecom operator (wired/wireless)



Source: 2019 NICTHS, DICT and PSRTI

The telecom operators present in the surveyed barangays are Globe Telecom (including Touch Mobile) and Smart Communications (including PLDT, Talk n Text, and Sun Cellular). Telecom operators are present in urban and rural areas in the country, except for PLDT which is not available in BARMM and in rural areas in CAR and Region IX (**Table 5.5**). Only 8 of the 17 regions have "other" operators or telcos other than Globe, Smart and PLDT.

Barangays in CAR, Regions I (Ilocos), IV-B, VII (Central Visayas), VIII (Eastern Visayas), IX (Zamboanga Peninsula), X (Northern Mindanao), XI (Davao Region) and BARMM reported not having "other" operators in their locality.

Table 5.5. Proportion (%) of barangays with a telecommunication operator (wired/wireless), by type of operator

Barangay Classification	Globe	Smart	PLDT	Others
Urban	83.0	72.2	70.2	11.1
Rural	88.7	76.0	23.3	4.9
Total	85.6	74.0	48.8	8.3

Source: 2019 NICTHS, DICT and PSRTI

Presence of Telecommunications Tower

Only 36 percent of the surveyed barangays reported having a telecommunications tower in their community, while 92 percent of barangays have access to a cellphone signal. 3G technology is still pervasive in the rural areas of the Philippines. As expected, there are more telecom towers in urban barangays (61%) than in rural areas (19%). Almost all the telecom towers (95%) in both urban and rural barangays are privately-owned.

Based on the NICTHS responses, there is an average of two telecom towers per surveyed barangay (**Table 5.6**). NCR reported the highest number of towers, with 404 towers present in the barangays, but Region IV-A reported the highest average, at 2.98 towers per barangay.

Table 5.6. Barangays with telecom tower, with cellphone signal

Region	Average number of towers per barangay	Total number of towers
NCR	2.62	404
CAR	1.50	51
REGION I	1.48	37
REGION II	1.41	41
REGION III	1.65	155
REGION IV-A	2.98	188
REGION IV-B	1.55	93
REGION V	1.45	32
REGION VI	2.08	104
REGION VII	2.52	174
REGION VIII	1.53	49
REGION IX	1.61	50
REGION X	2.15	129
REGION XI	1.79	104
REGION XII	2.35	120
BARMM	1.92	25
CARAGA	1.43	43
Total	**2.06**	**1799**

Source: 2019 NICTHS, DICT and PSRTI

Of all surveyed barangays *with* telecom towers and *with* a cellphone signal:

- 81 percent reported having 4G signal (88% in urban, 64% in rural);
- 16 percent have 3G
- Three percent have 2G
- NCR has the highest number of barangays getting a 4G signal, at 97 percent
- Region IX has the most number of barangays with access to 3G signal, at 61 percent
- BARMM has the highest proportion of barangays receiving 2G signal, at 29 percent

Of all surveyed barangays *without* telecom towers, but *with* cellphone signal:

- 48 percent experience 4G
- 38 percent have 3G
- 14 percent have 2G

The assumption in these results is that towers are in a neighboring barangay.

In NCR, 91 percent of surveyed barangays reported not having telco towers in their area but still receive 4G signal. More than 45 percent of surveyed barangays in Regions II (Cagayan

Valley), V (Bicol), VII (Central Visayas), VIII (Eastern Visayas), XI (Davao Region), XII (SOCCSKSARGEN) and BARMM *without* a telecom tower experience 3G in their community. In BARMM, 46 percent of surveyed barangays reported experiencing 2G signal.

In surveyed barangays *without* a tower, but with cellphone signal, more urban areas (74%) experience 4G signal, but notably, surveyed urban barangays in BARMM (60%) and Region XI (67%) receive more 3G signal. In surveyed rural barangays, 44 percent experience 3G signal while 38 percent have 4G signal. Half of surveyed rural barangays in BARMM receive 2G signal, 43 percent reported receiving 3G signal and only seven percent have 4G signal.

Barangays without towers and without cellphone signal comprise seven percent of all barangays surveyed. BARMM reported the highest among the regions at 31 percent.

Despite the fact that 92 percent of barangays reported getting a cellular signal, only about 54 percent said there was a telecom operator present in their barangay. This may suggest that telco infrastructure, offices and/or stores are not present in the barangay, even while end users in the community can access a cellphone signal.

Communities with a tower and with a cellular signal can be classified as having "coverage" in terms of network infrastructure and network service. Barangays without a tower but are reached by a cellphone signal can be described as covered by a mobile network service but not the infrastructure. The results also reveal that while 4G coverage is improving, 3G technology is still pervasive in the rural areas and in select regions, particularly in Mindanao.

An ADB and Thinking Machines report (Sy et al. 2021) said that about 850,000 Filipinos do not live within the serviceable scope of cell sites (Thinking Machines 2020). Using Project BASS data to check the proximity of the population to cell towers at the last mile, the report reveals that only 9.5 percent of the 9.4 million at the last mile live within 500 meters from a cell tower.

Cellular mobile services operate on various radio frequencies (2G, 3G, and 4G), which differ in how they provide coverage and capacity (amount of data they can carry). The lower frequencies have longer range but less capacity. The higher frequencies offer more capacity but shorter range. The radio frequencies between 5 GHz and 300 MHz are the predominant spectrum used for mobile access (GSMA 2017).

Global System for Mobile (GSM) or 2G networks, for example, largely operate in the 900MHz, 1800 MHz, 850 MHz, and 1900 MHz bands. They were primarily designed for voice communications but can also support data services, such as GPRS and EDGE, which can provide data speeds of up to 200 kilobits per second (Kbps). See Annex 5.2 for more detail on mobile access frequencies.

A telecom tower is a key infrastructure for mobile voice and mobile broadband services. A tower (or base station) is where digital data is transmitted (send and receive) when an end user makes a phone call or connects to the Internet. Depending on the radio frequency used, it is important to have enough towers installed within a certain distance in order to facilitate the handoff of a mobile device to the next cell site while the end user is moving or mobile, in order to avoid service interruption.

Therefore, the absence and limited number of a telecom tower, to which a telco's radio equipment is attached, may result in degraded or poor cellular signal for end users in a barangay. Perhaps future surveys can include questions on quality of service of cellular and mobile broadband services to determine whether and how the absence/presence and number of towers can affect the quality of ICT services.

According to TowerXchange, a global tower industry publication, November 2020 data (MB Business 2021) showed that Thailand had 52,483 telecom towers, Vietnam had 90,000, while the Philippines had 17,850. Looking at the number of users sharing a tower (contention ratio), Vietnam had 756 users per tower, Thailand had 991, and the Philippines had 4,090 users per tower, which translates to congestion.

In 2019, the DICT reported that the country needs 50,000 more towers to improve Internet services[48]. In May 2020, the DICT issued Department Order 008, s. 2020 on the sharing of passive telecom tower infrastructure (DICT 2020), The guidelines aim to expand wireless network coverage by encouraging the use of common towers and the entry of independent tower companies (ITCs). An infrastructure sharing policy is a step in the right direction. To align with global best practice, the policy must create an environment that helps independent infrastructure providers thrive, which, in turn, will increase efficiency for all network operators and lower the cost of digital infrastructure rollout, especially in less profitable areas. In February 2021, the DICT adopted a target of building 5,000 towers per year for 3 years (Atienza 2021).

Internet service providers

Globe and Smart/PLDT are the main Internet service providers (ISPs) in the country. Globe is present in 65 percent of all surveyed barangays, Smart in 52 percent, PLDT in 31 percent of barangays, while other ISPs are present in six percent of barangays.

One in five (20%) of all surveyed barangays have no Internet service providers, with eight percent of barangays surveyed in NCR (22 barangays) reporting not having ISPs in their area.

By region, CAR has reported the highest share of barangays with no ISP, at 47 percent. The result for CAR is no surprise. While CAR has a relatively high average monthly family income, third among the 17 regions, [49] it has the lowest population density in the country, at 87 persons per square kilometer. CAR's terrain is considered difficult for network rollout, being a mountainous area. ProjectBASS data shows the disparity in the cell site density among the provinces in CAR, with Benguet, where popular tourist spot Baguio City is located, having the most number of cell sites detected despite being located in the mountains.[50]

The result suggests that service providers consider market size and income, and the economic activity that can sustain subscription (hence, revenues), as key factors in network rollout. Terrain is also a big consideration, as this can affect access of last mile service providers to the nearest backbone facility.

[48] https://www.pna.gov.ph/articles/1059240
[49] Based on data sourced from 2018 FIES.
[50] No cell site was recorded in Apayao provinces. No cell site data for a particular province could also mean that there was no BASS app user in the area.

While it is surprising that some barangays in NCR would not have an ISP operating in their area, the results could provide a glimpse into a different kind of digital divide—that within cities—even in metropolitan centers like NCR. While NCR does not have rural areas, its population density is the highest in the country (at 20,785 persons per square kilometer), and it has the highest average family income annually, it also has many areas with income poor communities, with a lower socio-economic profile and, thus, low purchasing power (low income combined with the high cost of living in NCR) and income levels not enough to regularly subscribe to broadband services or access a digital device (Kenna 2015). About nine percent of the country's urban poor population are in NCR. In future surveys, perhaps it would help inform the results if the socio-economic profile of the barangay were included.

Also worth noting that the survey only identified six percent of barangays where "ISPs other than PLDT and Globe" are operating. Other players can be found in the fixed broadband market. In 2019, Converge ICT had a 10 percent market share while Sky covered six percent of the fixed wired broadband market. In December 2020, Converge ICT reportedly reached one million subscribers. PLDT had 44 percent and Globe made up 40 percent of the fixed broadband market, which also include fixed wireless service. This does not include yet the cable broadband operators that are present in almost all municipalities. For the mobile service market, PLDT had 42 percent while Globe cornered 58 percent of the market in 2019.

Access to free Wi-Fi

Only 12 percent of all barangays surveyed have free Wi-Fi. Of this, about 70 percent are publicly provided and 33 percent are privately provided. Less than two percent of barangays without a telco have access to free public Wi-Fi.

About seven percent of surveyed barangays have both free Wi-Fi and telcos operating in their area. By region, this is highest in NCR at 21 percent. Of the barangays that reported having both, 84 percent are urban barangays and only 16 percent are rural.

On the opposite**,** 44 percent of barangays reported not having both telcos and free public Wi-Fi. Of the barangays that reported the absence of both in their area, 23 percent are urban barangays and 77 percent are rural.

For barangays without telcos, only two percent have free public Wi-Fi, while for barangays with telcos, 48 percent are without free public Wi-Fi (**Table 5.7**).

Table 5.7. Barangays with/out telcos and with/out free Wi-Fi (%)

Region	Barangays with telcos and with free public Wi-Fi			Barangays with telcos and without free public Wi-Fi			Barangays without telcos and with free public Wi-Fi			Barangays without telcos and without free public Wi-Fi		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
NCR	20.7	-	20.7	56.5	-	56.5	4.3	-	4.3	18.5	-	18.5
CAR	3.1	0	0.7	12.5	0.8	3.3	3.1	0.0	0.7	81.3	99.2	95.3
REGION I	15.0	6.1	7.8	25.0	14.6	16.7	10.0	1.2	2.9	50.0	78.0	72.5
REGION II	5.9	2.3	2.9	47.1	18.2	22.9	5.9	0.0	1.0	41.2	79.5	73.3
REGION III	23.2	1.1	12.4	76.8	94.7	85.6	0.0	0.0	0.0	0.0	4.2	2.1
REGION IV-A	12.0	8.7	10.7	61.3	34.8	51.2	2.7	0.0	1.7	24.0	56.5	36.4
REGION IV-B	3.1	0.0	0.8	81.3	44.1	53.6	0.0	1.1	0.8	15.6	54.8	44.8

Region	Barangays with telcos and with free public Wi-Fi			Barangays with telcos and without free public Wi-Fi			Barangays without telcos and with free public Wi-Fi			Barangays without telcos and without free public Wi-Fi		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
REGION V	12.5	1.6	3.4	66.7	16.4	24.7	0.0	4.1	3.4	20.8	77.9	68.5
REGION VI	11.1	3.3	5.9	77.8	63.1	68.1	0.0	0.8	0.5	11.1	32.8	25.4
REGION VII	4.2	4.2	4.2	43.7	55.6	49.7	5.6	0.0	2.8	46.5	40.3	43.4
REGION VIII	18.2	0.6	2.5	72.7	93.3	91.0	0.0	0.0	0.0	9.1	6.2	6.5
REGION IX	2.9	3.4	3.3	14.7	8.6	10.9	11.8	5.2	7.6	70.6	82.8	78.3
REGION X	10.0	1.3	5.1	65.0	20.5	39.9	1.7	0.0	0.7	23.3	78.2	54.3
REGION XI	4.3	0.0	2.3	65.2	20.0	44.2	1.4	0.0	0.8	29.0	80.0	52.7
REGION XII	20.0	0.0	10.4	70.0	61.8	66.1	0.0	0.0	0.0	10.0	38.2	23.5
BARMM	0.0	0.0	0.0	30.0	4.1	8.5	0.0	0.0	0.0	70.0	95.9	91.5
CARAGA	23.5	2.1	7.8	55.9	38.3	43.0	2.9	0.0	0.8	17.6	59.6	48.4
Total	14.1	1.9	6.9	58.4	40.2	47.6	2.9	0.8	1.6	24.6	57.2	43.9

Source: 2019 NICTHS, DICT and PSRTI

The most common way to access Internet globally is via mobile broadband networks, fixed-wireless networks, and public or private Wi-Fi networks (WB 2019a, p.28). This is especially true in developed nations and countries with geographically challenging terrains.

As described earlier, Wi-Fi and other wireless technologies can help communities overcome challenges in geography and financing. Communities with lower income, inadequate wired infrastructure, and low population density can benefit from wireless technologies that are often more cost-efficient to deploy in rural areas with difficult terrain or low number of potential users.

Thus, the government's investment in Wi-Fi infrastructure can help connect underserved and unserved areas, apart from potentially decongesting existing mobile networks or lowering the cost of Internet service for some communities, by providing Internet service in public places free of charge.

However, access networks are only as good as the other segments that bring the bandwidth to the last mile. In the past years, an infrastructure gap was cited by some of the free Wi-Fi service providers,[51] who had invested in and installed Wi-Fi access points at the last mile, as part of the DICT's Free Public Wi-Fi program, but were not able to light up their facilities because of the absence of the middle mile link that the telcos were supposed to provide.

About the same time that the NICTHS was being conducted, in August 2018, the DICT reported a total of 3,509 sites already installed, with only 1,592 sites live and 1,689 sites with access points installed but awaiting telco links (UNDP 2019). A UNDP project brief available online also described the challenges faced by the free Wi-Fi program (UNDP 2019):

> *"The vision is to reach 200,000 sites by 2026. However, challenges in the bidding and implementation process, limited access to cost-effective and up-to-date*

[51] The Federation of International Cable TV Association of the Philippines (FICTAP), for example, was very vocal at public consultations and hearings about the missing middle mile link that telcos failed to provide, which prevented some of their members who have invested in last-mile access points, from lighting up their Wi-Fi network.

technology options, as well as limited capacity of Philippine telecommunications companies at the local level have slowed progress toward this goal."

As of 28 December 2020, there were 7,556 free Wi-Fi live hotspots throughout the country. This is four percent of the 200,000 sites targeted until 2026. Although a low number, this is already the result of accelerated rollout in 2020. According to the DICT, in the period 2016-2019, the free Wi-Fi program has deployed 3,251 live sites only. For 2020 alone, the DICT was able to put up an additional 4,305 live sites, an increase by 500 percent in its yearly free Wi-Fi rollout (DICT 2021).

Access to Fiber Optic Cable Network

About three in 10 (29%) of surveyed barangays nationwide have access to a fiber optic cable (FOC) network: 53 percent of surveyed urban barangays and 12 percent of surveyed rural barangays.

Fiber offers the highest bandwidth and reliability, but has limited coverage outside of the urban centers. For several decades, the dominant telcos have focused investment in cellular mobile networks. Investment in fixed wired broadband networks to provide fiber to the premises (FTTP) or fiber to the home (FTTH) service and to support bandwidth-heavy use and 4G/LTE and 5G deployments happened fairly recently.

According to Ookla, a broadband speed analytics company, the telcos have started to invest heavily on their fiber-optic network, with a total of 543,740 cable-kilometers laid out nationwide (Baclig 2021). However, FOC, as a backhaul technology, is expensive and time-consuming to deploy, especially in areas with low population density (Mirandilla-Santos et al 2018). Thus, FOC investments have mostly been concentrated in the highly urbanized areas.

It is safe to assume that there is FOC in communities where there are cable TV operators at the last mile. Based on existing policy, cable operators are allowed to deploy FOC either through aerial (pole attachment) or underground installation. Hence, many of them offer cable broadband service. However, there are several challenges to offering fiber broadband service:

- Lack of access to a nearby domestic backbone facility;
- Access to poles and inconsistency in pole attachment arrangements;
- Difficulty in securing right of way for underground ducts; and
- High cost and inefficiency of civil works individually done by each service provider.

Free Use of ICT equipment for residents

Over 70 percent of surveyed barangays offer free use of ICT equipment for residents. Barangays offer ICT equipment for free use to its residents. For all barangays, 72 percent have ICT equipment that can be used by its residents for free. Region VIII reported the lowest share of barangays with ICT equipment that can be used for free at six percent. However, there are still barangays that do not have ICT equipment that can be used for free.

About half (47%) of surveyed barangays provide the use of a computer, which presumably is Internet-ready. Noticeably, there is a slightly higher number of barangays that offer audiovisual equipment or a printer compared to those that offer computer use (**Table 5.8**).

Table 5.8. Proportion (%) of barangays offering free use of ICT equipment, by location

ICT equipment	Urban	Rural	Total
Telephone/cellphone	50.1	16.3	30.1
Computers (desktop, laptop, tablet)	44.4	49.6	47.5
Fax machines	4.6	1.4	2.7
Printers	48.1	47.9	48.0
Audio-visual equipment (projector, microphone, speaker)	61.3	40.5	49.0
Others	6.6	7.3	7.0
None	17.2	35.7	28.1

Source: 2019 NICTHS, DICT and PSRTI

Of all surveyed barangays, 88 percent use computers in providing government services (e.g., barangay clearance, community tax certificate, etc.).

About half (46%) of the surveyed barangays have some degree of automation as residents directly encode to a computer to fill out forms, while three fifths (60%) maintain a computerized database.

There are 23 percent of barangays surveyed with ICT equipment, use computer in delivery of services, direct encoding of forms and maintain a computerized database. Of the barangays that reported this, 39 percent are urban barangays and 61 percent are rural barangays.

By region, CARAGA has the highest reported at 48 percent of barangays and the lowest is Region VIII at three percent.

Also, almost five percent of surveyed barangays reported having ICT equipment for free use of their residents and do not use computer in the delivery of their government services. Of the surveyed barangays that reported this, 28 percent are urban barangays and 72 percent are rural barangays.

The provision of access to shared ICT equipment is important considering that households without Internet connection at home find the high cost of ICT devices as prohibitive for going online. The access of households to Internet connection and other ICT services will be discussed in the next section.

5.2.2. Household Survey

Access to electricity

Ninety-five percent of households have access to electricity. This is consistent with the survey results at the barangay level, and results of other surveys conducted by the Philippine Statistics Authority such as the 2019 Annual Poverty Indicator Survey that puts access to electricity at 94 percent (PSA 2020). This also means that households are able to use and maintain computers, mobile devices, and an Internet connection. The presence of electricity also means that ICT equipment can operate and be maintained in the area. However, as noted in the community survey analysis, access to reliable electricity supply remains a challenge.

Use of analog broadcast technology

A significant portion of households still use analog broadcast technology; in the Philippines, TV is still king. Traditional ICTs like radio and television are still available in 47 percent and 83 percent of households, respectively (**Table 5.9**). Among the regions, BARMM reported the lowest radio availability of 20 percent, while Region VI reported the highest household radio availability at 60 percent. BARMM also has the lowest TV availability (48%).

In terms of service, more than 40 percent of total households in the country use analog TV signal for their television service (**Table 5.9**). By region, Region I households reported the highest use of analog TV services of 73 percent while NCR recorded the lowest at 16 percent. Households in Region VI have the highest reported use of smart TV of 18 percent, while more than half of households in Region IV-B and Region VIII use satellite TV service.

Notably, although barangays in regions NCR, CAR, I, III, IV-A, V, VII reported more than 50 percent availability of digital TV signal, **it is only in NCR (62%) and Region IV-A (44%) where households reported a high adoption of digital TV service**.

Table 5.9. ICT availability in the household, proportion (%) of households with access to ICT infrastructure

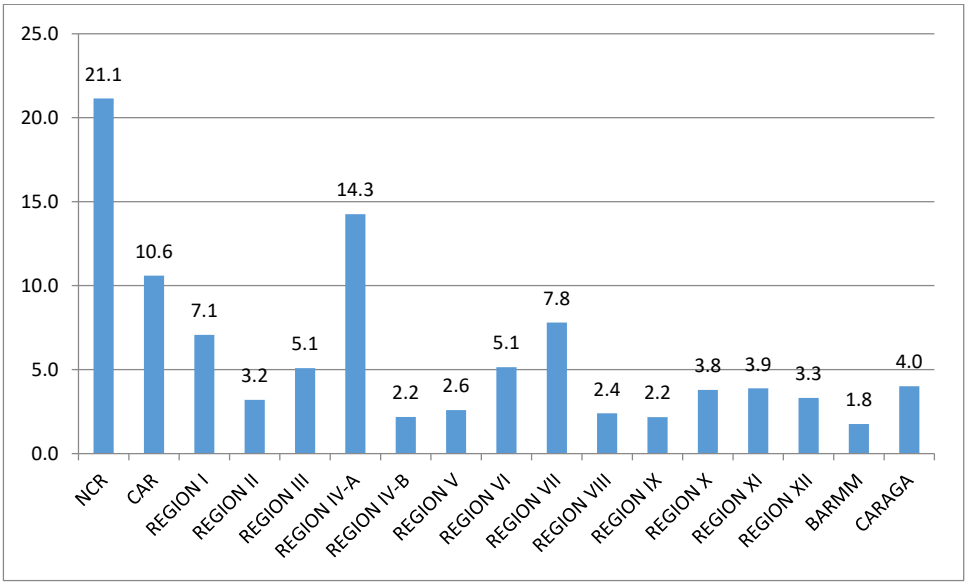
ICT infrastructure and service	Urban	Rural	Total
A radio	47.4	46.9	47.1
A television	88.8	76.5	82.8
Television, by type of TV			
Portable TV	2.3	2.9	2.6
Regular/traditional TV (CRT, analog with antenna)	37.0	54.9	45.1
Flat screen (LCD/LED/plasma)	63.3	44.1	54.6
Television, by service			
Cable TV	16.2	12.1	14.3
Direct-to-home (DTH) satellite services	11.6	24.3	17.3
Smart TV	6.4	2.5	4.7
Digital terrestrial (DTT)	32.5	13.1	23.7
Analog TV	36.1	49.7	42.2
Others	1.1	0.8	0.9
A fixed telephone line	12.7	3.5	8.2
A cellphone (communal use)	22.3	25.8	24.0
Computer, by type of computer			
Desktop	29.0	16.9	24.7
Laptop	67.3	63.4	65.9
Tablet	36.6	44.7	39.4
Others	0.3	0.3	0.3
Internet, by type of service			
Fixed (wired) broadband network	62.8	36.4	54.4
Fixed (wireless) broadband network	21.8	23.5	22.3
Satellite broadband network	3.1	3.1	3.1
Mobile broadband network	15.5	38.8	22.9

Source: 2019 NICTHS, DICT and PSRTI

Use of fixed telephone service

Only less than two million households use a fixed telephone service. At the national level, only eight percent of households have fixed telephone subscription; this translates to 1.9 million households that have a fixed telephone line. NCR has the highest reported fixed telephone subscription of 21 percent and the lowest is BARMM with two percent fixed telephone subscription among households (**Figure 5.8**).

Figure 5.8. Proportion (%) of HHs with fixed telephone line subscription



Source: 2019 NICTHS, DICT and PSRTI

The low subscription rate of telephones today shows how fast-paced change can be in technologies, business models, and demand. The huge investment made by government in establishing fixed telephones for two decades, between 1980s and 2000s, did not translate into significantly higher subscription for telephone lines because the initiative was overtaken by market forces. However, the government was already deep in debt and had to pay loans for many years after the project was closed and even though the intended outcomes were not achieved. Digitel Philippines, a private telco which leased from the government telephone program in North Luzon, reportedly had to upgrade the facilities. Upgrading and maintaining a network can be costly and is not the core competency of the government; even the private sector takes time and can face difficulties.[52]

Access to computers at home

Only about a quarter (24%) of households have a computer at home. Of these, 66 percent of households have a laptop, 39 percent have a tablet and 25 percent have a desktop computer. **A quarter of households have a communal cellphone[53] available.**

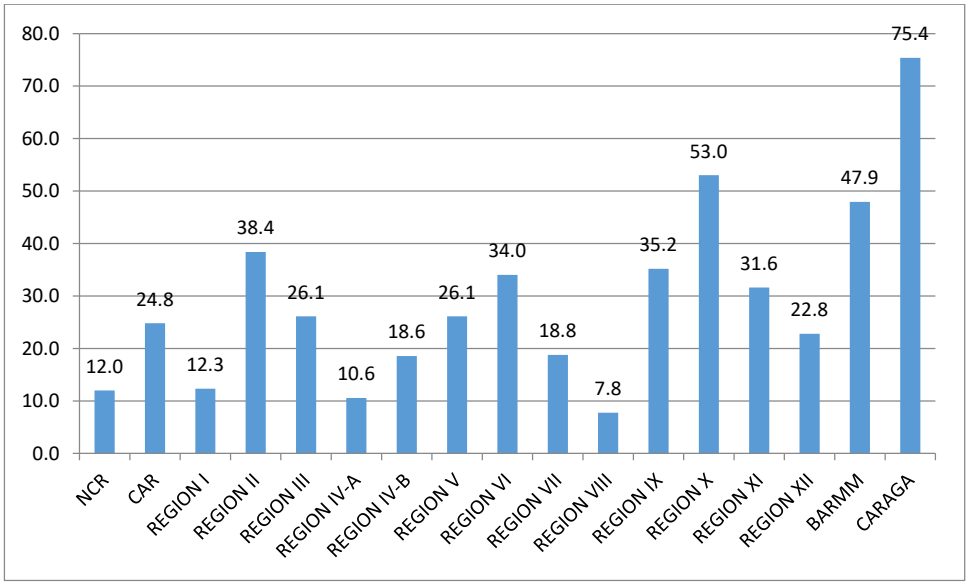
[52] PLDT, for example, just announced in 2020 that it was upgrading all its old copper lines to fiber. See. https://mb.com.ph/2020/09/21/pldt-upgrading-all-old-copper-phone-wires-to-fiber/

[53] In the survey, households that have a cellphone should have the device available to all household members for use at any time. It may or may not be owned by the household, but it must be considered a household asset. The device should be in working condition at the time of interview

Urban households with computers seem to be slightly more likely to also have Internet connectivity, compared to rural households. The average difference between regions' shares of urban households with computers and with Internet subscriptions stands at one percent, while the figure for rural households is three percent. This may indicate that computer ownership correlates more closely with an Internet subscription for urban households, and hint at a reason for the difference in connectivity between urban and rural areas that goes beyond computer ownership.

Only 12 percent of households in NCR have a cellphone available for communal use, 12 percent in Region I, 11 percent in Region IV-A, and the lowest is Region VIII at eight percent. Three Mindanao regions—CARAGA (75%), Region X or Northern Mindanao (53%), and BARMM (48%)—have the most households with a cellphone available for communal use (**Figure 5.9**).

Figure 5.9. Proportion (%) of households with communal cellphone



Source: 2019 NICTHS, DICT and PSRTI

About 76 percent of households have no computer. Of this, more than half do not use computers at all, 36 percent access it in computer shops, and 11 percent gain access to computers in school or at work (see **Table 5.10**).

Households with no computer but with communal mobile phone comprise 19 percent of households. Of these, 44 percent are urban households and 56 percent are rural households.

Table 5.10. Proportion (%) of Urban and Rural Households *without* computer at home that reported alternative ways to access computers

	Urban	Rural	Total
Does not use other computers	46.7	59.2	53.3
School/work	11.9	10.5	11.2
Relatives/friends/neighbors	5.6	4.2	4.9
Barangay/community computers	1.1	1.3	1.2

Computer shops	43.4	28.6	35.6
Others	2.9	3.2	3.0

Source: 2019 NICTHS, DICT and PSRTI

Apart from the network infrastructure, digital infrastructure also includes the devices at the edge that will enable end users to connect to the Internet. The low percentage of households with a computer can be a barrier to accessing the Internet. The device gap, however, can be addressed by the availability of cheaper smartphones that are providing the low-income population a gateway to Internet use.

However, as is observed in other countries, the pandemic has made connectivity a must for individual use, in order to facilitate the activities of each family member. In the US, for example, low-income smartphone users were found to likely use their mobile phones for tasks traditionally reserved for large screens, such as online learning and work from home (Anderson and Kumar 2019).

In future conducts of the NICTHS, it would be useful to include questions about smartphone use to determine whether this device can help address the low computer penetration in households. A household profile would also allow a glimpse into how devices and home Internet connection are used.

Access to Internet at home

Only 18 percent of households have their own Internet connection at home. NCR households with their own Internet connection are subscribed mostly to fixed wired broadband, while BARMM households are mostly subscribed to mobile broadband. By region, NCR has the highest share of households with their own Internet access at 33 percent while in BARMM, households with their own Internet connection make up only four percent.

Of the 18 percent of households with own Internet access, more than half (54%) are subscribed to fixed wired broadband network, 23 percent have mobile broadband network, 22 percent have fixed wireless broadband network, and three percent have satellite broadband network.

Households in NCR reported the highest fixed wired broadband network subscription for their Internet service at 77 percent, while mobile broadband subscription is highest in BARMM at 88 percent.

There are over three times more "highly connected" households—those with several options for communicating and going online—in the urban areas than in the rural areas.

Only one percent of households reported having a fixed phone, communal mobile phone and computer. Of these, 77 percent are urban households while 23 percent are rural households. By region, the highest recorded proportion with access to these ICT devices is in NCR with 32 percent of households, and the lowest is reported in BARMM at less than one percent (0.9 percent) of its households.

Also, four percent of households reported having no fixed phone subscription but has communal mobile phone and computer. Of these, 56 percent are urban households while 44 are rural households.

There are 22 percent of households that reported having no fixed phone line but have communal cellphone. This is higher in rural households at 54 percent, while it is at 46 percent of urban households.

Only seven percent of households have fixed phone line and Internet subscription, mostly in NCR and Region IV-A.

The pandemic has made the problem of household connectivity even more challenging, as mobility restrictions and quarantine policies prevent people from going to schools, places of work, and public places to access the Internet. The government must look at how to make Internet more accessible to households beyond COVID-19 and towards helping Filipinos families use the Internet to build back their lives.

Access to TV but not to Internet

A significant proportion of households has a TV but no Internet subscription. Around 40 percent of households with TVs but without Internet subscriptions are concentrated in Regions IV-A, III, and NCR, at 16 percent, 13 percent and 12 percent, respectively. Notably, the same regions all reported to have barangay ISP coverage above 90 percent. Despite this, however, nationally 40 percent of households fitting the category can be found in these regions. This implies that for a significant proportion of households in the Philippines, the barrier to obtaining an Internet subscription is not coverage, but cost.

Among the top three regions, Including NCR, there is a greater share of households with TVs but no Internet access in urban areas. Overall, 51 percent of households with TVs but without Internet access are located in urban areas. However, excluding NCR, only Regions III, IV-A, XI, and XII had more urban than rural households fitting the category, representing 38 percent of households. For all other regions, households with TVs but without Internet subscriptions were more prevalent in rural areas.

These findings imply that a significant proportion of urban households with TVs but without Internet connectivity are concentrated in only a few areas, namely Regions III, IV-A, XI, XII, and NCR. Particularly for Regions III, IV-A, and NCR, their size and population density may mean that a significant proportion of unconnected urban households with TVs are in these regions. For the rest of the country, therefore, it is possible that unconnected rural households make up as much as or more than unconnected urban households.

Knowledge about Internet

Countrywide, there are also households reporting not knowing what the Internet is (6%) and how to use it (16%). More than 20 percent of households in Regions I, II, VII, VIII, IX, XI, XII and BARMM reported not knowing how to use the Internet, while more than 10 percent of households in Regions II, VIII, XI, and BARMM reported not knowing what the Internet is.

Barriers to Internet Access

A majority of households that do not have their own Internet connection noted the "high cost of Internet subscription" as a barrier to access. The top three reasons for households not having their own Internet connection are the high cost of Internet subscription (52%), high cost of equipment (33%), and Internet service is not available in their area (19%) (**Table 5.11**).

More than half of households in Regions III, VIII and X reported the high cost of equipment, 50-70 percent of households in eight of the 17 regions cites the high cost of Internet subscription, and more than half or 53 percent of households in BARMM reported not having Internet service in their area. In NCR, there are still households (5%) that reported absence of Internet service in their area.

Examining this further, there is no statistically significant correlation between selecting the high cost of Internet service and the lack of Internet service in the area as reasons for not having an Internet subscription. This implies that there are two distinct groups of respondents: one for which the main barrier to connectivity is cost, and another for which the main barrier is access. This would be logical in practical terms, as only respondents in areas where Internet service is available will be able to make household assessments of the cost of Internet service. Policy-wise, this implies that there are two distinct sets of issues contributing to the lack of connectivity in the country – cost and access – which must both be addressed to ensure more Filipinos get Internet access.

Table 5.11. Proportion (%) of households without Internet access, by reason for not having access

Reason for not having home Internet connection	Urban	Rural	Total
High cost of Internet subscription (service charges, installation fees, maintenance fees)	60.3	45.4	52.5
High cost of equipment	33.0	34.6	33.8
Internet is not available in the area	11.3	26.6	19.4
Do not know how to use it	11.9	20.0	16.2
Do not need the Internet (not useful, not interesting, lack of local content)	11.1	7.0	8.9
Members have individual/personal connection	9.2	8.5	8.8
Poor quality and speed	3.8	10.3	7.2
Don’t know what the Internet is	4.6	7.1	5.9
Have access to the Internet elsewhere	6.2	3.1	4.6
Others	2.6	1.6	2.1
Privacy or security concerns	1.5	0.8	1.1
Exposure to harmful content	0.3	0.2	0.3
Not allowed to use the Internet	0.5	0.3	0.4

Source: 2019 NICTHS, DICT and PSRTI

The high cost of Internet subscription is reported to be the topmost reason for households in Region IV-A (70%) and Region III (65%). The high cost of equipment is considered the most significant barrier for Region III (53%) and Region VIII (52%). The absence of Internet service in their area is the biggest concern for BARMM (53%) and Region V (40%) (**Table 5.12**).

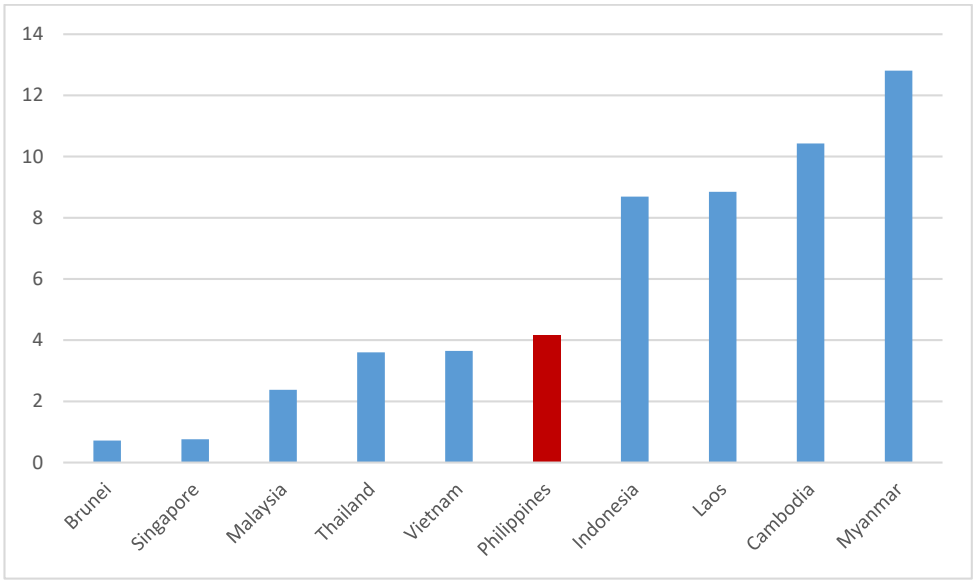
Table 5.12. Proportion (%) of households that identified top three reasons why they do not have home Internet subscription, per region (multiple response)

Region	High Internet subscription cost	High cost of equipment	Internet service not available in area
NCR	59.1	31.1	5.4
CAR	25.9	22.3	29.9
REGION I	56.9	24.9	13.0
REGION II	23.7	37.9	17.3
REGION III	65.5	53.2	12.7
REGION IV-A	69.6	24.4	18.4
REGION IV-B	48.6	39.7	15.7
REGION V	25.4	20.7	39.7
REGION VI	58.5	16.4	29.5
REGION VII	53.2	39.2	4.8
REGION VIII	49.9	51.6	15.8
REGION IX	51.8	15.2	22.3
REGION X	47.3	50.0	18.7
REGION XI	37.2	27.6	32.0
REGION XII	59.8	41.6	24.6
BARMM	5.5	34.5	53.1
CARAGA	44.5	43.9	33.5
Total	**52.5**	**33.8**	**19.4**

Source: 2019 NICTHS, DICT and PSRTI

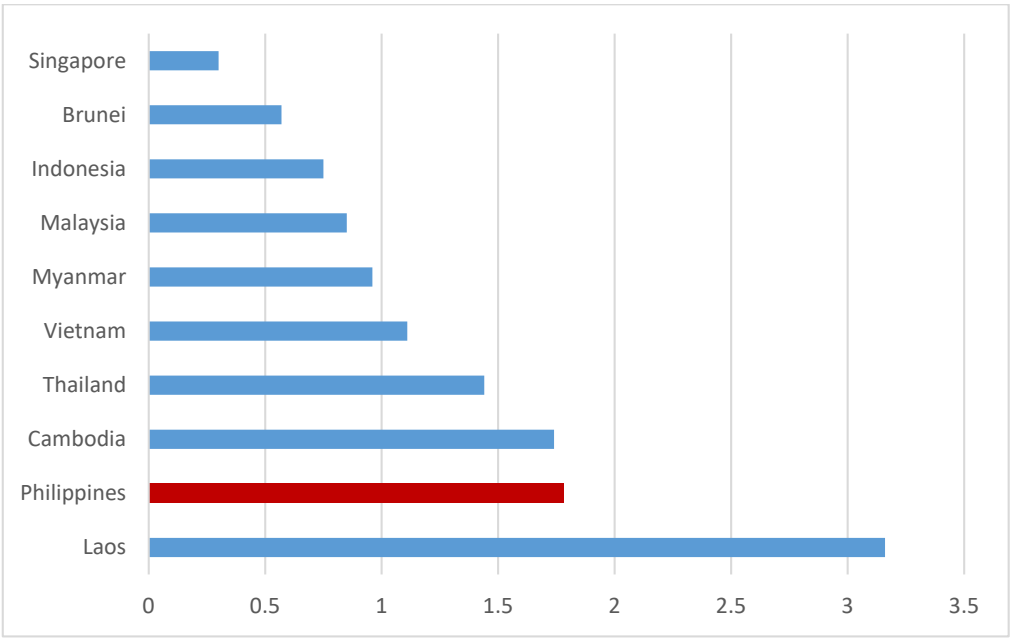
The results of the household survey seem to confirm various surveys on affordability. The ITU estimates the Philippines' fixed broadband cost at four percent of GNI per capita. This puts the country's fixed broadband cost to be somewhere in the middle, performing better than Indonesia, Laos, Cambodia and Myanmar (**Figure 5.10**). However, mobile broadband cost is higher than all ASEAN countries except for Laos (**Figure 5.11**).

Figure 5.10. Fixed broadband cost as % of GNI per capita (2019)



Source: ITU 2019c.

Figure 5.11. Mobile Broadband Cost as % of GNI per capita (2019)



Source: ITU 2019c.

Use of Internet

Ninety percent of households use their Internet connection at home for social media, two-thirds use Internet for both entertainment and studies, and more than half use it for work/business (**Table 5.13**).

Table 5.13. Proportion (%) of households, by usage of Internet connection at home

Usage of Internet connection at home	Urban	Rural	Total
Work/business	53.9	46.7	51.6
Studies (school projects/research)	67.1	64.8	66.4
Social media (long distance communication with family and friends)	90.2	90.1	90.2
Entertainment (movies, games)	70.5	59.7	67.1
Others	0.2	0.4	0.3

Source: 2019 NICTHS, DICT and PSRTI

Spending on Internet services

Households with home Internet connection spend an average of PHP 1,280 monthly. The average monthly spending is highest for households in Region VII, at PHP 1,538.36. The lowest monthly average spending is recorded in BARMM at PHP 395.25. On average, urban households spend 28 percent higher than rural households for their monthly home Internet subscription (PHP 1,406.99 in urban, PHP 1,008.33 in rural).

By technology, the average monthly cost of a Fixed (Wired) Broadband subscription is PHP 1,558, Fixed (Wireless) Broadband is PHP 1,371, Satellite Broadband subscription is PHP 1,368 and Mobile Broadband subscription is PHP 556.

By region, Region IX reported the highest average monthly cost of Fixed (Wired) Broadband subscription, while Region XII reported the highest average monthly cost of Satellite Broadband subscription (**Table 5.14**). Region VII households reported the highest average monthly cost of Fixed (Wireless) Broadband and Mobile Broadband subscription.

Table 5.14. Average monthly spending of households with own Internet connection at home (in PHP)

	Average monthly cost for all households	Highest by region	Region
HH Internet subscription (all type)	1,281	1,505	NCR
Fixed (Wired) Broadband Network	1,558	1,877	Region IX
Fixed (Wireless) Broadband Network	1,371	1,697	Region VII
Satellite Broadband Network	1,368	1,464	Region XII
Mobile Broadband Network	556	914	Region VII

Source: 2019 NICTHS, DICT and PSRTI

5.2.3. Individual Survey

Access to television

Nine in ten individuals (91%) have watched television in the last three months. About 9 in 10 individuals (for both females and males) watch television. The top TV viewers come from individuals who graduated from high school (30%), with a college degree (28%), K-12 program (21%), and elementary graduates (17%). Single (47%) and married (41%) individuals make up 88 percent of the TV viewers, while 80-98 percent of individuals across different labor force status are TV viewers.

By region, 45 percent of all TV viewers are from Luzon: Region IV-A (16%), NCR (16%) and Region III (14%), combined.

On average, Filipinos spend 3.1 hours daily watching television, and this is highest among Region III viewers that spend an average of 3.8 hours daily.

Access to a cellphone

Almost 80 percent of individuals reported having used a cellphone. About 8 in 10 for both female and male individuals have used a cellphone in the last 3 months. The use of cellphones is particularly high among individuals aged 18-34 years old, with 9 out of 10 using a cellphone in the last three months. More than 90 percent of individuals that have completed post-secondary, alternative learning system (ALS), college and post-baccalaureate education have used a cellphone. By labor force status, use of a cellphone is lowest among persons with disability (50%).

On the average, an individual has access to 0.8 ~ 1 cellphone that is working, has an active SIM and is used for communication. For all regions, the minimum is no ownership at all, while maximum is five cellphone units with active SIM and is used for communications.

Access to computer

About 34 percent of Filipinos use the computer. Slightly more males use the computer (35%) than females (33%). By age group, about 5 in 10 individuals (49%) who are 10-17 years old have used a computer; the proportion is highest in NCR at 73 percent. About 44 percent of individuals who are 18-34 years old, 23 percent who are 35-54 years old, and 13 percent who are 55 years old and above have access to a computer.

By highest educational attainment, the top three computer users are individuals with post baccalaureate degree (73%), with college degree (53%), and graduates of K-12 program (51%).

By employment, individuals who have used a computer comprise of 61 percent who are unemployed, 47 percent who are retirees, and 42 percent who are employees.

Computer used by individuals in the last three months include desktop computer (56%), laptop (39%), tablet (22%) and others (1%).

Top three uses of a computer are communication (69%), entertainment and gaming (63%), and sending emails (23%).

Table 5.15. Top uses of computer among individuals

Type of Computer-Related Activities	%
1. Communication	69.0
2. Entertainment and Gaming	63.5
3. Sending Emails (Plain Text)	23.1
4. Using Copy and Paste Tools to Duplicate/Move Information (Files/Folder)	22.9
5. Sending Emails with Attached Files (Document, Picture, Video)	22.8
6. Distance/Online/Computer-Aided Learning	22.1
7. Data Encoding	21.5
8. Transferring Files Between A Computer and Other Devices	20.0
9. Creating Documents Using A Word Processing Software	17.8
10. Finding, Downloading, Installing and/or Configuring Software	9.7

Source: 2019 NICTHS, DICT and PSRTI

More than 80 percent of individuals aged 55 years old and above use the computer for communication. While, two-thirds of individuals in the 10-17 years age group use the computer for entertainment and gaming. This age group also reported the highest share of individuals (26%) using the computer for distance/online/computer-aided learning.

Across educational attainment and labor force status, the top computer-related activities are communication, entertainment and gaming, sending emails (plain text and with attachment), and distance learning. These activities are consistent with the overall uses of computers by all individuals.

For those that have used a computer and have not used the Internet, the top three reasons cited are high cost of Internet subscription (34%) unavailability of Internet in their area (27%), and high cost of equipment (15%). These reasons are consistent with the top three reasons given by households (based on the household survey results) for not having Internet subscription at home.

Table 5.16. Reasons why individuals with access to a computer do not use the Internet

Reasons	%
High Cost of Internet Subscription (Service Charges, Installation Fees, Maintenance Fees)	34.4
Internet Service Is Not Available in The Area	26.8
High Cost of Equipment	15.4
Privacy or Security Concerns	15.0
Poor Quality and Speed	10.9
Not Allowed to Use the Internet	8.6
Do Not Know How to Use It	8.2
Do Not Need the Internet (Not Useful, Not Interesting, Lack of Local Content)	8.0
Others	4.6
Exposure to Harmful Content	3.1
Don't Know What Internet Is	2.3

Source: 2019 NICTHS, DICT and PSRTI

Access to Internet

About 47 percent of individuals have used the Internet from any location (48% male, 46% female). By age group, 6 in 10 individuals aged 18-34 years old (61%) used the Internet in the last 3 months. This was followed by individuals aged 10-17 (60%), 35-54 (38%), and 55 and above (18%).

With a margin of about 20 percentage points, more individuals from urban areas use the Internet (57%) compared to those from the rural areas (36%).

Internet use is highest among individuals with higher level of education completed, and lowest among persons with disability (9%).

Table 5.17. Internet Use by Highest Educational Attainment and Labor Status

By highest grade completed	%	By labor force status	%
No schooling	5.8	Employee	59.6
Preschool	11.2	Employer	56.2
Elementary	16.1	Own-account worker/self-Employed	32.2
High school	37.2	Member of producers' cooperatives	24.2
K-12 program	63.1	Contributing family worker	17.9
ALS	69.1	Worker not classified by status	45.9
Post-secondary	59.5	Unemployed	71.3
College	66.7	Student	49.3
Post-baccalaureate	76.6	Retired	38.6
N/A	31.9	Homemaker/housewife	30.3
		Person with disability (PWD)	9.4
		NA	52.1

Source: 2019 NICTHS, DICT and PSRTI

Among individuals, 85 percent access the Internet through their cellphone, 30 percent use a desktop computer and 19 percent use a laptop.

Table 5.18. Devices Used to Access the Internet

Device used to access Internet	%
Cellular phone	85.1
Desktop computer	29.8
laptop	19.3
tablet	7.4
TV	0.6
Gaming consoles	0.4
Others	0.3

Source: 2019 NICTHS, DICT and PSRTI

An estimated 63 percent of individuals access the Internet using mobile data so it is expected that a huge percentage of individuals use their cellphone in accessing the Internet. There are 40 percent of individuals that access the Internet at home, 26 percent in commercial establishments, and 14 percent at work. The use of a cellphone to access the Internet is highest

in Region I at 93 percent, while half of individuals in Region X reported accessing the Internet using a desktop computer.

The heavy reliance of individuals on cellular phones and mobile data to connect to the Internet suggests that the country's digital infrastructure has been mostly concentrated in mobile technology, with very poor investment in wired Internet infrastructure, especially going to the homes. During the pandemic, this has had huge implications on the ability of individuals to engage in relatively bandwidth heavy activities, such as online learning and remote work.

In the last 3 months, the top uses of the Internet among individuals are:

- Social activities/communication (94%)
- Access to information (44%)
- Leisure/lifestyle (37%)
- Learning (15%)
- Access to government websites/services (13%).

The fact that almost 95 percent of individuals who use the Internet access social media and communicate can be linked to the dominance of mobile data service in the Philippines, which is often offered in prepaid plans bundled with access to social media apps, such as Facebook and Instagram, and instant messaging apps, such as Facebook Messenger and Viber. Accessing websites and apps outside of the bundled service will incur regular mobile data charges.

The common use of the Internet to individuals in different communities throughout the country can be used as a benchmark for the bandwidth need in particular areas. However, since the survey was conducted pre-pandemic, it is highly likely that the identified top uses of the Internet would have changed. Online class, for example, was the primary mode of learning for schools throughout the country for school year 2020-2021. Back in May 2020, the Department of Education (DepEd) said that **52 percent of all public schools did not have access to Internet facilities**. However, its learner's survey in August 2020 revealed that only 3.6 million of 21.8 million enrollees for the school year had Internet access. This means about 83 percent of students who are currently enrolled in public schools did not have Internet access (Ramos, 2020).

The top reasons cited by individuals for not using the Internet are:

- Lack of knowledge on how to use it (39%);
- High cost of Internet subscription (29%);
- Unavailability of Internet in the area (23%); and
- High cost of equipment (22%)

In Regions VIII, IX and XII, an estimated 60 percent of individuals cited "not knowing how to use the Internet."

Almost 50 percent of individuals from BARMM (49.7%) and Region V (47%) cited the "unavailability of Internet in the area" as a barrier to going online.

Region III has the highest share of individuals who cited the "high cost of Internet subscription" (50%) and the "high cost of equipment" (45%) as the reasons for not using the Internet.

The unavailability of Internet in the area, the high cost of Internet subscription, and the high cost of equipment are similar to the top reasons given by households for not having a home Internet subscription.

In summary, individuals have significant access to a television and good access to a cellphone, but low use of a computer and the Internet, at less than 50 percent.

Table 5.19. Individual's Access to ICTs

ICTs	%
Television	91.1
Cellphone	79.0
Computer	33.9
Internet	46.9

Source: 2019 NICTHS, DICT and PSRTI

5.3. Summary

Policy reform that updates the country's laws will help improve our digital infrastructure. The most critical role of the government in promoting the expansion and improvement of digital infrastructure is in ensuring that the necessary policy and regulation that address access, affordability and quality are in place.

In its study on the economic contribution of broadband, the ITU saw the impact of **policy and regulatory framework** on the growth of markets for digital services and applications. It found that an increase of one percent in the ICT regulatory tracker[54] yielded a positive increase in the ecosystem development index of 0.0348 percent in the subsequent time period. An increase in the ICT regulatory tracker was also found to be linked with an increase in the pillars measuring the development of infrastructure of digital services, connectivity of digital services, household digitization and digital factors of production (ITU 2020a, p. 32).

National broadband policy and policy approaches relevant to broadband coverage, bandwidth and affordability are important determinants of a country's digital infrastructure and performance. If the government does not have the funds to subsidize rural networks, the ITU recommends that it must "encourage and facilitate private investment on network expansion and reduce construction cost to enhance broadband affordability" (ITU 2019a, p. 51).

The persistence of outdated policy and regulation is where the Philippine Internet problem truly lies. Existing laws, such the Radio Control Law of 1931, the Public Service Act of 1936, and the Public Telecommunications Policy Act of 1995 still adopt analog principles and the mindset that networks are large, vertical, centrally operated infrastructure like the public switched telephone network. In the absence of a law for Internet connectivity, decades after it became commercially available and pervasive, the default policy for broadband networks is the Public

[54] The ITU's ICT Regulatory Tracker is an evidence-based tool to help decision-makers and regulators make sense of the rapid evolution of ICT regulation (ITU 2019b). It uses 50 indicators grouped into four clusters (regulatory authority, regulatory mandates, regulatory regime, and competition framework for the ICT sector).

Telecommunications Policy Act, which provides that only entities with a legislative franchise from Congress as a PTE can put up its own "network." The term "network" is not defined in the law,[55] but the default interpretation is that this covers *any type* of network, regardless of whether or not the entity intends to offer telecommunications services—i.e., local exchange, inter-exchange, international, and mobile radio services, as identified in RA 7925. This means an entity cannot deploy facilities crossing cities or municipalities without a telco franchise, even if it is just to pick up bandwidth a town away to provide Internet service at the last mile.

This is especially problematic for "non-telco ISPs" that are barred from putting up a middle mile network between Point A (community being serviced) to Point B (the nearest backbone facility), unless they get a franchise or, in the case of cable TV operators, a provisional authority for every town in between Points A and B.[56] If there is no accessible data center or no fiber optic network going to a community, microwave radio is used to carry bandwidth from Point A to Point B. Microwave, however, has limitations and is unable to carry high bandwidth. As a result, non-telco ISPs, especially in the rural areas, are not able to grow their market share or offer higher data plans because of the limited bandwidth that they can access through the telcos.

Congress has not passed a law that will introduce rules specifically for Internet connectivity. RA 10929 or the Free Internet Access in Public Places Act of 2017 introduced some landmark provisions, which allow non-telco ISPs to participate in the government's free Internet program. Its benefits should be applied outside of the Free Wi-Fi program.

There are pending legislation in Congress that aims to open up the market and allow more players to participate in building the digital infrastructure and improving the quality of Internet service. These include the proposed Open Access in Data Transmission Act and the Better Internet Act (in the Senate) and Faster Internet Services Act (in the House of Representatives). If passed, the Open Access bill will allow greater market access to broadband networks, as it introduces a simpler and more efficient process for the entry of data transmission industry players and provides a framework for infrastructure sharing, which should lower the cost of rolling out digital infrastructure. The Better Internet bill, on the other hand, aims to introduce rules on service reliability and quality of service for Internet services.

The digital infrastructure is a combination of many different technologies, not just mobile. As seen in the level of mobile broadband penetration based on the NICTHS results, cellular mobile services are widely available in the Philippines and is the top means for Filipinos to connect to the Internet. However, the poor performance of the country compared to its ASEAN counterparts when it comes to broadband download speed average and the growing bandwidth needs of individuals, households and establishments show that there also needs to be focus on other technologies, which can either carry more bandwidth or are appropriate and cost-efficient to deploy in the rural areas. The policy and regulatory environment must be designed to accommodate different types of Internet technologies that will best suit the needs and requirements of underserved and unserved communities in the Philippines.

[55] The NTC defined "network" in MC No. 08-09-1995 or the Implementing Rules and Regulations for RA 7925 as "a set of nodes and links that provides connections between two or more defined points to accommodate telecommunication between them" (NTC 1995, p.2) The law also left open-ended the definition of the term "value-added service (VAS)" and, similarly, was defined by the NTC in the IRRs under the term "enhanced service" as a service which adds a features [sic] or value not ordinarily provided by a public telecommunications entity." See: NTC (1995). For a discussion on the definition of "VAS," see the Supreme Court's decision in *Globe v NTC and Smart Communications* (Supreme Court 2004).

[56] Interview with Joel Dabao, Philippine Cable and Telecommunications Association (PCTA), 29 January 2021.

Different technologies have their own advantages and setbacks, depending on how and where they will be used. Wired technologies deliver faster speeds and are more reliable than wireless. Due to wireless technologies use of radio frequencies, they may be prone to atmospheric attenuation, interference from other radio-emitting devices, and line-of-sight issues. Furthermore, different wireless technologies have different radio propagation characteristics depending on the frequencies used – hence the difference in range between cellular and Wi-Fi, for example.

There are, however, developments in wireless last-mile access technologies that may make it a more viable option for deployment by small players. Large-scale Wi-Fi mesh networks, for example, use unlicensed frequencies and use a network design that allow them to overcome the short range of conventional Wi-Fi networks (ITU 2020). These technologies do not require towers, as co-location of radio equipment on buildings, houses and other establishments will do. Small cell technology, which is at the core of the 5G cellular standard, may potentially lower the cost of deploying individual cell sites and make them more financially viable to deploy in some areas (Bouras et al. 2014).

Wired broadband technologies (fiber, in particular) provide high performance, high data capacity and low transmission error rates" that have yet to be matched by wireless (ITU 2020b). The main drawbacks of installing cables, particularly in rural areas, remains to be the deployment costs and coordination challenges. Expanding the reach of a wired last-mile access network means deploying more cables, which comes with increased pole attachment fees (for overhead deployments), expenditures on digging and installing underground cabling, and obtaining the necessary permits and regulatory approval. Indeed, "deployment costs and coordination challenges are major impediments to the installation of fiber-optic cables, particularly in rural areas" (ITU 2020b, p. 66). This key constraint was reflected in the survey where less than 30 percent of barangays have access to fiber optic cables.

As an archipelago, wireless connectivity solutions may still be more feasible and appropriate for the connecting the country's geographically isolated and disadvantaged areas. However, wireless technologies are subject to licensing restrictions, which make it difficult for small players to deploy wireless. According to the Radio Control Law of 1931, only entities with a legislative franchise can be given a license to operate radio stations and use licensed radio frequencies (Barcenas and Serafica 2018). Combined with the requirements of the Public Telecommunications Policy Act of 1995, only public telecommunications entities or providers that offer voice telephony services can access radio spectrum, a barrier to entry for those who wish to offer Internet services only, as they will be forced to get a telco franchise and offer telephony services (WB 2020c). There are pending bills in both houses of Congress introducing a Spectrum Management Policy, which will update the rules for the distribution and utilization of spectrum, especially as the demand for bandwidth and Internet services continue to grow. These include House Bill No. 0299 filed by Rep. Victor Yap and Senate Bill No. 793 filed by Sen. Risa Hontiveros in the 18th Congress.

Government investment in digital infrastructure, if necessary, must be limited and targeted at network segments and areas where the market fails to deliver. It is important to examine whether the Philippines' policy and regulatory environment has indeed allowed market players to invest, build, compete, and innovate. "Market players" here should not be limited to the telcos; it includes any entity that can comply with basic licensing and regulatory requirements and is technically capable of building and operating a broadband network using *any* available technology.

Some key questions about licensing, network rollout, and spectrum management need to be addressed:

- Does the licensing regime attract the most innovative and dynamic service providers and welcome investment from both local and foreign, big and small, active and passive infrastructure players alike?
- Are the rules designed to create a level playing field, where market players can compete based on which one offers the best service at the most affordable rate?
- Is there a policy that promotes the sharing of passive infrastructure, such as towers, ducts, poles, and in-building cabling, that will help lower the cost of deploying a broadband network and improve efficiency for everyone?
- Are there rules in place encouraging the coordination of network build out with other infrastructure owners, such as roads, railway, electricity transmission, and utilities, in order to address right of way and permitting issues?
- Are constraints lessened for ISPs that operate or wish to expand services to underserved areas?
- Is spectrum management based on a set of key principles and national policy that is known to all concerned stakeholders, where "efficient use" is well defined, assignment criteria and obligations are clearly articulated, and spectrum utilization and review are regularly monitored and enforced?

These questions can help guide the government in evaluating whether the right conditions are in place for industry players and stakeholders to take part in building and expanding the digital infrastructure.

Apart from the market players, other countries, especially in the developing world, have also created a space for alternative, often non-profit, service providers called "community networks," which are allowed by the regulator to deploy community-based and owned networks and to use spectrum to connect the areas that are less commercially attractive to traditional operators.[57]

The priority of the government for its Build, Build, Build (BBB) program is still the traditional infrastructure and only the Luzon Bypass Infrastructure and the National Broadband Plan directly involve access-enabling ICT infrastructure (Cuenca 2020). The remaining ICT-enabled projects in BBB are not meant to improve ICT access among the public. Past government investments must guide present-day decisions on whether or not, how, where, and how much the government should use public funds for the digital infrastructure. Decision makers should take caution not to succumb to the blanket recommendation that government investment is the answer to improve broadband Internet in the country.

Which segment of the broadband network should the government fund that will bring the most impact to consumers and best serve the public interest. The DICT has said that given the high cost of buying bandwidth from the existing providers, the government is targeting to have alternative international links (access to PLCN and two government cable landing stations) and a domestic backbone network. The idea is to offer a cheaper source of bandwidth. The country currently has access to at least seven international submarine cable systems, nine cable landing stations, and four operational nationwide backbone (PLDT's DFON, Globe's FOBN, FOBN

[57] Some national regulators, such as in India, Mexico, and Brazil, give a special spectrum license to non-traditional network operators, including community networks, to connect the remote rural areas. See World Bank. (2020, p.50).

2, and Telecphil) and one planned by Converge ICT. The government NBP initiative will provide more options. As previous assessments by the UNESCAP and NTC have shown, the bottleneck, seems to be in the middle mile. The main challenge for service providers is to efficiently and affordably access and distribute bandwidth to the end users at the last mile. Thus, the government must decide on its investment in infrastructure based on what it considers as the key constraint in bringing reliable and affordable broadband service down to the last mile.

6. Summary, Conclusions and Ways Forward

This section presents key insights and policy recommendations based on the findings of the study's three main themes: ICT Development for Promoting a More Inclusive and Innovative Society; Gender Dimensions in ICT Usage and Online Entrepreneurship; and Digital Infrastructure Development.

- *ICT Development for Promoting a More Inclusive and Innovative Society*

Key Insights

Individuals living in rural and less metropolitan areas/regions, have less schooling, and are older have low connectivity. The digital divide is present among geographical locations, education, and age. The NICTHS results indicate that there is gender disparity in ICT access. Inadequate geographical coverage, especially of good quality Internet, is a continuing concern in connectivity. Meanwhile, people that were not able to attend or stay long in school and the older adults could have been disconnected because of economic circumstances, or weak cognitive skills for learning new technologies. Savolainen (2015) found that cognitive barriers such as poor search skills and low confidence can result in frustration for not getting adequate (or correct) information or for not seeking information at all.[58]

Digital skills are quite low in the country (40% have at least one ICT skill), and are in favor of women, but there are some disparities in skills. An interesting finding is that among the young, the proportion of ICT-skilled females are higher; while among adults (working-age and older), the proportion of digitally-skilled males are higher. In addition, women dominate men in basic digital skills such as communications, and file creation and management; while, more men are skilled in intermediate activities related to using modeling and simulation software, and data management and analysis. The findings suggest that women appear to have fewer and less complex digital skills than men once they enter the labor force.

The Internet is used mostly by Filipinos for communication/social media and entertainment/gaming. Online purchase of goods and services is another common activity, while electronic payment and online banking are not as common. Communication/social media and entertainment/gaming are very popular activities in the country, the latter especially among the youth. It can be alarming if use of the Internet merely stops at being recreational. The challenge is to develop this into a motivation to learn higher digital skills, such as programming and creating content. Meanwhile, online shopping as a relatively common activity is good indication of increasing use of e-commerce, but digital finance, which is being advocated by the government and private sector to promote inclusion (among others) is not very common for people who buy or sell online. The government targets digital payments, in value and volume, to reach 50 percent by 2023 (Noble 2021). In the first quarter of 2020, Better Than Cash Alliance reported that 20 (10) percent of the value (volume) of payment transactions were digital (BSP 2020). The figures are still far from the target, but there could have been optimism from the improved digital payment transactions from previous years and the increased e-commerce and online banking activity during the COVID-19 pandemic. The most recent Google, Temasek and Bain & Co. (2020) e-conomy SEA report suggests an increase of use of the Internet, including digital platforms, amid the pandemic,

[58] Other cognitive barriers include: unwillingness to see one's needs as information needs, inability to articulate one's information needs, unawareness of information sources, and inability to deal with information overload (Savolainen 2015).

especially during the hard lockdown, and that this increased use is going to be sustained in a post COVID-19 world. Still, government should be promoting the use of electronic transactions more than ever, and increase attempts to digitize transactions, especially as we would expect improvements in the Internet infrastructure in the years to come.

Lack of awareness and security concerns hinder people from using the Internet and engaging in online services. Through digital transformation or digitalization, government and business innovatively deliver services with efficiency, as well as inclusiveness from the accessible-to-all characteristic of digital platforms in general. But if there is less knowledge about such services and concerns about safety and protection, then there would be less online engagement than what is desired.

Recommendations

The National Broadband Plan (NBP) and the Free Wi-Fi in Public Places Program implementation to include a sub-project or component with monitoring that focuses on areas that are prone to exclusion from ICT such as rural and remote communities. It is quite known how some students, especially in remote areas, struggled with getting a cellular network signal for their online classes. In this case, e-education, as well as other digital systems, cannot be implemented successfully without widespread connectivity. Adequate infrastructure is needed to support ICT development in the country. Policies have to be continuously implemented without delay, and reformed to considerably improve coverage and quality of connectivity. One example which ought to be replicated is the DICT's initiative to push for an executive order that promotes inclusive access to satellite services for internet connectivity. Executive Order 127 (s. 2021) is the first liberalization policy since 1995 that is focused on internet connectivity. The policy allows telcos, ISPs and value-added service providers alike to directly access satellites for Internet service.[59] The deployment of satellite services, especially in areas where other terrestrial and submarine broadband technologies are not feasible, is clearly one of the ways to improve the coverage and quality of connectivity in the countryside.

Investing in digital skills development is crucial. On the one hand, investment refers to devoting efforts to identify, collect and measure specific digital skills that are important to assess our global competencies, especially in the wake of changes in the labor market from the FIRe and the great "reset" from the COVID-19 pandemic. On the other hand, investment involves investing money to upgrade with digital skills the courses/curricula offered in education institutions, the training programs in the business sector, and the human resource development programs of the government. It is further suggested that in skills development, building of capacities consider a good balance of demand and equity, be it in terms of gender, age or any other circumstance. The DICT should work toward the measurement of digital skills, follow the recommendations of the ITU, especially in monitoring SDG Indicator 4.4.1.

Policies should involve advocacy of digital literacy and Internet safety. ICT development would not be successful if the technology is there but is not used. The DICT can partner with other agencies and the private sector in a national campaign to spread information about ICT and FIRe technologies, cyber security and business/consumer protection. An objective would be to encourage people to go online – shop or sell goods/services, pay and send remittances

[59] The discussion on digital infrastructure provides more details.

electronically, do government-related transactions; and be informed about policies that protect them as consumer or producer/provider of ICT goods and services.

The DICT should regularly conduct the NICTHS, preferably every two or three years, and improve on the current design and implementation of the survey. It is recommended that the collection of asset data (e.g. durable goods owned by the household) be included in subsequent conducts of the NICTHS as this will provide information about the digital divide between the poor and non-poor. Alternatively, the DICT and PSA can explore whether the NICTHS can be integrated with other national surveys, e.g. FIES, APIS, NDHS, etc. to exploit the multi-topic information in these surveys, including asset data. An asset index could be generated with asset data to proxy welfare conditions of households and individuals. The DICT could involve more parties, especially experts on ICT statistics, in the preparation of the questionnaire for the next and future rounds of the NICTHS. More resources for the conduct of the NICTHS will also be important to go beyond the current survey protocol of selecting one respondent randomly from the interviewed household to answer the individual questionnaire.

The DICT and PSRTI should be congratulated for adding on digital skills categories in the NICTHS questionnaire; however, there should have been more attention to ensuring that all and not only six of the nine ICT skills for SDG Indicator 4.4.1 were part of the NICTHS individual questionnaire. While ICT statistics are generated for country use, international statistical standards are promoted to ensure comparability of country statistics. Statistics become more meaningful when they are compared. It is recommended that the next round of NICTHS include all nine ICT skills and/or any future revisions under the SDG Indicator 4.4.1. For instance, there is recent work on this indicator which the DICT should keep track of. Revised and new skills categories, for instance, were agreed upon at the 6th and 7th Expert Group meetings on ICT Household Indicators (EGH), in Geneva.[60] It is further recommended that the DICT keep itself updated about the international standards in measuring ICT development, such as through continuous participation in international benchmarking bodies, e.g., the EGH and the Expert Group on Telecommunication/ICT (EGTI).

Meanwhile, the DICT could also work with the PSA toward experimenting with digital skills measurement, currently merely reported skills in the survey, to see whether we could actually observe these skills, as is done for functional literacy in the PSA's Functional Literacy, Education and Mass Media Survey (FLEMMS). There is scope to work with PSA in the FLEMMS for ensuring that digital skills measurement is part of functional literacy measurement.

- *Gender Dimensions in ICT Usage and Online Entrepreneurship*

Key Insights

ICT use based on the NICTHS shows that women are at par with men; in some aspects they outperform them. In particular, NICTHS data shows that relatively more women use the cellular phone (81%), are aware of online business transactions (47%), and have online buying/selling accounts (11%) than men. Furthermore, a significantly greater proportion of female Internet users (5%) engage in online selling than men (4%). It is noticeable that male

[60] Source: Metadata for SDG Indicator 4.4.1 (https://unstats.un.org/sdgs/metadata/?Text=&Goal=4&Target=4.4).

online sellers earn more than female sellers, at P10,898 compared to P6,041 respectively, though further research is needed to firmly establish whether this disparity is purely gendered or attributable to other factors that have their own effects, as well as interactions with gender effects.

Online entrepreneurs are highly confident about online selling, mostly as an alternative source of income. For women specifically, majority of online sellers are employed (25%), though interestingly, self-employed women and housewives combined comprise a sizable proportion of women sellers (36%). This illustrates the potential of online selling as a means for women traditionally unable to participate in the formal economy to engage in the sector. Online entrepreneurs appear to be more tech savvy than the general population, with more online sellers engaging in online transactions (29% of sellers), accessing information online (60% of sellers), conducting professional services (20% of sellers), and carrying out online financial transactions such as paying bills (19% of sellers) and online banking (23% of sellers).

Education and training are significant correlates of online selling, which means that addressing digital skills gaps are important. This finding draws from the previous insight on the digital skills of online sellers being relatively higher than that of the general population, implying that ICT skills and training shall open up opportunities for individuals in online entrepreneurship. Also, one of the most common reasons for not using the Internet, the survey shows, is lack of knowledge.

Recommendations

There is a strong incentive for the government to pursue policies for reskilling the workforce and enhancing educational capacity of the population. The country needs to regularly measure and monitor digital skills, both life skills and competencies for work, of the entire population. Training of the older population and less educated with regard to the practical applications of ICT, as well as enhancing the general population's knowledge and usage of online platforms in conducting online transactions will equitably improve the population's ability to benefit from ICT.

Further research studies, especially behavioral ones, are necessary to examine ICT skills gaps in both men and women, and how these skills may be harnessed fully. Notably, the NICTHS shows that online platforms offer livelihood opportunities for women who otherwise are unable to participate in the economy. Current and future training programs must focus on enhancing capacities identified to equitably improve online business and online employment skills of both men and women. There is a possibility that having the right digital skills may also not be enough, at least for women, whose economic empowerment is not maximized likely because of unpaid care work. According to the Labor Force Survey (LFS), conducted by the PSA, the gender gap in labor force participation has been around 30 percentage points in favor of men among the working-age population[61] 15 years and over since 1990, with about 80 percent of men being part of the Philippine workforce, compared to only half of women. Further, data from the LFS shows that unpaid care work is the main bottleneck to women's

[61] The working-age population aged 15 and over can be divided into three groups, viz., (a) the employed, (b) the unemployed, and (b) those who are neither. The labor force or economically active population comprises the employed and unemployed. The unemployed consists of working-age persons who are (1) without work, (2) currently available for work, and (3) seeking work or not seeking work because of the belief that no work is available, or awaiting results of previous job application, or because of temporary illness or disability, bad weather or waiting for rehire or job recall. Those who are outside the labor force (i.e., who are neither employed or unemployed) include stay-home spouses, students, persons with disability, retired persons, and seasonal workers, as well as discouraged workers not actively seeking employment.

labor participation. The principal reason given by (about three-fifths of) women of working age for being economically inactive, i.e., being outside the labor force is unpaid care work, whereas for about half of their men counterparts, "schooling" is the primary reason for being outside the labor force.

There is a need to address issues that constrain people's ability to take advantage of online platforms for various transactions and other welfare-enhancing activities. Utilization behaviors of both men and women show that digital platforms can be potent media for disseminating welfare-enhancing information such as social protection programs and livelihood opportunities. Apart from the lack of knowledge on how to operate the system and necessary instruments, these can be related to challenges in accessing formal institutions such as in online banking and in online government transactions. Furthermore, although the report highlights the confidence of current users on online platforms for selling and purchasing, the issues of trust and reliability on these platforms are important areas in future inquiries. Improving ICT-related infrastructure such as mobile Internet connection across the country shall be vital in allowing greater engagement in ICT of all Filipinos, both women and men alike, in order for everyone to gain sufficient digital dividends.

- *Digital Infrastructure Development*

Key Insights

Although much data on the digital infrastructure is available, the NICTHS further provides validation of the main challenges faced in the country in improving ICT infrastructure, especially as it pertains to the disparities in access across various sub-populations, often with rural folk at a disadvantage compared to urban residents. The following are key findings from the NICTHS.

Barangay access to ICT infrastructure

Telecom tower. **Only a third (36%) of the surveyed barangays in the NICTHS reported having a telecommunications tower in their community; meanwhile, although 92 percent of barangays have access to a cellphone signal. 3G technology is still prevalent in the rural areas.** There are more telecom towers in urban barangays (61%) than in rural areas (19%). Almost all the telecom towers (95%) in both urban and rural barangays are privately-owned. The survey results show an average of 2 telecom towers per surveyed barangay. NCR reported the highest number of towers, with 404 towers present in the barangays, but Region IV-A reported the highest average, at 2.98 towers per barangay. Almost half of all the barangays surveyed can get a 4G signal and about 38 percent of the barangays receive a 3G signal, but there is no telecom tower in their community. A telecom tower is the passive infrastructure, to which a radio equipment that facilitates data transmission, is attached. Depending on the radio spectrum used, it is important to have enough towers installed within a certain distance in order to facilitate the handoff of a mobile device to the next cell site while the end user is moving or mobile, in order to avoid service interruption and degraded or poor cellular signal.

Fiber optic cable. **About three in 10 (29%) of surveyed barangays nationwide have access to a fiber optic cable (FOC) network**: half (53%) of surveyed urban barangays and a tenth (12%) of surveyed rural barangays. Fiber offers the highest bandwidth and reliability to date, but has limited coverage outside of the urban centers. For several decades, the dominant telcos

have focused investment in cellular mobile networks. Investment in fixed wired broadband networks to provide fiber to the premises (FTTP) or fiber to the home (FTTH) service and to support bandwidth-heavy use and 4G/LTE and 5G deployments happened only fairly recently.

Free Wi-Fi. **Only 12 percent of all barangays surveyed have free Wi-Fi. Of this, about 70 percent are publicly provided and the remaining are privately provided. Less than two percent of barangays without a telco have access to free public Wi-Fi.** About seven percent of surveyed barangays have both free Wi-Fi and telcos operating in their area. By region, this is highest in NCR at 21 percent. Of the barangays that reported having both, 84 percent are urban barangays and only 16 percent are rural. On the other hand**,** 44 percent of barangays reported not having both telcos and free public Wi-Fi. Of the barangays that reported the absence of both in their area, 23 percent are urban barangays and 77 percent are rural.

Access to Internet by households

Only 18 percent of households have their own Internet access at home. NCR households with their own Internet connection are subscribed mostly to fixed wired broadband, while BARMM households are mostly subscribed to mobile broadband. By region, NCR has the highest share of households with their own Internet access at 33 percent while in BARMM, households with their own Internet connection make up four percent. Of the 18 percent of households with their own Internet access, more than half (54%) are subscribed to fixed wired broadband network, 23 percent have mobile broadband network, 22 percent have fixed wireless broadband network, and three percent have satellite broadband network. Households in NCR reported the highest fixed wired broadband network subscription for their Internet service at 77 percent, while mobile broadband subscription is highest in BARMM at 88 percent. **There are over three times more "highly connected" households—those with several options for communicating and going online—in the urban areas than in the rural areas.** The pandemic has made the problem of household connectivity even more challenging, as mobility restrictions and quarantine policies prevent people from going to schools, places of work, and public places to access the Internet. The government must look at how to make the Internet more accessible to households in a post-COVID-19 world, and towards helping Filipinos families harness the Internet to build back their lives.

Barriers to Internet Access

A majority of households that do not have their own Internet connection noted the "high cost of Internet subscription" as a barrier to access. The top three reasons for households not having their own Internet connection are the high cost of Internet subscription (52%), high cost of equipment (33%), and Internet service is not available in their area (19%). More than half of households in regions III, VIII and X reported the high cost of equipment, 50-70 percent of households in eight of the 17 regions cites the high cost of Internet subscription, and more than half (53%) of households in BARMM reported not having Internet service in their area. In NCR, there are still households (5%) that reported absence of Internet service in their area.

Lack of access to a device is also a barrier to Internet access. Only about a quarter (24%) of households have a computer at home. Of these, 66 percent of households have a laptop, 39 percent have a tablet and 25 percent have a desktop computer. **About a quarter of**

households have a communal cellphone[62] available. The low percentage of households with a computer can be a barrier to accessing the Internet. The device gap can be addressed by the availability of cheaper smartphones that are providing the low-income population a gateway to Internet use. However, as is observed in other countries, the pandemic has made connectivity a must for *individual* rather than shared or household use, in order to facilitate the activities of family members who may be working from home, attending online classes, or running a business online. Individualized connectivity will make Internet in the Philippines, which is already expensive to begin with, even more out of reach to more Filipinos.

Recommendations

Policy reform that updates the country's archaic laws will help improve our digital infrastructure. The most critical role of the government in promoting the expansion and improvement of digital infrastructure is in ensuring that the necessary policy and regulation that address access, affordability and quality are in place. The ITU has reported about the impact of a country's **policy and regulatory framework** on the growth of markets for digital services and applications. National broadband policy and policy approaches relevant to broadband coverage, bandwidth and affordability are important determinants of a country's digital infrastructure and performance. But in the case of developing countries which do not have the funds to subsidize rural networks, the ITU recommends that governments "encourage and facilitate private investment on network expansion and reduce construction cost to enhance broadband affordability."

Outdated policy and regulation has stifled the growth of the broadband industry in the Philippines by restricting the players who can build broadband networks to telecom operators. If the country were to accelerate its digital transformation and use digital technologies as tools for economic recovery, it needs a law specific for Internet connectivity. There are pending legislation in Congress, such as the Open Access in Data Transmission Act and the Better Internet/Faster Internet Service Act, that aims to open up the market and allow more players to participate in building the digital infrastructure and improving the quality of Internet service. If passed, the Open Access bill will allow greater market access to broadband networks, as it introduces a simpler and more efficient process for the entry of data transmission industry players and provides a framework for infrastructure sharing, which should lower the cost of rolling out digital infrastructure. The Better Internet bill, on the other hand, aims to introduce rules on service reliability and quality of service for Internet services. The executive needs to work with Congress to pass these laws with urgency.

The digital infrastructure is a combination of many different technologies, not just mobile. The NICTHS results reveal that cellular mobile services are the top means for Filipinos to connect to the Internet. However, the poor performance of the country compared to its ASEAN counterparts when it comes to broadband download speed average and the growing bandwidth needs of individuals, households and establishments show that there also needs to be focus on other technologies, which can either carry more bandwidth or are appropriate and cost-efficient to deploy in the rural and unserved areas. Different technologies have their own advantages and setbacks, depending on how and where they will be used. The policy and regulatory environment must be designed to accommodate different types of Internet

[62] In the survey, households that have a cellphone should have the device available to all household members for use at any time. It may or may not be owned by the household, but it must be considered a household asset. The device should be in working condition at the time of interview

technologies that will best suit the needs and requirements of underserved and unserved communities in the Philippines.

Government investment in digital infrastructure, if necessary, must be limited and targeted at network segments and areas where the market fails to deliver. It is important to examine whether the Philippines' policy and regulatory environment has indeed allowed different types of market players to invest, build, compete, and innovate. "Market players" includes telcos, ISPs, and any entity that can comply with basic licensing and regulatory requirements and is technically capable of building and operating a broadband network using *any* available technology. Key questions about licensing, network rollout, and spectrum management need to be addressed in order for the government to say that it has exhausted efforts to put in place the right conditions for market players to take part in building and expanding the digital infrastructure. Finally, the government must identify which segment of the broadband network needs public funds and will bring the most impact to consumers and best serve the public interest.

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Annex

Chapter 2: Annex 2.1. Published laws, policies and programs on ICT

SUBJECT	DATE ISSUED	PURPOSE	DESCRIPTION	DOMAIN
Approval of the Philippine National Public Key Infrastructure (PNPKI) Certificate Policy (Version 1.0)	December 23, 2013	For PNPKI RootCA Operation	Allows users of public networks like the Internet to exchange private data securely	Data and information security
Approval of the Philippine National Public Key Infrastructure (PNPKI) Certification Authority (CA) Certificate Practice Statement (CPS) (Version 1.0)	December 23, 2013	For PNPKI GovCA Operation	PKI is essentially a set of hardware, software, policies, personnel and procedures needed to create, manage, distribute, use, store and revoke digital certificates. It shall foster trust in the government by **ensuring secure and reliable online transactions.**	Data and information security
Approval of the Philippine Electronic Government Interoperability Framework (PeGIF) Version 1.0 for Implementation by Government Agencies	July 30, 2014	Standards Catalogue for Government System Interoperability	Interconnect government offices to enhance operations and improve the delivery of services to the people.	Streamlining of processes; efficient service delivery
Prescribing Policies and Procedures Governing the Accreditation of Government Registration Authorities under the National Certification Scheme for Digital Signatures	April 25, 2014	For PNPKI GovRA Operation	EO No. 810, s. 2009 "INSTITUTIONALIZING THE CERTIFICATION SCHEME FOR DIGITAL SIGNATURES AND DIRECTING THE APPLICATION OF DIGITAL SIGNATURES IN E-GOVERNMENT SERVICES"	Data and information security
Rules and Regulations on Migrating to the Government Web Hosting Service (GWHS) of the Department of Science and Technology's Information and Communications Technology Office (DOST-ICT Office)	April 27, 2015	For Government Webhosting Service	AO 39, s. 2013 mandates all line agencies to transfer their Internet hosting requirements to the Government Web Hosting Service (GWHS) for more efficient use of technology and greater protection against hacking and cyber-attacks. All government agencies are also tasked to strictly follow the Uniform Website Content Policy (UWCP) that gives their websites a common look and feel and the government a corporate identity.	Streamlining of processes; efficient service delivery; data and information security
Prescribing the GovMail Service Guidelines for Philippine Government Agencies	April 27, 2015	For Government Mail Service Operation	The GovMail is provided to employees and officials to assist in the operation of the government and deliver effective and efficient service to the general public.	Data and information security; efficient service delivery
Approval of the Philippine Electronic Government Interoperability Framework (PeGIF)PART 2 otherwise known as the Information interoperability Framework (IIF) for implementation by Government Agencies	April 27, 2015	For Government Agencies to share and reuse information in a uniform and effective manner	Increased efficiency in government services. Improved government decision-making practices. Reduced cost and increase savings for the government.	Streamlining of processes; efficient service delivery; reduced cost

ISSUANCE	POLICY	DESCRIPTION	DOMAIN
Section 14 of RA 11032	PRESCRIBING THE IMPLEMENTING RULES AND REGULATIONS FOR SECTION 14 OF R.A. 11032 – FOR THE DEPARTMENT OF INFORMATION AND COMMUNICATIONS TECHNOLOGY (DICT) TO ESTABLISH, MANAGE AND MAINTAIN THE PHILIPPINE BUSINESS DATABANK (PBD)	Philippine Business Databank (PBD) shall provide concerned national government agencies (NGAs) and local government units (LGUs) access to data and information of registered business entities for the purposes of verifying the validity, existence of and other relevant information pertaining to business entities.	Streamlining of processes; efficient service delivery
RA 10929	GUIDELINES ON THE USE OF THE FREE PUBLIC INTERNET ACCESS FUND (FPIAF)	No fees shall be collected from users to connect to the public internet access points. Under the Program, the minimum internet speed per user is two megabits per second (2Mbps) or as prescribed by the National Broadband Plan, whichever is higher.	Improving internet access
DC 007, s. 2020	PRESCRIBING THE DICT ANTI-VIRUS POLICY	Adoption, use and implementation of current version of TLS protocol. Duty of the MIS Officer and Service Administrators; TLS Certificate Use of Future Versions of TLS or Other Cryptographic Protocols	Building ICT structures
	ADOPTION OF THE NATIONAL COMPETENCY STANDARDS (NCS) FOR e-CENTER KNOWLEDGE WORKERS (KW)	The National Competency Standard for e-Center Knowledge Workers (NCS-KW) defines the knowledge, skills, and abilities required for assisting and empowering communities to utilize ICT for access to basic social services and economic activities.	Web accessibility
Joint MC No. 1, s. 2018	ESTABLISHMENT OF THE FREE INTERNET ACCESS IN PUBLIC PLACES PROJECT IN BASIC EDUCATION PUBLIC SCHOOLS AND LEARNING CENTERS	Accelerate economic, social, and educational opportunities and reduce growing Digital Divide under the overarching e-Filipino program.	Improving internet access
MC No. 004, s. 2017	PRESCRIBING THE PHILIPPINE WEB ACCESSIBILITY POLICY AND ADOPTING FOR THIS PURPOSE ISO/IEC 40500:2012 INFORMATION TECHNOLOGY – W3C WEB CONTENT ACCESSIBILITY GUIDELINES (WCAG) 2.0 AS THE PHILIPPINE STANDARD FOR MAKING WEB CONTENT MORE ACCESSIBLE TO A WIDER RANGE OF PEOPLE WITH DISABILITIES	Enable persons with disabilities to access government programs, products, and services offered online through the websites.	Web accessibility
MC No. 005, s. 2017	PRESCRIBING THE POLICIES, RULES, AND REGULATIONS ON THE PROTECTION OF CRITICAL INFOSTRUCTURE (CII) STIPULATED IN THE NATIONAL CYBERSECURITY PLAN (NCSP) 2022	The aim of the NCSP 2022 is for our country to have a "trusted and resilient infostructure"	Building ICT structures

ISSUANCE	POLICY	DESCRIPTION	DOMAIN
MC No. 007, s. 2017	PRESCRIBING THE POLICIES, RULES, AND REGULATIONS ON THE PROTECTION OF INDIVIDUALS STIPULATED IN THE NATIONAL CYBERSECURITY PLAN (NCSP) 2022	To ensure the rights of individuals to privacy and confidentiality of their personal information; to ensure the security of critical ICT infrastructures; and provide oversight over agencies governing and regulating the ICT sector and ensure consumer protection and welfare, data privacy and security, foster competition and the growth of the ICT sector.	Data and information security, consumer protection
	AMENDING THE PHILIPPINE NATIONAL PUBLIC KEY INFRASTRUCTURE (PNPKI) ROOT CERTIFICATION AUTHORITY CERTIFICATE POLICY VERSION 1.0	Allows users of public networks like the Internet to exchange private data securely.	Data and information security
MC No. 003, s. 2015	APPROVAL OF THE PHILIPPINE ELECTRONIC GOVERNMENT INTEROPERABILITY FRAMEWORK (PeGIF) PART 2 OTHERWISE KNOWN AS THE INFORMATION INTEROPERABILITY FRAMEWORK (IIF) FOR IMPLEMENTATION BY GOVERNMENT AGENCIES	Interoperability means the ability to exchange and reuse government data and information in a uniform and efficient manner across multiple ICT systems and across agencies.	Streamlining of processes; efficient service delivery
MC No. 09001, s. 2014	APPROVAL OF THE PHILIPPINE ELECTRONIC GOVERNMENT INTEROPERABILITY FRAMEWORK (PeGIF) VERSION 1.0 FOR IMPLEMENTATION BY GOVERNMENT AGENCIES	Interoperability means the ability to exchange and reuse government data and information in a uniform and efficient manner across multiple ICT systems and across agencies.	Streamlining of processes; efficient service delivery
MC No. 001, s. 2014	PRESCRIBING POLICIES AND PROCEDURES GOVERNING THE ACCREDITATION OF GOVERNMENT REGISTRATION AUTHORITIES UNDER THE NATIONAL CERTIFICATION SCHEME FOR DIGITAL SIGNATURES	Government agencies and instrumentalities providing e-government services to its clients shall perform the following functions as RA: • Identify the user and register the user information; • Transmit certificate request to government CA; • Validate certificates from the CA directory server and CRL; request revocation of certificates.	Data and information security; building ICT structures
MC No. 002, s. 2013	APPROVAL OF THE PHILIPPINE NATIONAL PUBLIC KEY INFRASTRUCTURE (PNPKI) ROOT CERTIFICATION AUTHORITY (CA) CERTIFICATION PRACTICE STATEMENT (CPS) (VERSION 1.0)	Allows users of public networks like the Internet to exchange private data securely	Data and information security
	NTC		
MC No. 03-06-2019	RULES AND REGULATIONS IMPLEMENTING REPUBLIC ACT NO. 11202 OTHERWISE KNOWN AS THE "MOBILE NUMBER PORTABILITY ACT"	Consumers will be able to keep their mobile number even if they switch service providers or change their subscription to postpaid to prepaid, and vice versa –free of charge	Consumer protection
MC No. 02-06-2019	FREQUENCY BAND ALLOCATION AND TYPES OF EMISSIONS FOR AMATEUR RADIO SERVICE	Radio amateur license holders, depending on their license class, shall be authorized to operate only within the prescribed frequency bands and types of emissions	Consumer protection
MC No. 01-05-2019	RULES AND REGULATIONS ON UNLOCKING OF MOBILE PHONES AND DEVICES	Allow subscribers to switch to compatible wireless service providers	Consumer protection
MC No. 05-12-2017	PRESCRIBING A ONE (1) YEAR EXPIRATION PERIOD FOR PREPAID LOADS	Prepaid loads of whatever amount shall expire one (1) year from date of top-up of prepaid loads.	Consumer protection

PROGRAM	MAJOR TARGET	DOMAIN
ICT Ecosystem Development	• Development of plans and policies relative to the implementation and adoption of infrastructure, systems, and applications and other related framework.	Building ICT structures
National Connectivity	• Established TV White Space (TVWS) base stations in 21,000 sites of Elementary, High School, and Rural Health Units in 4th to 6th class municipalities by 2016 • Improve the delivery of government services to underserved communities	Improving internet access; efficient service delivery
e-Filipino	• 1, 000 new Tech4ED Centers established • 10, 000 new Tech4ED Centers established in barangays through a Franchise Model utilizing PPP • one entrepreneur created per center	ICT education, building ICT structures
e-Government Harmonization	• 50th or better in global eGov ranking • Improve in the delivery of government services to underserved communities	Efficient service delivery
e-Civil Servants	• Administer and manage ICT Competency-based Training Programs (e-Government Management, Application Development, and Technology Solutions) • Develop the digital competencies of the public service employees	ICT education
Next Wave Cities	• 141, 000 new employees by end of 2015 • Additional 3 NWCs (IT-BPM hubs outside MM) established per year	Building ICT structures
ICT Enabled Startup	• Total of 50 ICT-Enabled Start-ups with an annual revenue of Php 10 Million each by the end of 2016	Building ICT structures
Stepping-up the Value Chain	• Industry capacity/capability building through the provision of industry trainings, seminars, workshops & Rural Impact Sourcing.	ICT education

PROGRAM	MAJOR TARGET	DOMAIN
National Cybersecurity Plan 2022	The primary goals of this Plan are as follows: (1) assuring the continuous operation of our nation's critical infostructures, public and military networks (2) implementing cyber resiliency measures to enhance our ability to respond to threats before, during and after attacks, (3) effective coordination with law enforcement agencies and (4) a cybersecurity educated society.	Data and information security
National Broadband Plan "Building Infostructures for a Digital Nation"	✓ Open - Broadband is developed through an innovative, multi-stakeholder approach taking into consideration the emergence of policy and regulatory challenges ✓ Pervasive - Complemented by emergent wired and wireless broadband technology solutions, access to the Internet is available anytime, anywhere ✓ Inclusive - Broadband is relevant and accessible to all segments of the society, including the marginalized sectors ✓ Affordable - Broadband internet access is financially-accessible and worth paying for ✓ Trusted - Users can confidently access internet in a fast, reliable, and secure manner	Building ICT structures; improving internet speed, accessibility, and affordability
The Philippine Framework for the Digital Terrestrial Television Broadcasting Migration Plan	The DTTB Migration Plan addresses policy, regulatory and technical issues as well as fiscal considerations, industry and consumer support interventions, and other measures necessary for the country's migration to Digital TV Broadcasting, including the Public Communications Strategies in preparation for the planned Analog Switch Off (ASO).	Building ICT structures; consumer protection

Chapter 3: Annex 3.1. Proportion of individuals that carried out computer-related activities, by type of activity (ICT skills), by region

REGION	COMMUNICATION	ENTERTAINMENT AND GAMING	DISTANCE / ONLINE / COMPUTER-AIDED LEARNING	USING COPY AND PASTE TOOLS TO DUPLICATE/MOVE INFORMATION	TRANSFERRING FILES BETWEEN A COMPUTER AND OTHER DEVICES	SENDING EMAILS (plain text)	SENDING EMAILS WITH ATTACHED FILES (DOCUMENT, PICTURE, VIDEO)	DATA ENCODING	FINDING, DOWNLOADING, INSTALLING AND/OR CONFIGURING SOFTWARE	RUNNING SOFTWARE PROGRAM	USING BASIC ARITHMETIC FORMULA IN A SPREADSHEET	CREATING DOCUMENTS USING A WORD PROCESSING	CREATING ELECTRONIC PRESENTATIONS WITH SOFTWARE	DATA MANAGEMENT AND ANALYSIS	USING MODELLING, SIMULATION AND RENDERING SOFTWARE	OTHERS
NCR	77.1	72.0	23.9	21.8	17.8	24.9	28.5	7.2	5.8	3.5	3.0	10.5	5.4	2.7	0.8	1.0
CAR	47.7	48.7	8.7	18.5	13.2	9.1	6.1	50.1	7.9	2.7	0.7	18.9	5.0	1.2	0.3	1.8
REGION I	66.1	63.0	22.4	19.3	22.0	35.9	32.6	39.3	13.8	2.0	4.8	8.6	5.1	3.5	1.0	0.2
REGION II	41.7	39.7	13.6	29.6	21.5	15.1	9.3	37.0	7.8	4.8	2.3	8.3	4.2	3.4	0.2	0.4
REGION III	76.4	69.7	39.0	19.5	18.8	19.3	19.6	22.8	9.4	3.6	5.9	14.9	7.4	7.7	1.0	0.9
REGION IV-A	72.4	62.2	21.8	26.2	23.8	28.8	24.5	17.1	15.9	7.6	10.5	28.5	15.6	7.4	7.3	3.5
REGION IV-B	49.4	47.2	32.5	34.4	32.4	18.0	19.0	32.5	18.3	11.6	11.6	28.2	12.3	3.9	0.3	3.8
REGION V	63.3	56.9	17.8	8.6	15.9	15.5	12.8	38.9	8.1	2.5	3.6	7.8	2.7	4.6	2.0	1.2
REGION VI	67.1	66.4	9.6	31.1	16.4	22.7	20.0	11.9	5.8	1.5	11.0	15.0	7.9	1.5	0.1	1.6
REGION VII	79.9	74.7	18.8	21.2	21.1	23.8	33.8	10.8	16.3	9.8	9.0	19.6	6.5	5.2	1.1	1.7
REGION VIII	51.5	44.9	12.0	32.9	23.0	22.5	23.4	62.4	11.0	6.6	13.8	19.1	10.8	2.1	1.4	4.0
REGION IX	58.7	49.9	15.0	11.6	14.0	18.3	26.2	32.8	7.5	4.5	1.9	33.6	3.2	0.0	0.0	0.2
REGION X	73.6	67.0	14.2	5.6	2.7	11.0	14.6	24.4	1.8	0.9	0.0	9.6	0.5	0.0	0.8	1.1
REGION XI	50.9	66.9	9.5	33.0	32.6	27.2	21.5	33.6	3.9	1.1	8.2	34.6	8.4	1.6	0.5	1.7
REGION XII	69.4	55.9	32.9	18.7	12.8	10.0	13.2	12.6	3.4	0.6	1.1	9.6	1.2	3.3	0.3	0.1
BARMM	17.7	58.2	2.4	9.7	1.2	7.0	5.3	30.6	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
CARAGA	77.1	57.8	15.2	27.5	26.2	20.8	19.1	32.3	6.1	0.6	2.8	15.4	4.3	0.2	0.0	1.9
Total	69.0	63.5	22.1	22.9	20.0	23.1	22.8	21.5	9.7	4.5	6.4	17.8	8.1	4.3	2.3	1.8

Source: 2019 NICTHS, DICT and PSRTI

Chapter 4 Annex

Table A4.1 Test of difference of proportion of usage to total population on ICT usage, between women and men

ICT Usage	Difference	t-value
Cellphone usage	*0.381****	*7.65*
Computer usage	*0.005*	*0.9609*
Internet usage	*0.009***	*1.613*

Note: Null hypothesis: diff = mean(Female) - mean(Male)=0.
** Cannot reject the alternative hypothesis: diff = mean(Male) - mean(Female)>0 at 0.05 level significance
***Cannot reject the alternative hypothesis: diff = mean(Male) - mean(Female)>0 at 0.01 level significance

Figure A4.1. Use of digital platforms used by online sellers only (%), by sex

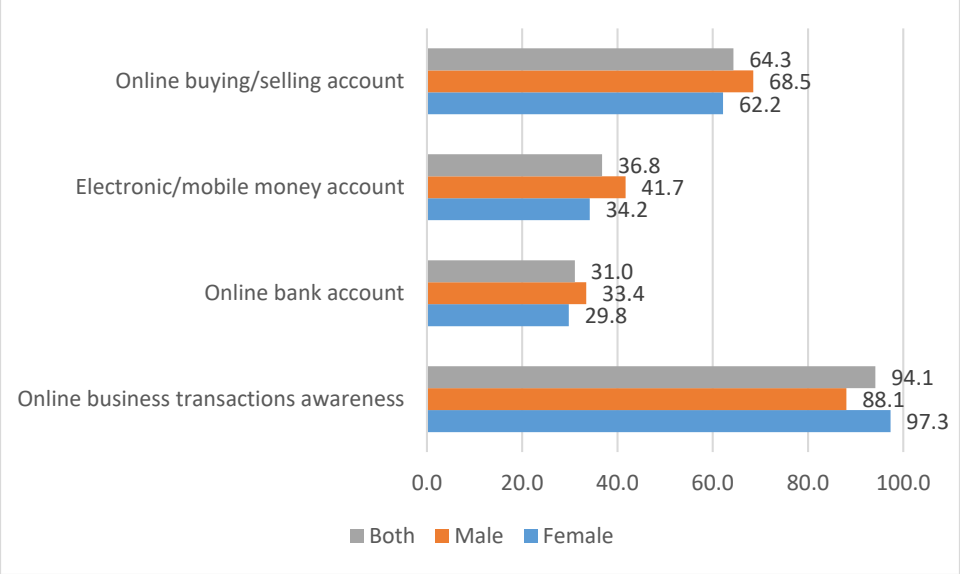


Figure A4.2. Characteristics of online sellers (%), by sex

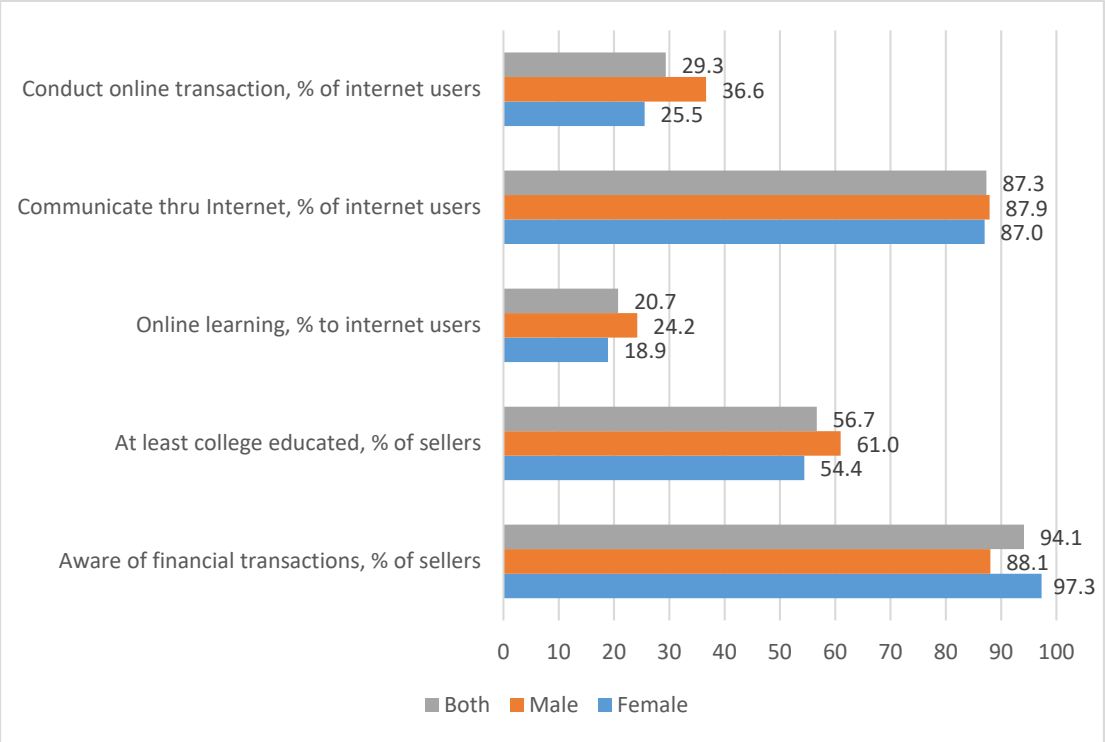


Figure A4.3. Use of digital platforms by online buyers only (%), by sex

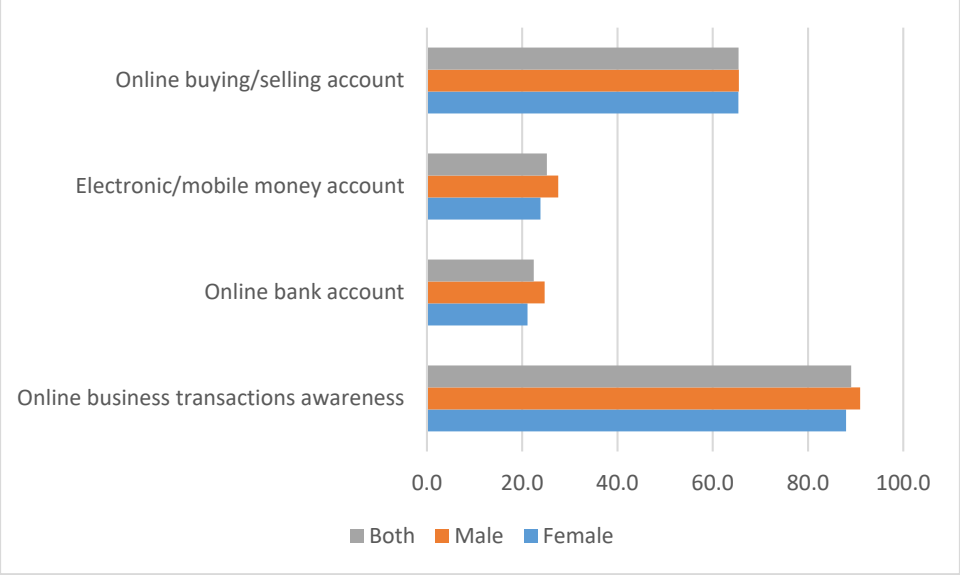


Figure A4.4. Digital platform activities of online buyers only (%), by sex

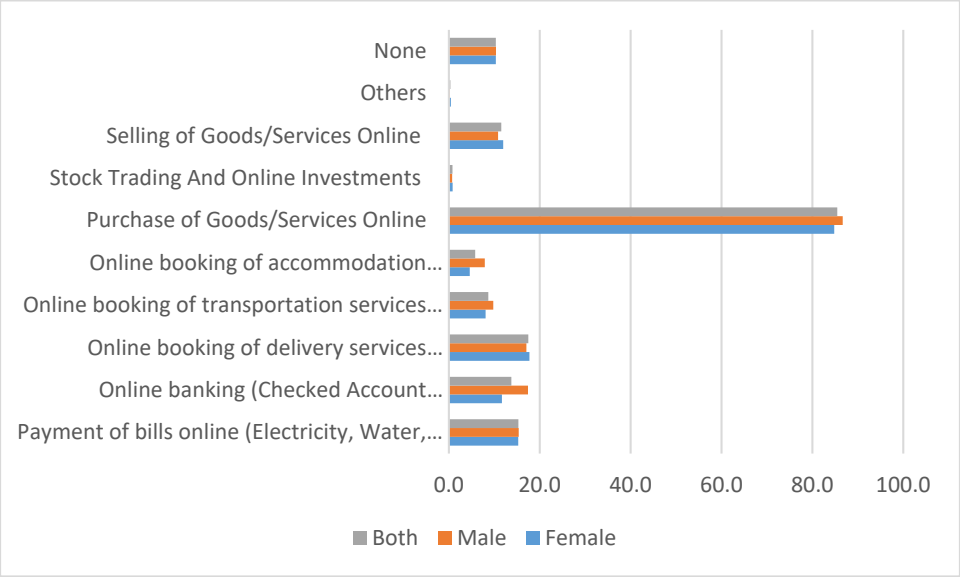
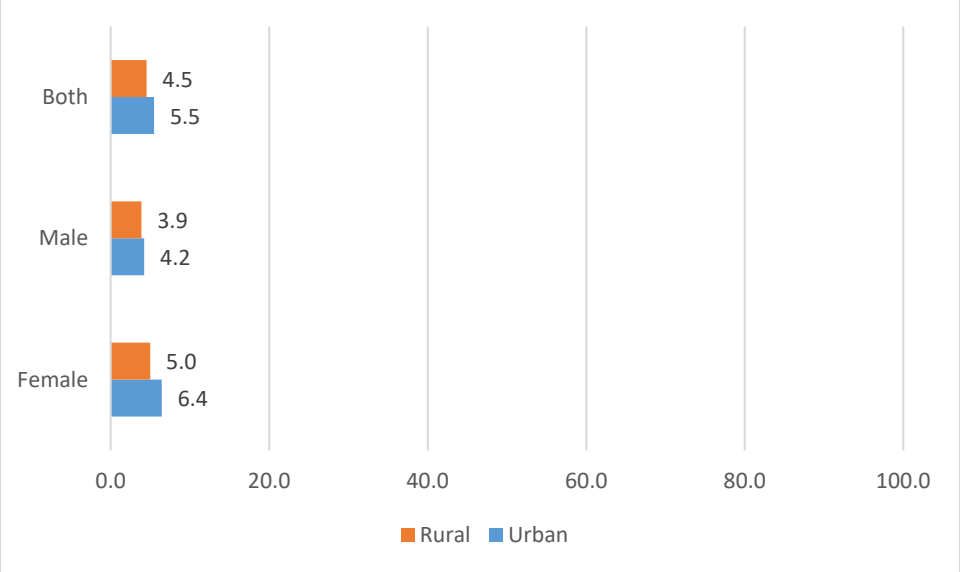


Figure A4.5. Proportion of online sellers (%) by sex, by area



Chapter 5 Annex

Annex 5.1. Philippine ICT Infrastructure

The incumbent operators Globe and PLDT have discrete, vertically integrated networks that allow them to obtain international connectivity, bring it to their distribution centers and regional networks, and deliver it to their business-to-business clients and end users. The operators' networks begin with their stakes in international submarine cable networks, which are run by consortia and handle international traffic. PLDT has stakes in six international submarine cable consortia: EAC-C2C, APCN-2, SEA-ME-WE-3, AAG, ASE, and Jupiter. Globe, meanwhile, has stakes in four: EAC-C2C, SJC, TGN-IA, and SEA-US (Telegeography 2021).

Collectively these represent the nine active submarine cable networks delivering international bandwidth to the Philippines. These cables are landed in 10 locations across the country, at cable landing stations owned by either Globe or PLDT. One network – EAC-C2C – is the result of a merger between two systems with investments by PLDT (EAC) and Globe (C2C), with Telstra as a major partner. EAC-C2C therefore lands in two separate stations located in Luzon.

There are currently four additional international submarine networks which are planned to land in the country. Notably, the Pacific Light Cable Network (PLCN), which is designed to connect Hong Kong, Taiwan, the Philippines, and the United States, will enter the country through an agreement with the DICT under which the government, through the Bases Conversion and Development Authority (BCDA) will provide landing and terrestrial crossing facilities (called the Luzon Bypass Infrastructure, or LBI), in exchange for bandwidth (Submarine Cable Networks 2019; Camus 2020).

From the cable landing stations, bandwidth is brought to the telcos' transmission centers, from where it is then distributed around the country by their respective national backbone networks. As of 2017, PLDT's Domestic Fiber-Optic Network (DFON) measured 174,000 km, comprising of its fiber backbone and distribution networks. The DFON fiber backbone itself was completed in 1997 and runs 11,100 km. Including its fiber to the end users, PLDT's fiber network spans 429,270 kilometers (Ookla 2020, as cited in Camus 2021).[63] PLDT's domestic traffic capacity currently stands at 55 Terabits per second (Tbps).

Globe's backbone network, on the other hand, spans 12,000 km, and is comprised of three systems dubbed Fiber Optic Backbone Network (FOBN1), FOBN2, and FOBN3. FOBN1 and -2 comprise a "geo-redundant and complementary" network "linking the Luzon, Visayas and Mindanao island groups" (Globe Telecom 2019). FOBN3, on the other hand, is "composed of the Boracay, Palawan and Coron submarine-cable systems" (Marasigan 2015). In total, Globe's fiber optic backbone, distribution networks, and fiber to the end users total to 67,414 kilometers (Ookla 2020, as cited in Camus 2021).[64] While no information on the total capacity of Globe's fiber network is publicly available, FOBN3 by itself had a total capacity of 19.2 Tbps in 2013 (Barton 2013).

[63] See also: Baclig (2021)
[64] See also: Baclig (2021)

While PLDT and Globe remain the firm leaders in terms of wired network deployment, other players are also deploying fiber of their own. Fiber-only Internet service provider Converge ICT's network stood at 33,000 km for 2020, comprising its backbone, distribution network, and fiber to the premises (Ookla 2020, as cited in Camus 2021). As of 2017, Converge obtained international connectivity from at least three consortia: AAG, ASE, and TGN-IA (Converge ICT 2017). While the total capacity of Converge's network has not been disclosed, the latest phase of its backbone expansion alone has a capacity of 25.6 Tbps (Converge ICT 2019).

On the other hand, new entrant DITO Telecommunity's deployed 14,056 km of cable in 2020 (Ookla 2020, as cited in Camus 2021). It is not yet clear how much of this length is comprised of the operator's backbone network. There is also no information yet available as of writing on the total capacity of DITO's network, nor where DITO will source its international bandwidth.

In addition to these commercial operators, the government also has access to a dark fiber network owned by the National Transmission Corp. (Transco) and operated by the (National Grid Corporation of the Philippines). In total, the DICT has access to 6,154 km of NGCP's fiber backbone, connecting Luzon, Visayas, and Mindanao (Pateña 2018). The National Broadband Plan calls for the use of NGCP's fiber to distribute PLCN bandwidth to government facilities throughout the country, including to Free Wi-Fi Program deployments.

As Filipinos primarily access the Internet via mobile, another important measure is the number of base stations and cell sites deployed by the three full service telcos: PLDT-Smart, Globe, and DITO. It should be noted that the term 'base stations' refers to radio equipment that transmits a signal to wireless devices, while 'cell site' refers to the passive infrastructure (such as a tower or mast) on which base stations are hoisted. A single tower can be host to several base stations, and a single physical location could host several cell sites (particularly for small cell deployments). The most recent available data on the number of cell sites in the country put the count at 17, 850. (TowerXChange 2019, as cited in Caliwan 2020).

Meanwhile, as of 2020, PLDT-Smart disclosed it had over 59,000 base stations deployed around the country (Rappler 2021). Globe had just over 69,000 base stations for the same period.[65] New entrant DITO, on the other hand, submitted a list of 1,602 base stations deployed to the NTC for its first technical audit as of February 2021 (Rey 2021). Taken together, the number of base stations and of cell sites imply that radio equipment may be concentrated in relatively few areas. Similarly, not all base stations provide the same level of ICT access, depending on what technology is used. In 2017 for example, PLDT-Smart had only 8,700 LTE and 9,850 3G base stations nationwide (PLDT 2017). For the same year, Globe had 10,178 4G stations out of a total of 37,517 base stations (Globe Telecom 2017).

[65] Globe reported 40,522 base stations for 2018 in its 4th Quarter 17-Q report to the SEC. A statement from its website says that the company's base stations increased by 68% compared to its 2018 total (Globe 2020a). A separate statement said that the company added 593 new towers within the year, bring the total to 69,075 towers (Globe 2020b).

Annex 5.2. Infrastructure Demands of Mobile Technology Generations

As higher frequency bands are used, the higher the need for density

Beginning with 2G in the early 1990s up to the 5G being deployed today, mobile technologies have drastically changed in terms of both quality and coverage. Improvements in each successive generation of mobile technology can be traced to the innovative use of new radio frequencies to deliver service. With each new combination of frequency and technology, however, has also come new demands for ICT infrastructure deployment. A level and pattern of infrastructure deployment that would have sufficed for nationwide 2G coverage will likely not be sufficient for 5G. Indeed, the trend with each new technology has been the increased need for ever-denser cell site deployments.

Whereas the very first generation (1G) of mobile technology was analog, the second generation, called 2G, was the first to go digital. Going digital meant converting "phone calls into binary digital code," allowing for more efficient use of spectrum and for more secure services (GSMA 2017, p.30). Going digital also allowed phones to begin sending and transmitting data in a form other than voice calls for the first time – initially through text messages (called short message service, or SMS), and eventually emails and other basic Internet services.

2G networks around the globe "largely operated in the 900 MHz, 1,800 MHz, 850 MHz and 1,900 MHz bands," which had the benefit of being able to cover large distances and with little degradation of service through obstacles. This is because of a direct inverse relationship between a frequency and its propagation area; the higher the frequency, the shorter the distance it could reliably travel. Lower frequencies are also better able to penetrate walls, foliage, and other obstacles that might hinder coverage (GSMA 2017).

2G was originally designed for voice and SMS; however, as demand for mobile Internet services grew, 2.5G (GPRS) and 2.75G (EDGE) were developed to allow for greater bandwidth using the same frequencies. At the end of the generation's development, 2G-EDGE could transmit at speeds over 200 Kbps (GSMA 2017).

The next generation of mobile technology, 3G, was the first primarily designed for Internet connectivity. Operating in the 800, 850, 900, 1,700, 1,900, and 2,100 MHz bands, 3G's frequencies were not too far off the bands used for 2G. Instead, 3G's main innovation was its ability to slice up data and spread it across different frequencies (GSMA 2017). 3G was thus able to deliver faster speeds, initially at a modest 300 Kbps, but eventually reaching 42 Mbps and beyond.

Increasing demand for data called for a new mobile technology that would support high-bandwidth applications. 4G was the first completely packet-based mobile technology to be based on the Internet Protocol (IP) (GSMA 2017). 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.

A wide variety of frequencies are used for 4G, ranging from 600 MHz to as high as 3500 MHz (Qualcomm 2014). A significant hurdle for LTE deployment however is that many of the lower frequencies remain in use by analog or 2G networks. This may result in operators being forced to use higher frequencies for their 4G networks. While higher frequency networks have the benefit of supporting more bandwidth, base stations will have to be deployed in a denser configuration in order to achieve a comparable level of coverage to older technologies.

With 5G networks just beginning to be deployed, the question of what frequencies will be used carry heavy implications for the level of ICT infrastructure necessary – and consequently, where it is likely to be deployed first. PLDT-Smart has carried out 5G tests on the 700 MHz, 2.6 GHz, and 3.5 GHz bands (Smart Corporate Newsroom 2020a), while Globe has begun deploying a 3.5 GHz 5G network (Globe Telecom n.d.). GHz-band 5G radios will have to be deployed in much denser networks if they are to deliver the same level of coverage as previous mobile generations. Furthermore, as higher frequencies are more likely to be affected by obstacles, reaching the full potential of 5G's speeds will also require very dense deployments. As operators also prepare to roll out millimeter wave (mmWave) frequencies in the ultra-high bands between 30 and 300 GHz, the increased demands on infrastructure deployment are only clearer; some tests imply 5G mmWave base stations might need to be deployed every 500 meters (Viavi Solutions n.d.).

The question now and in the future will be whether such dense deployments are viable outside of heavily urbanized areas. Even as data demands grow across the country, it is possible that rural areas will be left out of the latest in mobile technologies due to the expense of deploying radios and associated equipment in dense configurations, relative to the number of revenue-generating users in an area. There is a definite risk therefore that the digital divide – in terms of both coverage and connection quality – between urban and rural areas will only continue to grow as 5G becomes the norm.