Leveraging Investments in Broadband for National Development

THE CASE OF CAMBODIA

UN-OHRLLS

supporting
Least Developed Countries
Landlocked Developing Countries
Small Island Developing States

United Nations Office of the High Representative for Least Developed Countries, Landlocked Developing Countries and Small Island Developing States

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Note

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Acronyms and abbreviations

ADSL	Asymmetrical Digital Subscriber Line
ASEAN	Association of South East Asian Nations
GB	Gigabit
ICT	Information and Communication Technology
ISP	Internet Service Provider
LDC	Least Developed Country
MB	Megabit
MPTC	Ministry of Posts and Telecommunications
MSME	Micro, Small and Medium Enterprise
NIS	National Institute of Statistics
NSDP	National Strategic Development Plan
RGC	Royal Government of Cambodia
TRC	Telecommunications Regulator of Cambodia
UN	United Nations

Executive Summary

This report, based on field research (See Organizations Consulted) and primary source material (see References), reviews steps that the Kingdom of Cambodia has taken to leverage broadband Internet for national development. In regard to affordability and use, Cambodia has both the cheapest mobile Internet prices and the third highest mobile data usage in the world. Internet usage in the country is second highest among Least Developed Countries (LDCs). Virtually the entire nation is covered by a mobile signal and almost half the population over the age of 14 had a smartphone in 2016. These are remarkable achievements for an LDC.

The major driver behind these accomplishments is one of the most competitive markets in the world. Up to now, the market has been largely unregulated, attracting significant foreign investment. There are seven mobile and over thirty wired Internet service providers. There is no incumbent operator influencing the market and spectrum has been allocated rather than auctioned, contributing to low prices.

Although broadband connectivity is robust for an LDC, Cambodia has not fully seized the socio-economic impacts from this. Most usage is for social and entertainment purposes. The top website is the video sharing YouTube portal. Practically, every Cambodian online is a Facebook user and many government agencies and private businesses have a Facebook page making it one of the most popular websites in the country. Although there are anecdotal stories of the beneficial impact of such usage—educational videos or e-commerce—they are rare and most usage is for entertainment purposes. The usage of web sites by businesses is limited and Cambodia fares poorly in online e-government usage compared to other LDCs.

While there is a direct economic impact from the country's Information and Communication (ICT) sector, it is not particularly high relative to other LDCs. At the same time, the country incurs a significant trade deficit in ICT-related activities. Personal data is sent abroad generating millions of dollars of advertising revenue for overseas ICT companies. Despite a growing ICT workforce and cheap labor costs, Cambodia also imports far more than it exports in computer and information services.

There is a need for a high level, holistic strategy of how to leverage the country's relatively high level of broadband connectivity for greater social and economic impact. This should be accompanied by enactment of key digital economy laws on electronic transactions, data privacy, consumer protection and cyber security to inspire confidence and attract investment in the development of applications and services. Regulatory guidelines are also needed in areas such as new housing zones including spaces for telecommunications equipment and the use of micro sites for mobile antennas. The light touch regulatory approach that has been a hallmark of Cambodia's inexpensive Internet prices should be retained. Consideration might also be given to establishing an inter-ministerial group considering the crosscutting nature of broadband that would include not only the Ministry of Posts and Telecommunications but also the Ministry of Finance and other ministries. Government needs to implement the ICT sector Masterplan that deals with key areas fundamental to the development of the digital economy and which would result in greater impact from broadband connectivity. Public e-services need to be launched that would not only save time

for businesses and citizens but also demonstrate that broadband has practical purposes beyond social networking and entertainment.

Cambodia has the building blocks for leveraging broadband for national development with a good supply side environment compared to other LDCs. It needs to seize on that through the employment of broadband as a general purpose cross cutting technology relevant for all sectors. In short, perspectives need to shift from broadband as just an infrastructure issue to a more holistic view of how to use the infrastructure. An overarching vision of how ICT will transform society and the economy, to be formulated in a strategy with a governance scheme placed directly at the president or prime minister's level is a prerequisite. Although there are ICT strategy documents, it is not clear that they have sufficient ownership and commitment to really leverage broadband and make it a transformational vector of the economy. The vision will require a commitment from the government in terms of funding and training of civil servants in order to generate transformational applications and services benefitting the nation.

Cambodia in Context

A country's social, economic, historical and geographic context influences the deployment and use of Information and Communication Technology (ICT) networks and services.[1]

The Kingdom of Cambodia is located in South East Asia. It has land borders with Thailand (to the Northwest), landlocked Lao PDR (to the Northeast) and Vietnam (to the East) (Figure 0.1). To the Southwest lies the Gulf of Thailand. The kingdom's 2016 population of 15.8 million lives in a land area of 176,520 km^2, with a population density of 89 people per square kilometer. Some 79% of Cambodian households are in rural areas (NIS, 2016). Compared to other developing nations, Cambodia has a relatively small diaspora of a little over 350,000 in 2015, with most living in the United States, Thailand and France.[2]

Figure 0.1: Map of Cambodia

Source: United Nations.

[1] Unless otherwise stated, economic, demographic and social statistics in this chapter sourced from World Bank.
[2] http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates15.shtml

The population is relatively ethnically, linguistically and religiously homogenous. In 2015, the per centage of the Khmer population was estimated at 96 per cent (NIS, 2016). Khmer is the official language and written in a distinctive non-Latin script. Khmer is the mother tongue of 97% of the population and similarly, ninety-seven per cent of the population is Buddhist (NIS, 2013).

Cambodian royal history stretches back at least to the South-East Asian Hindu state of Funan in the first century and the Kingdom of Angkor in the eighth century. The country became a French protectorate in 1863, temporarily suspended during the Second World War, and re-introduced after the Japanese surrender. In 1954, Cambodia gained full independence under King Norodom Sihanouk. Although Sihanouk emphasized Cambodia's neutrality, it was drawn into the Vietnam War and beginning in 1969, the country was heavily bombed by the United States.[3] Sihanouk was overthrown in 1970 and a military regime under General Lon Nol established. Sihanouk formed an alliance with the Cambodian communists, the Khmer Rouge. The government was overthrown and the Khmer Rouge gained power in 1975. In the next four years, the Khmer Rouge, under the leadership of Pol Pot, aimed to convert Cambodia into an agrarian, self-sufficient country. This social and economic experiment turned citizens into slave workers resulting in the deaths of around two million people.[4] Vietnam invaded Cambodia in 1978 forcing the Khmer Rouge towards the border with Thailand, from where they fought a guerrilla war against the Vietnamese backed government. A framework for a settlement between the opposing forces was agreed upon in 1990 and a year later, the UN was given authority to supervise a ceasefire and to organize elections that took place in 1993.

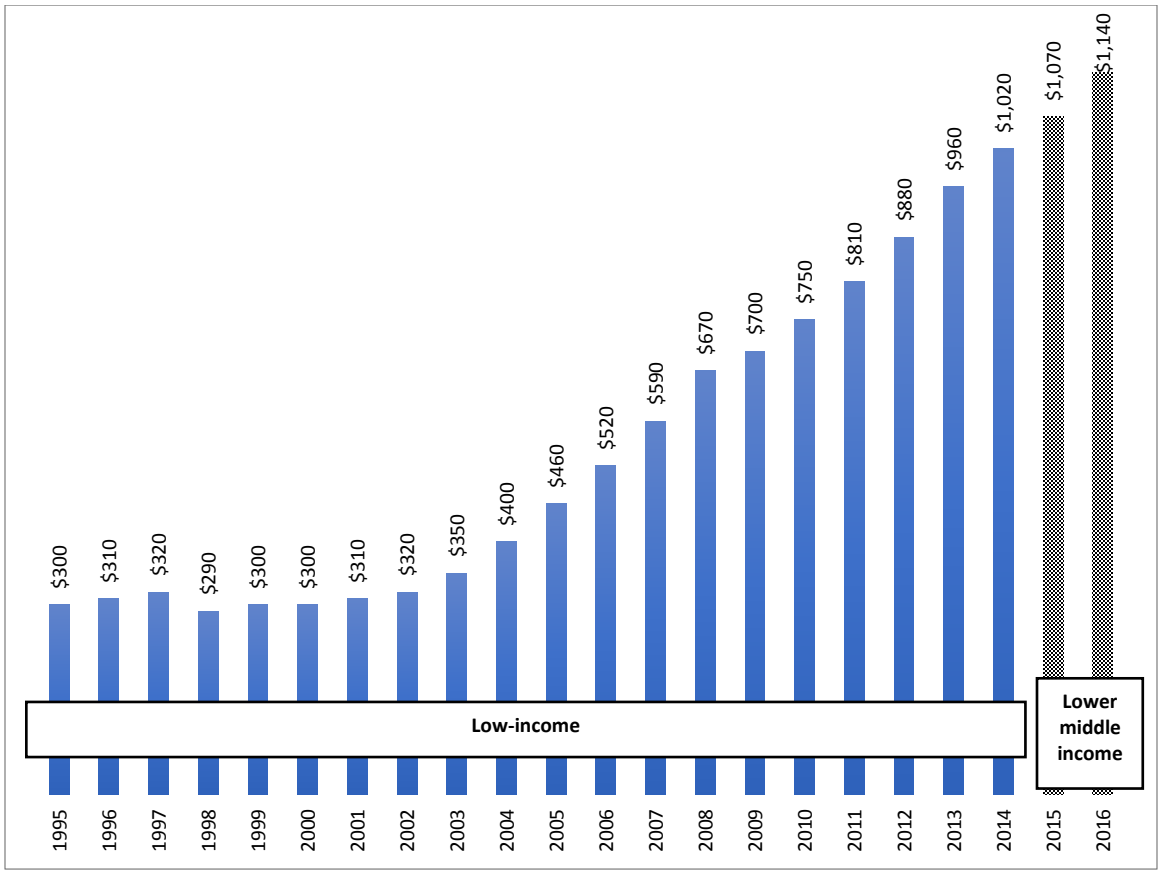
Gross National Income (GNI) per capita was estimated at US$1,140 in 2016 (Figure 0.2), putting Cambodia into the World Bank's lower middle-income economy classification despite being a Least Developed Country (LDC). Real GDP has grown at an average annual rate of 7.6% from 1994 to 2015, sixth in the world (World Bank, 2017). The poverty rate declined significantly from 48 per cent in 2007 to 14 per cent in 2014 (World Bank, 2017). One aftermath of the Khmer Rouge period was significant donor support to help rebuild the economy. Vast amounts of United States dollars were unleashed for various projects resulting in dollarization of the economy. Recent data finds the dollar accounting for over 80% of all transactions and more than 90% of banking deposits.[5]

[3] For more information on the bombing of Cambodia see: Ben Kiernan and Taylor Owen. 2015. "Making More Enemies Than We Kill? Calculating US Bomb Tonnages Dropped on Laos and Cambodia, and Weighing their Implications." *Asia-Pacific Journal*, April 27. http://apjjf.org/Ben-Kiernan/4313.html

[4] For more background on the Khmer Rouge see "Khmer Rouge History" at: http://www.cambodiatribunal.org/history/cambodian-history/khmer-rouge-history/.

[5] *Knowledge@Wharton*, October 6, 2015. "Is It Time for Cambodia to Wean Itself Off the Greenback?" http://knowledge.wharton.upenn.edu/article/is-it-time-for-cambodia-to-wean-itself-off-the-greenback/

Figure 0.2: Cambodia, GNI per capita (US$)



Source: World Bank.

Exports of goods and services have propelled economic growth. On the goods side, the garment industry has developed rapidly aided by preferential trade agreements and openness to foreign direct investment (FDI). Clothing exports were US$ 5.9 billion in 2015, accounting for 70% of merchandize exports (Figure 0.3, left). The figure is higher when footwear is included making total garment and footwear exports US$ 7.3 billion in 2016 or 78% of merchandize exports.[6] At the end of 2016, there were 626 garment and footwear factories employing over 600,000 people, about a third of the manufacturing workforce. Tourism is the biggest service industry, accounting for 80% of services exports in 2016 (Figure 0.3, right). Attracted by Cambodia's cultural, historical and natural resources, the number of international tourists grew over ten times between 2000 and 2016 from less than half a million to over five million. Agriculture also remains an important part of the economy accounting for 27% of GDP in 2015 and 42% of employment (NIS, 2016).[7] Although Cambodia receives official development assistance (ODA) due to its LDC status, relatively it is not as much as others (4% of Gross National Income in 2015 compared to the LDC average of 4.72%).[8]

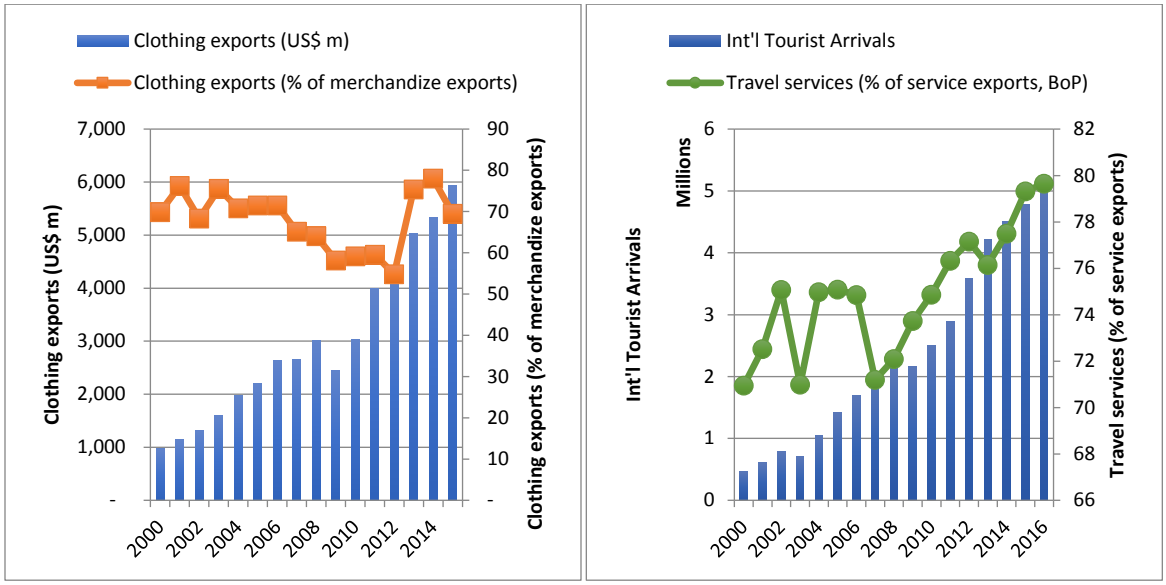
[6] ILO, May 2017, *Cambodian Garment and Footwear Bulletin*, http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_555290.pdf

[7] Gross Domestic Product by Expenditures share. https://www.nis.gov.kh/nis/NA/NA2015_Tab.htm

[8] https://data.worldbank.org/indicator/DT.ODA.ODAT.GN.ZS. The top five country donors in order in 2015 were Japan, United States, France, Republic of Korea and Australia. See: http://www.oecd.org/statistics/datalab/oda-recipient-sector.htm

Nevertheless, ODA was US$677 million in 2015 equivalent to almost a third of central government expenses.[9]

Figure 0.3: Economic engines



Source: World Trade Organization (WTO), Cambodia Ministry of Tourism and World Bank.

Cambodia became the tenth member of the Association of Southeast Asian Nations (ASEAN) when it joined in 1999. It became the second LDC to join the World Trade Organization (WTO) in 2004.

[9] World Bank, Net official development assistance and official aid received (current US$), https://data.worldbank.org/indicator/DT.ODA.ALLD.CD, and World Bank, Net ODA received (% of central government expense), https://data.worldbank.org/indicator/DT.ODA.ODAT.XP.ZS

Policy and Regulatory Environment

1.1 National Strategic Development Plan

Cambodia's *National Strategic Development Plan (NSDP)* covers the five-year period from 2014-2018. An overarching goal is Cambodia achieving upper middle-income status by 2030 and developed country status by 2050. The plan is structured around a "Rectangular Strategy" with Information and Communication Technology (ICT) considered a physical infrastructure with targets relating to infrastructure goals. This is different than plans in some countries where ICT is perceived as more of a crosscutting technology. ICT policy priorities in the plan are identified in Box 0-1.

Box 0-1: ICT Policy Priorities in the NSDP

RGC during the Fifth Legislature will further develop the information and telecommunication technology sector as a modern, state-of-the-art and high-quality service in accordance with international standards, and provide service at competitive rates, with nationwide coverage, for the public to use and benefit from the service. RGC's priorities are as follows:

1. Preparing the national policy for the development of information and communication technology sector with due consideration of all social and economic aspects.
2. Promoting the adoption of the Law on Telecommunication and the preparation of related laws including those on Cyber-crime and e-commerce as deemed necessary for the effective management of the information and communication technology sector.
3. Stepping up the implementation and preparation of additional regulations for the telecommunication sector and information and communication technology sector.
4. Strengthening the role of supervisory institutions and enhancing institutional coordination to develop and manage this sector with transparency and efficiency.
5. Preparing and implementing the National Broadband Planning order to help promote innovation, human resource development, competition, enhancement of economic productivity as well as greater participation from the public in socio-economic development.
6. Expanding the coverage and strengthening the efficiency of the backbone infrastructure, particularly by encouraging greater use of this infrastructure and further expanding to areas with high economic and tourism potential as well as remote areas without or with limited telecommunication services.
7. Promoting human resource development to respond to the fast-growing modern technologies and enhance public literacy level in information and communication technology aimed at more efficient use and deriving maximum benefit from this sector by strengthening all levels of education curricula, training of government officials and encouraging the private sector to participate in enhancing public's literacy in information and communication technology.
8. Further developing e-government.
9. Encouraging the private sector to invest in the modern and state-of-the-art technology including broadband Internet, cloud technology and software development to enhance the quality and efficiency of information and communication technology.

Source: NSDP, 2014-2018

There are two main ICT targets for the plan: an increase in fixed and mobile telephony subscriptions and Internet subscriptions. Given that the former is largely achieved (see next chapter), the latter is worth examining in light of market development since the plan was issued. NSDP calls for 19.6 million Internet subscriptions by 2018, a figure that exceeds the population of Cambodia. In any case, actual growth since the plan was issued has been lower.

Despite the focus of ICT as a physical infrastructure, its relevance across other areas is mentioned in the NSDP, providing an indication of its crosscutting role (Table 0.1).

Table 0.1: NSDP and ICT

ICT action	NSDP area
Promote the use of ICT to enhance the delivery of public services	Public Administration Reform
Taking measures to increase Cambodia's export market through ... improve the transport infrastructure and logistics systems, including the provision of Information and Communication Technologies (ICT) to facilitate movement of goods and services, including in financial services	Deepening Cambodia's Integration Into the Region and the World
Improving Information Communication Technology (ICT), public awareness, training course, and knowledge transfer, to improving farmers' livelihoods	Promotion of Agricultural Sector
Securement of ICT-based Technology: Reinforces the software capacity in order to swift the ICT paradigm to software base from hardware base	Science and Technology
Enhance use of ICT in providing services such as registration, employment seeking and staff recruitment, to help reduce time and costs	Development of Labor Market
Continue developing national capacity standards for competition, particularly in the sectors of construction, mechanics, business services, and ICT	Development of Labor Market

Source: Adapted from NSDP.

1.2 Sector plan, policy and law

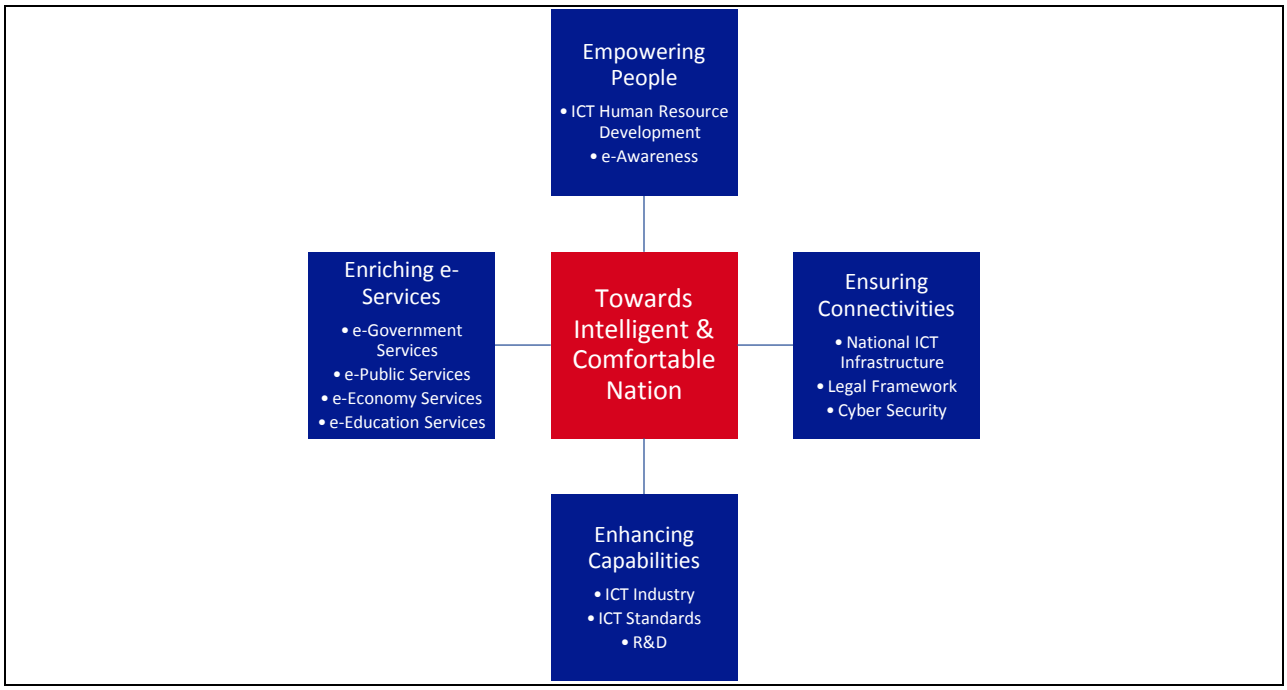
Several documents relating to the sector have been issued over the last few years. These include a sector plan, a policy and a new telecommunications law.

Cambodia ICT Masterplan 2020 was launched in August 2014. It was crafted with assistance from the Korean International Cooperation Agency (KOICA). The Plan was designed in the context of the ASEAN ICT Masterplan[10], the Connect Asia-Pacific Summit and the NSDP.[11] The Plan aims to use ICT to create an intelligent and comfortable nation and describes detailed steps to achieve this within four e-thrusts: people, connectivity, capability and services (Figure 0.1).

[10] ASEAN ICT Master Plan 2015 at: https://ccdcoe.org/sites/default/files/documents/ASEAN-110101-ASEANICTMasterplan2015.pdf

[11] Connect Asia-Pacific Summit, 2013, "Digital Inclusive Green Innovative Transformative Affordable Living," https://www.itu.int/en/ITU-D/Conferences/connect/Asia-Pacific/Documents/HD-fly-asia-pacific-smartly-digital.pdf

Figure 0.1: Four thrusts of the ICT Masterplan 2020



The plan identifies five flagship projects due to their importance and that merit rapid implementation to demonstrate proof of progress.

Table 0.2: Flagship projects in the ICT Masterplan

Project	Budget (US$ m)	Description
e-Government Development Framework	3.0	Establish set of core code (class, interface) for developing the public information system, which is the assortment of tools and guides that supports development and operations of systems in Cambodia.
CamCERT Enhancement for Establishing ICT Security	4.7	Expand business scope of CERT to the international level and enhance proactive response to incidents. Additionally, the RGC will change the CamCERT works from offline to online by implementing CERT-related information systems. Lastly, the RGC will extend the service scope of CamCERT to the whole of government agencies and major private agencies in Cambodia.
e-Commerce Promotion	60.2	Technical, administrative and legislative fundamentals for e-Commerce promotion.
Tourism Network Establishment	...	Application of ICT as well as digitization of all processes at the value chain which are made by all stakeholders in tourism industry.
Educational Programme Development	...	Developing education programmes including e-Learning which means the applications of ICT to support delivery of educational contents to learners.

Source: Cambodia ICT Masterplan 2020.

The *Telecom/ICT Development Policy 2020* was adopted in 2016. There are three key objectives: i) To improve and expand telecommunication infrastructure and usage; ii) To develop ICT human capacity; and iii) To diversify the ICT industry and promote ICT applications. The policy establishes a number of concrete targets to be achieved by 2020 such as 100% broadband coverage in urban areas and 70% in rural ones. It also targets an 80% Internet penetration rate.

There was no telecommunication law before 2015. The *Law on Telecommunications* adopted in December 2015 formally established the Telecommunication Regulator of Cambodia as an institution separate from the ministry. The law also streamlines the licensing regime by moving from service specific licenses to unified licenses. It introduces two new funds: one for universal service and one for R&D and human capacity training to which operators must contribute two and one per cent of gross annual revenues respectively. The general principles of the law are now being operationalized through specific regulations.

Cambodia lags in respect to other laws and strategies related to ICT.[12] Laws for electronic transactions and consumer protection are being drafted. There is no privacy and data protection legislation. Cybercrime legislation is being drafted but there is no cyber security strategy and Cambodia ranks 91st in the world in the 2017 Global Cyber Security Index.[13]

1.3 Institutions

The Ministry of Post and Telecommunications (MPTC) is responsible for sector strategy and policy. It also hosts the Cambodia Computer Emergency Response Team (CamCERT), responsible for computer security incidents in the country.[14] The National Institute of Posts, Telecommunications and ICT (NIPTICT), founded in 2014, is under the ministry. NIPTICT carries out training and research.[15] MPTC is also responsible for e-government and supervision of government service providers such as Telecom Cambodia and Cambodia Posts.

The Telecommunication Regulator of Cambodia (TRC) is responsible for regulation and licensing of telecommunications networks and services. Regulatory activities were carried out within the MPTC until 2012 when TRC was created as a separate agency. TRC's activities were formalized in 2015 with the enactment of the Telecommunications Law. TRC regulates operators covering a range of licenses (Figure 0.2).

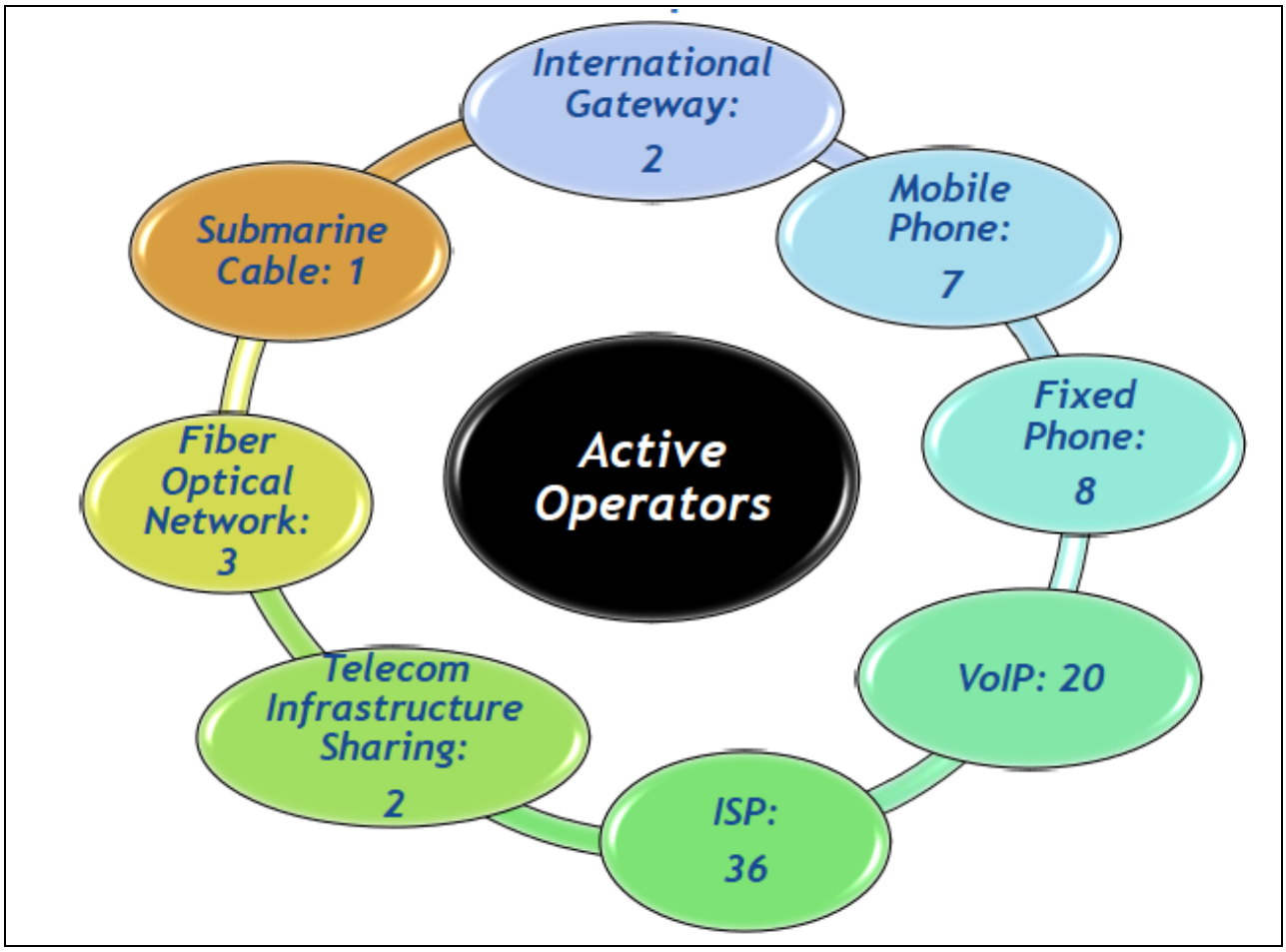
[12] For more information on laws and strategies related to ICT see "Summary of Adoption of E-Commerce Legislation Worldwide" at: http://unctad.org/en/Pages/DTL/STI_and_ICTs/ICT4D-Legislation/eCom-Global-Legislation.aspx

[13] ITU, 2017, *Global Cybersecurity Index*, https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2017-R1-PDF-E.pdf

[14] CamCERT, Cambodia Computer Emergency Response Team, https://www.camcert.gov.kh/en/

[15] NIPTICT, National Institute of Posts, Telecommunications and Information Communication Technology, http://niptict.edu.kh

Figure 0.2: Active operators, June 2017



Source: TRC.

Other institutions with a role in the ICT sector include the Ministry of Information, responsible for radio and television broadcasting policy and regulation. The Ministry of Commerce has played a leading role in promoting e-commerce and driving the development of related legislation.

Infrastructure Development

This chapter first looks at local access--fixed and mobile networks that serve end users. It then reviews the status of upstream national transmission backbones and access to international Internet bandwidth. It also identifies critical supporting infrastructure such as Internet exchanges and resources such as spectrum.

1.4 Local access networks

Cambodia has a history of a highly competitive telecommunications market characterized by on-going mergers and acquisitions. It also has the distinction of being the first country in the world where mobile subscriptions surpassed fixed telephone lines (in 1993) (Minges et al., 2002). There are presently six active mobile operators, up from three in 2000 but down from a peak of nine in 2012. Given the number of active operators in relation to its population, Cambodia has been cited as the "most saturated market in the world."[16] The largest largest operator (by subscriber share) is Smart, majority-owned by the Malaysian AXIATA group. AXIATA is active in nine other Asian nations. VIETTEL, the Vietnamese mobile group, is the second largest following the purchase of Beeline in 2015 and uses the Metfone brand. Viettel is active in nine other countries including neighboring Lao PDR. CAMGSM, operating under the brand CELLCARD is one of the oldest operators, in service since 1996 and 100% locally owned. These three account for 98% of the market.

Table 0.1: Cambodia's main telecommunications operators

Operator	Main investor (country)	Share-holding	Year of initial investment	Note
Smart	Axiata (Malaysia)	82.5%	1998	Merged with Hello in 2012. Mobile technologies used: GSM/3GLTE
Viettel	Viettel (Vietnam)	100%	2009	Purchased Beeline in 2015. Operates under METFONE brand. Also has national fiber optic, international gateway, ISP and fixed telephone licenses. Mobile technologies used: GSM/ 3G/LTE
CamGSM	Royal Group of Companies (Cambodia)	100%	1996	Acquired Mfone in 2013. Operates under CELLCARD brand. Was a joint venture until 2009 when Luxembourg-based Millicom sold its shareholding to the Royal Group. The Group also owns TelcoTech an ISP. Mobile technologies used: GSM/3GLTE
Cambodia Advance Communications Ltd (CADCOMMS)	Privately owned	100%	2008	Operates under QB brand. Mobile technologies used: GSM/3G

[16] Tom Brennan, 2011, "qb launches a 2G network," *The Phnom Penh Post*,http://www.phnompenhpost.com/business/qb-launches-2g-network

Operator	Main investor (country)	Share-holding	Year of initial investment	Note
South East Asia Telecom (SEATEL)	SEATEL Group (Singapore)	100%	2014	Had CDMA network through purchase of GT-Tell (Excell) in 2013. Launched LTE using 850 MHz in 2015.
XINWEI	Xinwei Telecom Enterprise Group (China)	100%	2013	Operating as COOLTEL. 3G using TD-SCDMA technology. Also offers fiber Internet.
Telecom Cambodia	Government of Cambodia	100%	2005	100% government-owned. Has national fiber optic, ISP and fixed telephone licenses.
Camintel	Booyoung Group (Republic of Korea)	100%	1995	WLL, ADSL, leased lines, fiber optic

Source: Company reports, TRC and news reports.

GSM mobile coverage covers 99% of the population and subscription penetration crossed the 100% mark in 2011. Home availability of cell phones is high for an LDC, standing at 87% including 96% in urban areas and 86% in rural ones according to the *2014 Demographic and Health Survey*.[17] By 2016, 97% of the population owned a mobile phone (Phong et al., 2016).

Mobile broadband has developed rapidly due to the scarcity of wired infrastructure with the first 3G network launching in 2007. SMART was the first to launch fourth generation (4G) Long Term Evolution (LTE) technology in 2014, and it is available across 25 provinces covering over half the population. It also introduced so-called 4.5G in 2017 achieving speeds of up to 600 Mbps in selected areas.[18] The other operators launched 4G/LTE in 2015. Of note is there are seven mobile broadband operators compared to six mobile operators as Kingtel operates a fixed wireless 4G/LTE network (Figure 0.1, right). Most Internet access is via mobile phones and almost half the population (48%) had a smartphone in 2016 (Phong et al., 2016). 3G covered 66% of the population and 4G/LTE 58% in June 2017. The main constraint for extending mobile broadband coverage is the lack of low frequency spectrum which has a wider coverage area than higher frequency and hence results in lower investments costs. It is expected that this will be made available upon the completion of the transition to digital broadcasting when lower frequency (700 MHz) will be freed up.

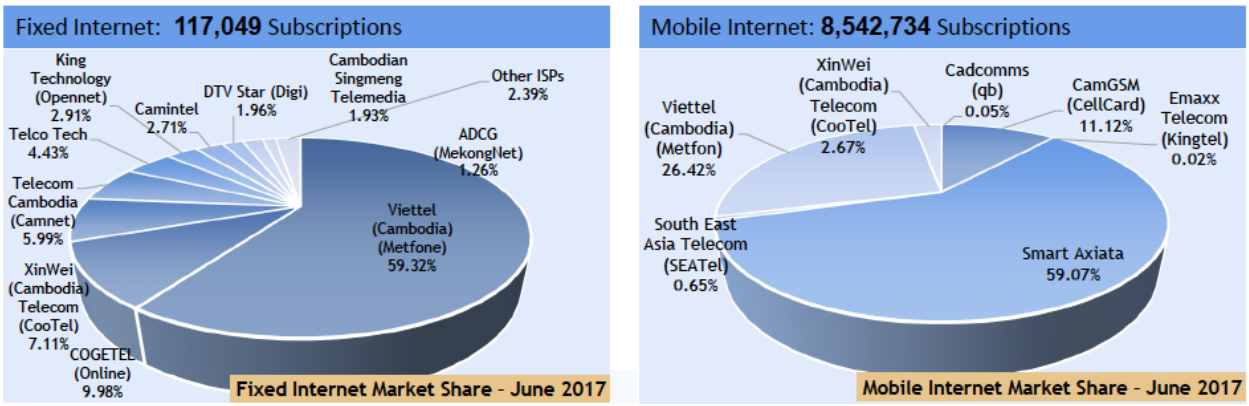
State-owned Telecom Cambodia is the main fixed telephone service provider. In addition, there are seven other operators licensed using either copper lines or wireless technology to provide fixed telephone service. Due to the popularity of mobile, fixed telephone subscriptions have been in decline since 2012. Fixed broadband is provided through a mixture of technologies including ADSL (a technology that uses the copper telephone line going to the premise), fixed wireless, cable modem and fiber. There are over 30 Internet Service Providers (ISPs) including mobile operators

[17] National Institute of Statistics, Directorate General for Health, and ICF International, 2015. *Cambodia Demographic and Health Survey 2014*.

[18] "Another 'First' by Smart Axiata: Launch of 4.5G," *Press Release*, 25 August 2017, https://www.smart.com.kh/news/press-release/first-smart-axiata-launch-4.5g

with the top ten capturing 98% of the market (Figure 0.1, right).[19] There were 117,049 fixed broadband subscriptions in June 2017, just over 1% of total Internet subscriptions in the country. Nevertheless, Cambodia ranks 12th among LDCs in fixed Internet penetration. Spider web tangles of overhead fixed broadband wires are quite visible in urban areas and the city of Phnom Penh has ordered the wires to be buried underground.[20]

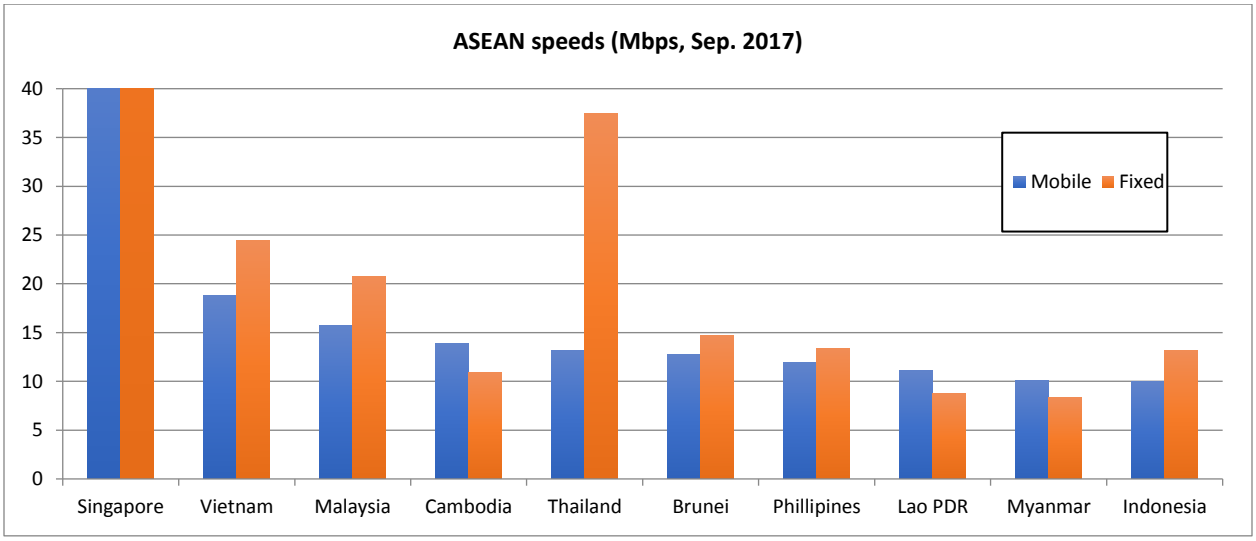
Figure 0.1: Internet market share, June 2017



Source: TRC.

Network quality is high with Cambodia's mobile broadband speeds the fourth fastest in ASEAN (Figure 0.2). Mobile broadband speeds are also higher than fixed broadband.

Figure 0.2: ASEAN broadband speeds, September 2017



Source: Adapted from Ookla.

[19] Note that the subscriber market share differs from traffic generated with some ISPs such as Opennet generating significant amounts of traffic.

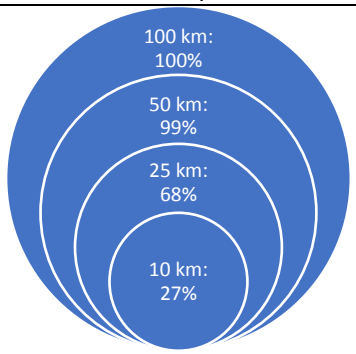
[20] Narim, Khuon, 2015, "City Hall Orders Utility Firms to Bury 'Anarchic' Cables," *The Cambodia Daily*, https://www.cambodiadaily.com/news/city-hall-orders-utility-firms-to-bury-anarchic-cables-102154/.

1.5 National backbone

The country has three *licensed* national fiber optic backbones. The largest is owned by VIETTEL with 17,200 km of fiber in June 2016. Cambodia Fiber Optic Communication Network (CFOCN), launched in 2006 is backed by Chinese shareholders and had 7,611 km of fiber in June 2016. Telecom Cambodia also operates some fiber optic backbone routes and had 1,600 km of fiber in June 2016. As of 2012, investment in this backbone infrastructure amounted to US$1.7 billion when 87% of the network had already been deployed (23,080 km) (RGC, 2014).

There is room for more densification of national fiber backbones. While they reach the country's borders for access to international bandwidth, their spread within Cambodia merits additional investment. While 99% of the population is within 50 km of the backbone, only 27% is within 10 km (Figure 0.3). The further the population is from the backbone, the slower the data transmission. Plans call for connecting all of the some 14,000 villages in the country to the national fiber optic backbone.

Figure 0.3: National fiber optic network licenses, June 2016

Operator	Km	Per cent of population within range of backbone, 2015
Viettel	17,200	
Cambodia Fiber Optic Communication Network (CFOCN)	7,611	
Telecom Cambodia	1,600	
Total	**26,411**	

Source: MPTC and ITU (https://www.itu.int/en/ITU-D/Technology/Pages/InteractiveTransmissionMaps.aspx).

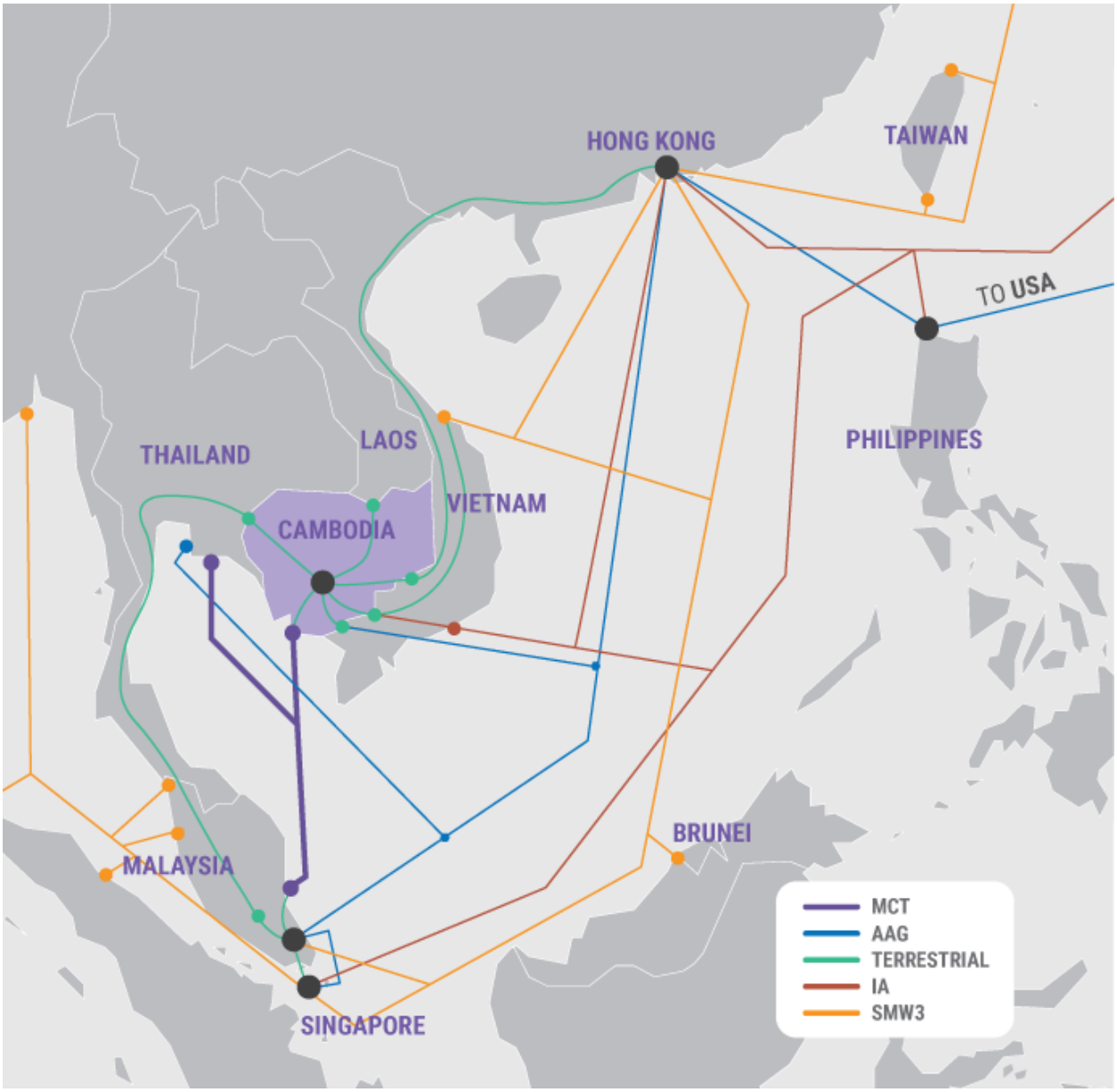
1.6 International connectivity

Despite a coastline of over 400 kilometers, Cambodia only recently connected to submarine cable. Instead, international Internet bandwidth is accessed over cross border terrestrial fiber optic routes to Thailand and Vietnam. It then goes via submarine cables in those countries or continues overland on terrestrial routes to Hong Kong, Malaysia and Singapore where most Cambodian international Internet traffic is exchanged (Figure 0.4). Many of the leading ISPs in the country have Points of Presence (PoPs) at Internet Exchange Points (IXPs) in those locations. In addition to the three licensed national backbone operators, several other ISPs have also strung fiber optic to the Thai and Vietnamese borders. As a result, there are numerous international bandwidth options with the consensus view among experts consulted for this report estimating the monthly cost was less than US$10 per Mbps.

In 2017, connections to two undersea submarine cables were established both landing in Sihanoukville on the Gulf of Thailand. Malaysia-Cambodia-Thailand (MCT) connects the three countries. Although Ezecom, a Cambodian ISP, is the partner for MCT, the cable allows for open access for Cambodia's licensed operators. The MCT submarine cable system cost around US$ 100

million.[21] Asia-Africa-Europe-1 (AAE-1) stretching from Hong Kong to France is a consortium cable with Metfone the Cambodian member.[22]

Figure 0.4: Cambodia backbone transmission networks



Source: https://www.telcotech.com.kh/index.php/international-network

[21] EZECOM, "MCT Submarine Cable has now Connected to Cambodia, Mittepheap Landing Station, Sihanoukville," https://www.ezecom.com.kh/newsdetail/Mct-submarine-cable-has-now-connected-to-cambodia,-mittepheap-landing-station,-sihanoukville

[22] Asia-Africa-Europe-1, About AAE-1, http://www.aaeone.com

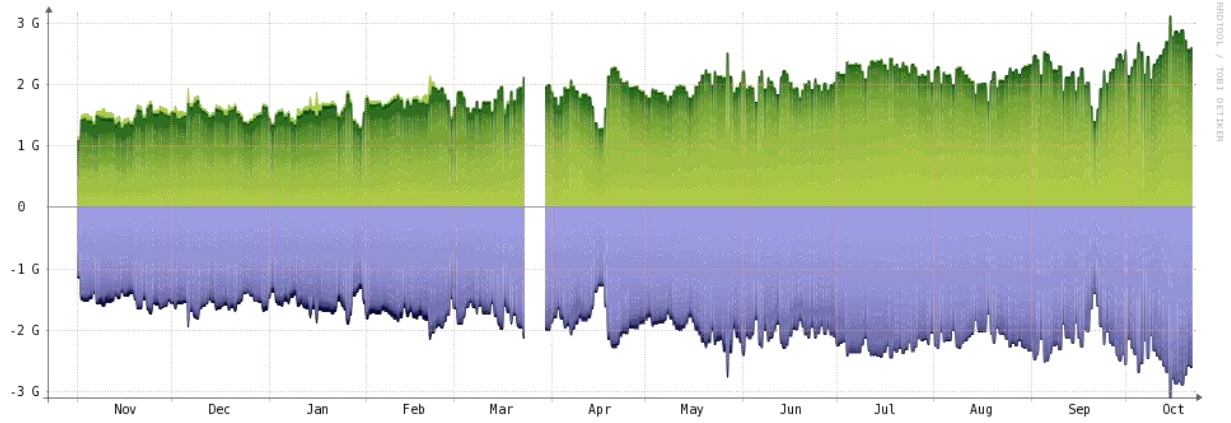
1.7 Other supporting infrastructure and resources

1.7.1 Key Internet infrastructure

There are three pieces of critical Internet infrastructure essential for maintaining the Internet, at least domestically, in case of disruption to international connectivity. These include the country code Top Level Domain (ccTLD) name server, access to a root server and an Internet exchange point.[23] [24]

The Cambodian Network Exchange (CNX) is a neutral Internet Exchange Point (IXP) launched in 2008. Different than other IXPs, CNX was founded and is managed by Sabay, a digital entertainment company, in order to speed up software updates to its Cambodian users. CNX has thirty members, including most of the country's leading telecom operators. Three locations in Phnom Penh allow for gigabit peering and provide operational redundancy. CNX estimates it is saving members a combined US$500,000 per year in transfer fees.[25] Traffic has grown from less than 2 Gbps in November 2016 to almost 3 Gbps by October 2017 (Figure 0.5). A 1GE port is US$ 100 per month (US$ 0.10 /Mbps) while 10GE is US$ 400 (US$ 0.04 /Mbps).[26] There are also two smaller IXPs in the country.

Figure 0.5: CNX traffic, November 2016 - October 2017



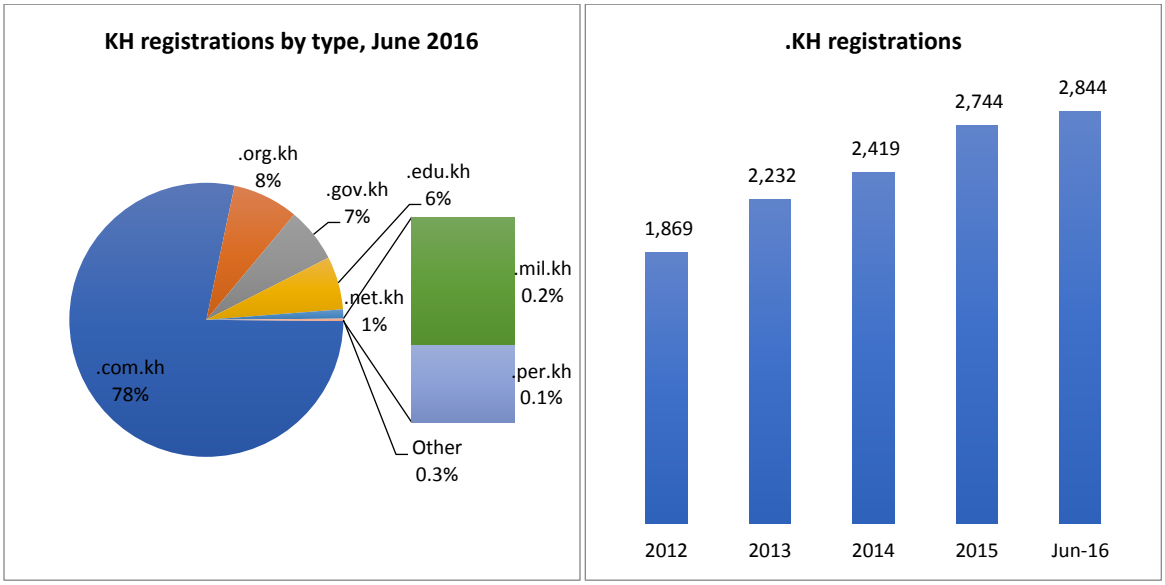
Source: http://cnx.net.kh/traffic/.

The country code Top Level Domain (ccTLD) of Cambodia is KH. It is administered by the Telecommunication Regulator and implemented by Telecom Cambodia. There were 2,844 .KH registrations in June 2016 with over three quarters using .com.kh suggesting that most are businesses (Figure 0.6, left). The number of registrations has been slowly rising, increasing by 52% between December 2012 and June 2016. The price of a .KH domain is US$40 for the first year and US$30 for subsequent annual renewals. One factor affecting KH domain registrations is that due to the popularity of Facebook in the country, many organizations opt for a Facebook page instead

[23] A computer that hosts the ccTLD—KH in the case of Cambodia—and manages requests to web sites, emails and other traffic.
[24] For more information on root servers see: "NETNOD, What are root name servers," at: https://www.netnod.se/i-root/what-are-root-name-servers
[25] Cambodian Network Exchange (IXP/DIX), "About," http://cnx.net.kh/about/
[26] Cambodian Network Exchange (IXP/DIX), "Pricing," http://cnx.net.kh/pricing-2/

of a web site. On the other hand, organizations may opt for a web site to also avail of an email address.

Figure 0.6: .KH



Source: MPTC.

There are a number of data centers in Phnom Penh. These include those operated by telecommunications operators SEATEL and MekongNet.[27] [28] One drawback is that the centers are not neutral, co-location facilities and users IP addresses are tied to the operators. This makes changing centers difficult. The government also has a data center.

Table 0.2: Core Internet infrastructure in Cambodia

Infrastructure	Name	Note
.KH name server	dns1.online.com.kh	Located in Cambodia.[29] KH ccTLD root domain also has 2 in country slaves at Online and Cellcard
Internet Exchange Point	Cambodian Network Exchange	30 members
Root server	D/F/M	http://www.root-servers.org. CNX also has a DNS cache from PCH, including D/M Root Server prefix & 300 ccTLD/TLD, F Root is hosted at Mekongnet
Google cache		11 cache instances connecting to 16 peered networks[30]

[27] seatel, Cambodia Cloud Data Center, http://www.seatelgroup.com/en/cdc-en/
[28] MEKONGNET Connecting You All, Co-Location, https://www.mekongnet.com.kh/en/90/co-location?m_id=126
[29] Verified by trace route (http://ping.eu/country-by-ip/)
[30] https://www.google.com/maps/d/viewer?mid=18FeuDz0xtVnpvLiFz9HsPk7ZTDg&hl=en_US&ll=10.487811882056645%2C108.129678296875&z=7

1.7.2 Spectrum

Cambodia has historically had a liberal approach to spectrum assignment. Operators were typically granted the spectrum they needed in a technology neutral approach. There were no spectrum auctions and instead operators paid an annual spectrum fee. The lack of auctions kept the price of spectrum low, and has been a major contributing factor in low broadband retail prices. The downside is that spectrum is not always used efficiently and some operators have frequency that is underutilized.

The 2015 *Telecommunications Law* introduced new principles for spectrum management. The law charges the Ministry of Post and Telecommunication (MPTC) with responsibility for spectrum planning and regulation. The Telecommunication Regulator of Cambodia (TRC) issues spectrum and apparatus licenses and enforces licensing conditions. The law stipulates that auctions are the preferred option for allocating spectrum to be co-organized by MPTC and the Ministry of Economics and Finance. The government has drafted a spectrum regulation to implement the law's principles after consultation with the private sector.

TRC has assigned frequencies for mobile and fixed wireless covering 3G and LTE as well as unlicensed spectrum for Wi-Fi networks. This includes 450 MHz for CDMA; 850 MHz for 4G/LTE; 1800 MHz for 3G and 4G/LTE; 2100 MHz for 3G and 4G/LTE; and 2600–2690 MHz for LTE.

One challenge is a shortage of spectrum including underutilization of existing frequencies by some operators and a lack of lower frequency spectrum for mobile broadband. The latters has inhibited the rollout of 3G and 4G/LTE in rural areas since higher frequencies have lower propagation. Ideally, lower frequency spectrum of 700 MHz currently used for analog broadcasting could be used for mobile broadband upon the transition to digital broadcasting. However, this has been delayed in Cambodia with the switch off anticipated for 2020-2023.

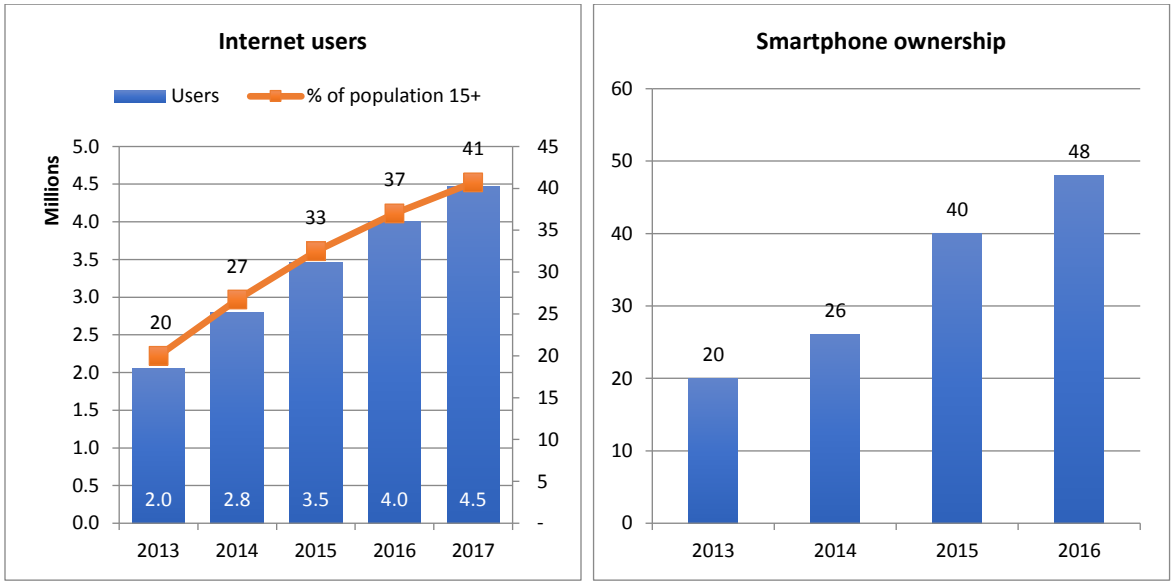
Usage, Skills and Digital Business

This chapter looks at the level of Internet usage in Cambodia. It explores factors influencing Internet use such as affordability and local content. An overview is provided of businesses involved in digital applications and services and the supporting ecosystem.

1.8 Internet usage

By 2016, 37% of the population aged 15 to 65 used the Internet (Phong et al., 2016), second highest among LDCs and close to the developing country average of 39%.[31] [32] By 2017, it is estimated that there were 4.5 million Internet users, equivalent to 41% of the population ages 15 to 65. Growth has been impressive with the number of users doubling from 2013 (Figure 0.1, left). Smartphone take-up is a major driver given that a third of Cambodians use a mobile to access the Internet. By 2016, just under half the age 15 to 65 population had a smartphone (Figure 0.1, right), a very high rate for an LDC.

Figure 0.1: Cambodian Internet usage and smartphone ownership



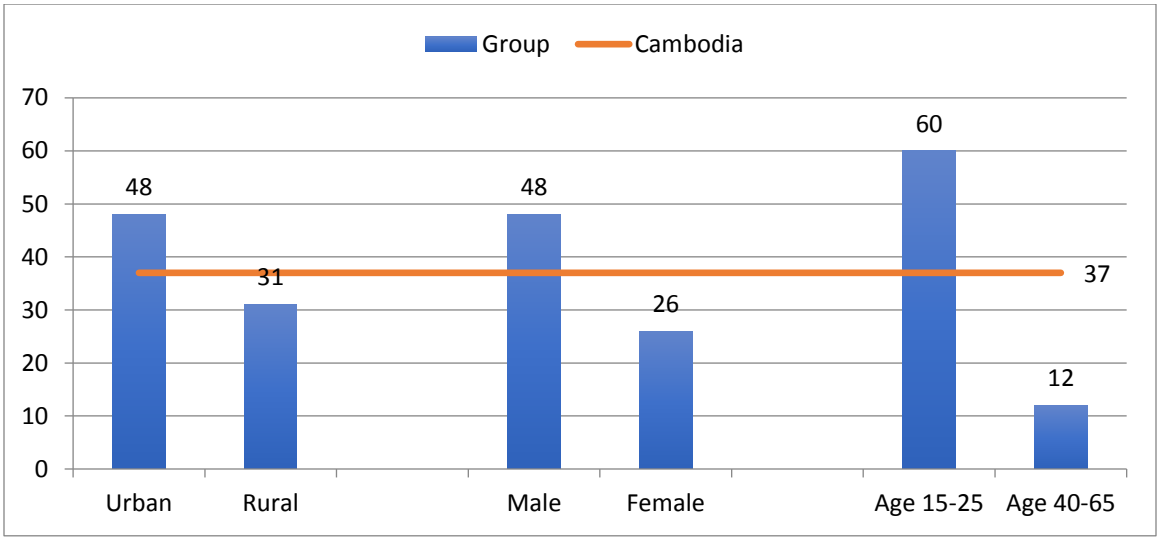
Note: Refers to ages 15 to 65. Figure for 2017 in left chart estimated by author on basis of adjusted Facebook users.
Source: Phong et al., 2013, 2014, 2015, 2016.

Like practically every other country in the world, Cambodia has a digital divide in Internet usage by age, gender and location (Figure 0.2). New universal service and capacity programmes can help to reduce this divide if implemented properly.

[31] The nationally representative survey has been carried out each year since 2013. The size of the sample — 2,000 participants — has a confidence interval of 2.19 and a confidence level of 95%. Note that the NIS does not carry out a dedicated survey relating to Internet use. A question was included in the 2013 *Inter-Censal Survey Population Survey* as to whether households (rather than household members) accessed the Internet. The figure was 5.5%. For more information see: Phong et al., 2016.

[32] For more information see ITU Statistics at: https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Figure 0.2: Internet usage among different groups, Cambodia, 2016



Source: Phong et al., 2016.

1.9 Factors affecting Internet usage

Internet usage is affected by various factors including the price of devices and service charges, the skills of the population, and the availability of local content.

1.9.1 Affordability

There are two distinct aspects of affordability related to Internet use. The first is how prices affect bringing new users on line and the second is how it affects the amount of usage by existing users. In the first case the price of the device is more relevant while in the second case, the service charge is important.

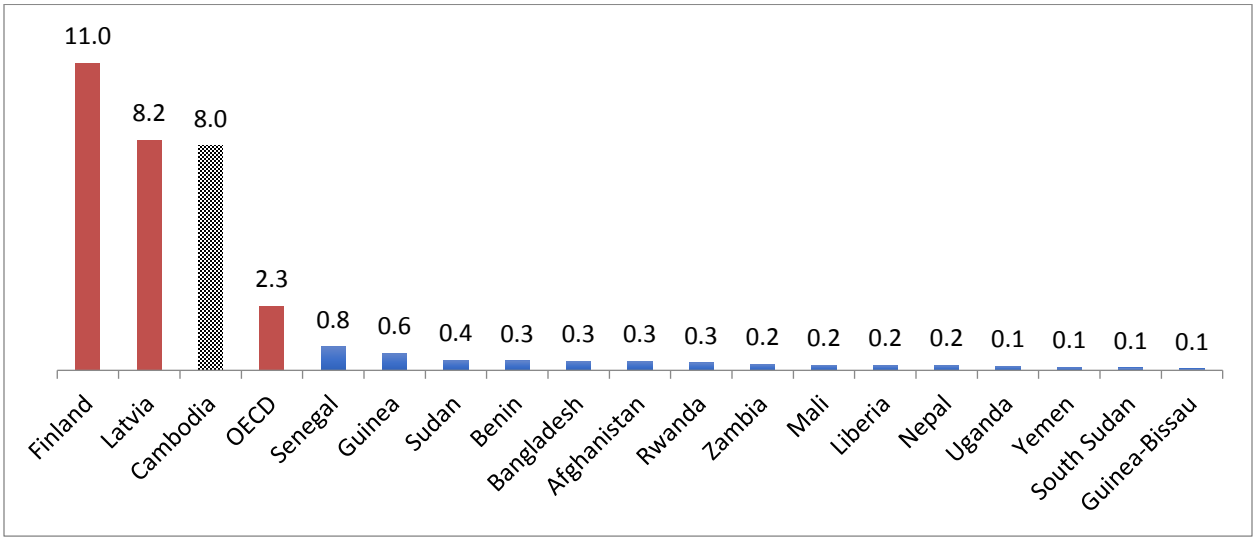
There is a range of smartphones available on the market, which can be purchased outright, or on an installment plan. The cheapest offered by the operator, Smart, was the Leagoo Z1 retailing for US$36 (Leagoo is a Chinese manufacturer and the phone uses the Android operating system). The price is equivalent to 2.8% of Cambodia's 2016 per capita GDP. Given the steady rise in smartphone penetration—up 8 percentage points between 2015 and 2016—the price of an Internet-enabled handset would not yet appear to be a major barrier to first time online usage. However, as smartphone growth slows, it may be difficult to reach the primarily low-income segment that does not have one. On the other hand, given that existing users are likely to replace their smartphone every few years, the market for cheaper used smartphones is likely to grow and thus ameliorate affordability. The price of bigger screen devices such as tablets, laptops and desktop PCs is more expensive which inhibits more intensive and exploratory use of the Internet. This can be remedied to some extent through availability of such devices at schools and public Internet facilities.

The price of a 500 MB per month mobile Internet bundle was US$1 in 2017, not only the cheapest among LDCs but also in the world.[33] This amounts to 0.9% of per capita income well below the 5%

[33] ITU. 2017. *Measuring the Information Society*. https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx

proposed by the Broadband Commission as an affordability target.[34] In reality, Cambodian mobile Internet users are spending more than US$ 1 per month and are receiving significantly more data due to price promotions in the highly competitive market. As a result, Cambodian mobile Internet users have by far the highest data usage rates among LDCs and third highest in the world (Figure 0.3).

Figure 0.3: Mobile data usage (GB per subscriber per month), 2016



Source: OECD[35], Sonatel[36], MTN[37] and Axiata[38].

Average household spending on communications in the country amounted to 1.5% of consumption expenditures in 2015 or around US$ 1.50 per month (NIS, 2016). Expenditure varies depending on the income of the household so some will spend more than 2% and some less. The price of a 500 MB monthly mobile Internet as proportion of monthly consumption expenditures varies among different household quintiles ranging from 0.5% in the richest and 2.2% in the poorest (Table 0.1). It would appear that prices are extremely affordable with even the poorest households only spending 2.2% of consumption expenditure for a monthly 500 MB mobile Internet package. The affordability of a smartphone would also appear affordable where an entry-level smartphone would account for 3.0% of annual consumption expenditure in Cambodia; 6.6% in the poorest household quintile and 4.6% in the next poorest quintile.

Table 0.1: Mobile Internet affordability, 2015

	Average monthly consumption expenditure US$ (2015)	500 MB monthly mobile Internet (% consumption expenditure)	Smartphone (% annual consumption expenditure)
Lowest fifth	$45	2.2%	6.6%
Second fifth	$66	1.5%	4.6%

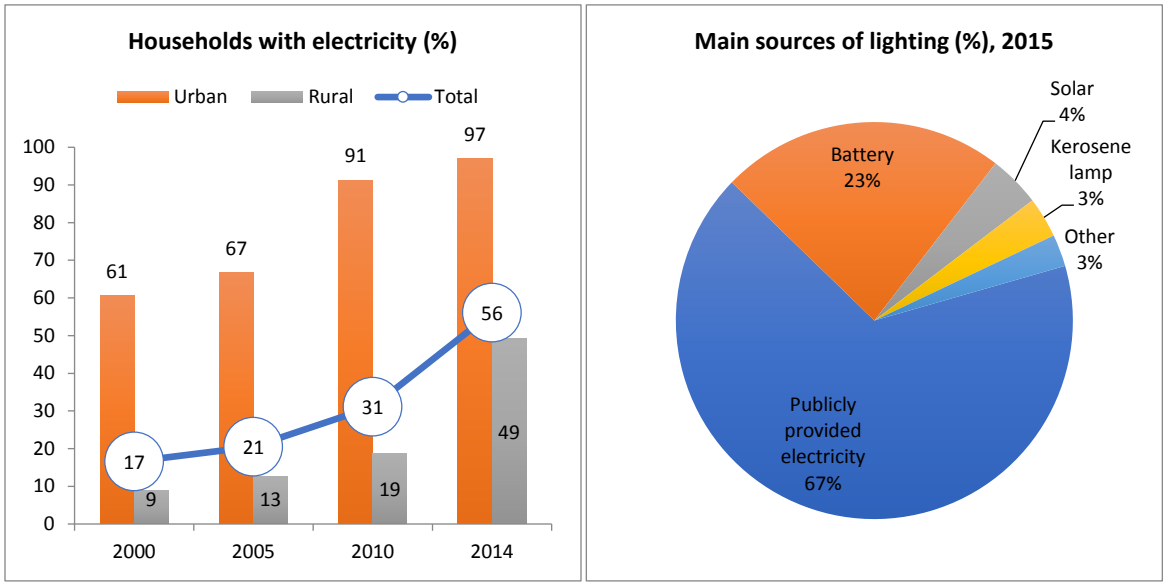
[34] For more information see "Broadband Targets for 2015" at: http://www.broadbandcommission.org/Documents/publications/Broadband_Targets.pdf
[35] OECD, Broadband Portal, http://www.oecd.org/sti/broadband/broadband-statistics/
[36] http://www.sonatel.sn/rapports-financiers/
[37] MTN, Investors, https://www.mtn.com/en/investors/Pages/default.aspx
[38] Axiata, http://axiata.listedcompany.com

	Average monthly consumption expenditure US$ (2015)	500 MB monthly mobile Internet (% consumption expenditure)	Smartphone (% annual consumption expenditure)
Middle fifth	$84	1.2%	3.6%
Fourth fifth	$108	0.9%	2.8%
Highest fifth	$200	0.5%	1.5%
Cambodia	**$101**	**1.0%**	**3.0%**

Source: NIS, 2016.

More challenging than Internet affordability is the availability and price of electricity, needed to power and recharge devices used to go online. Access to electricity has grown significantly particularly since 2010 (Figure 0.4, left). However, in 2015, while all households had some form of lighting, one third, most in rural areas, did not have grid-based electricity (Figure 0.4, right). At US¢ 17.8 per kWh, the cost of electricity is high relative to incomes.[39] In 2014, average per capita monthly electricity consumption was 23 kWh costing around US$4 per month, twice as much as average monthly communications consumption.

Figure 0.4: Household electrification



Source: Demographic and Health Surveys (DHS) and NIS.

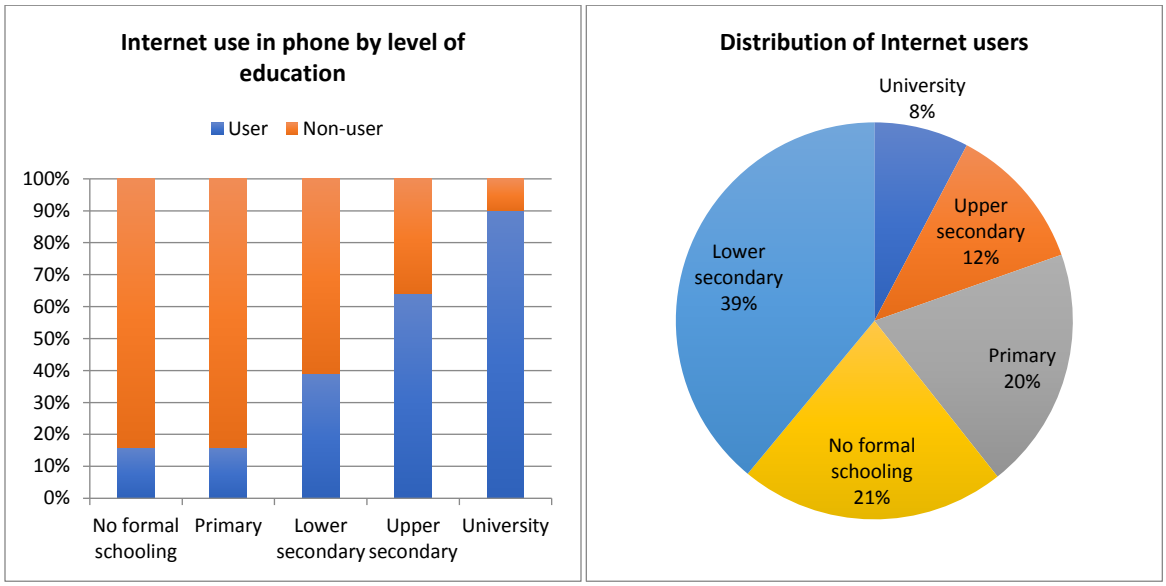
1.9.2 Digital literacy

Literacy is high at 81% of the population aged 15 and older in 2015 compared to the 63% LDC average, providing a good starting point for potential Internet usage. However plain literacy—the ability to read and write a simple sentence—is insufficient on its own to truly leverage the power of Internet access for learning and boosting income generating opportunities. Predictably, Internet use rises with educational attainment: while 90% of Cambodians with a university degree were online in 2015, only 16% of those with just a primary school education used the Internet, the same figure as those with no formal schooling (Figure 0.5, left). Given that those who have not completed a primary school education account for just under half the population aged 15 and older, they along with those with only primary education make up 41% of Internet users in the

[39] http://www.doingbusiness.org/Custom-Query

country (Figure 0.5, right). Those with a university degree or upper secondary education account for just 20%.

Figure 0.5: Internet use by level of education and distribution of Internet users by level of education, 2015

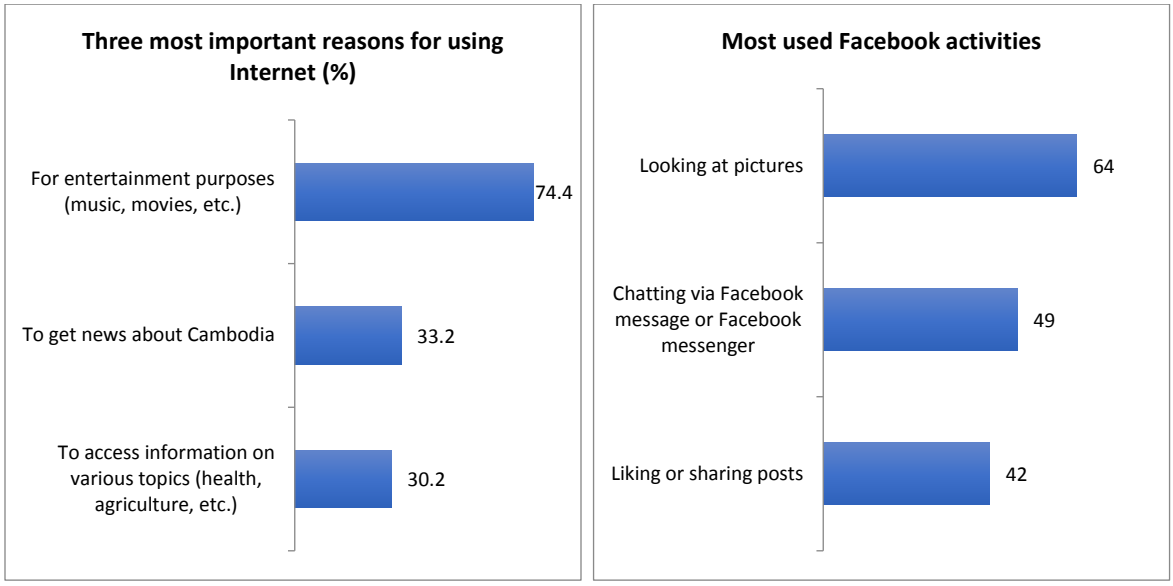


Source: NIS, 2013 and Phong, et al., 2016.

It is striking that two fifths of Cambodian Internet users have a primary education or less. However, the main reason cited for using the Internet is entertainment (Figure 0.6, left), which does not require a high level of skill. It is simple to access and use these types of applications (e.g., music, videos, etc.) by just pushing a couple of icons on a smartphone. Levels of digital literacy are thus quite low. A significant number of Cambodians use Facebook and in fact, there were more declared Facebook (48% of age 15 to 65 population) than Internet users (37%) in 2015. This is attributed to some respondents not realizing that when they are using Facebook they are using the Internet (note that 10% of Facebook users in Cambodia reported having more than one account, Phong et al., 2016). Basic Facebook use also does not require a high level of skills. The most popular Facebook activities are looking at pictures, chatting and sharing/liking posts (Figure 0.6, right).

Clearly, not every Cambodian Internet user is accessing just entertainment with around a third reading news and ten per cent obtaining information. These are likely used by more educated users. Productive use of the Internet requires a higher level of digital literacy among those with low levels of education.

Figure 0.6: Most important reasons for using Internet and most popular activities carried out on Facebook, 2016



Source: Phong et al., 2016.

1.9.3 Local content

Local content development is critical given that Khmer is the national language and not widely used outside of Cambodia. The vast majority of the literate population only reads Khmer. Just nine per cent of the population aged seven and older is literate in another language (including six per cent in English). Work by a team of dedicated researchers in the early 2000s led to standardization of the Khmer font and acceptance by the Unicode consortium.[40] This paved the way for Khmer to be implemented in computer software systems and the World Wide Web.

Although like most countries, the top sites are Google properties (YouTube, Google search) and Facebook. Unlike many other LDCs, the other top sites feature local content (Table 0.2). The Google and Facebook sites are localized for Khmer. Therefore, there is significant content in Khmer as well as locally generated content. The most popular content is concentrated on social networking or entertainment type information. Wikipedia ranks 21st among the most popular Cambodian web sites. There is a Khmer Wiki with around 5,600 articles.[41]

Table 0.2: Top ten web sites in Cambodia, October 2017

Rank	Site	Comment
1	Youtube.com	User-submitted videos.
2	Google.com.kh	Cache hosted in Cambodia
3	Google.com	Search engine
4	Khmerload.com	News aggregator. Hosted abroad.
5	Sabay.com.kh	Entertainment website. Hosted in Cambodia
6	Facebook.com	Social network

[40] The Unicode Standard, Version 10.0, https://www.unicode.org/charts/PDF/U1780.pdf
[41] Wikimedia, List of Wikipedias by language group, https://meta.wikimedia.org/wiki/List_of_Wikipedias_by_language_group#Mon-Khmer_.281.2C168.2C134_Articles.2C_1.2C501_Active_Users.29

Rank	Site	Comment
7	Freshnewsasia.com	Breaking news. Hosted in Cambodia.
8	Kbn-live.com	Khmer Breaking News. Hosted abroad.
9	Pmhotnews.com	Online lifestyle magazine. Hosted abroad.
10	Kohsantepheapdaily.com.kh	Online newspaper. Hosted in Cambodia.

Note: A site's ranking is based on a combined measure of unique visitors and pageviews.
Source: https://www.alexa.com/topsites/countries/KH.

1.10 Digital business

There is a small but active and growing tech startup scene in Cambodia. Ecosystem support facilities are starting to develop such as co-working spaces, incubators/accelerators, events and funding. Several universities offer degrees in ICT-related subjects. There is a steady supply of labor and some 4,000 students a year with ICT skills are estimated to be graduating each year. In 2013, some 27,689 persons reported having studied computer science (NIS, 2013).

Though still nascent, venture capital and other sources of financing for startups are emerging. Khmerload, a news aggregator and one of the most visited web sites in the country, secured funding of US$200,000 from 500 Startups, a California-based global venture capital seed fund.[42] Golden Gate Ventures, an early-stage venture capital firm that invests in Southeast Asia has expressed interest in the Cambodian market.[43] Local mobile operator Smart launched a US$ 5 million Digital Innovation Fund to invest in Cambodian startups.[44]

Online advertising is increasing in the country and can be a significant revenue source for digital businesses. A number of Cambodian web sites are earning revenue through online advertisements. Large IT companies such as Facebook and Google are already estimated to be earning significant revenues from ads targeted at Cambodian Internet users. AdAsia, a major digital advertising technology company in the region recently opened an office in Phnom Penh, citing a rise in mobile broadband penetration.[45]

Applications are growing particularly those using smartphones. Several target transportation such as BookMeBus, an app for reserving bus seats, which won a prize at the 2015-16 Cambodian ICT Awards.

There is some information services export activity. For example, the company Pathmazing provides outsourcing services for eBay Motors. Activities include enhancement of motor vehicle digital photographs and "scraping" of automotive sales information from various web sites into a database. The company employs around 80 staff. It recently launched the Tesjor app whereby users can order food and drinks from different places through an integrated end-to-end process of digital ordering and payment.

[42] "Khmerload, the Buzzfeed of Cambodia Secures a US$200K Investment from 500 Startups," *Reuters*, March 28, 2017, http://www.reuters.com/brandfeatures/venture-capital/article?id=3893.
[43] Vichea, Pang. 2017. "Startups turn heads in Silicon Valley." *Phnom Penh Post*, April 6, 2017. http://www.phnompenhpost.com/business/startups-turn-heads-silicon-valley.
[44] Smart Digital Innovation Fund, https://sadif.com.kh
[45] "AdAsia Holdings expands into Cambodia," *Press Release*, 10 February 2017, https://adasiaholdings.com/about/news_detail/2081/

Impacts

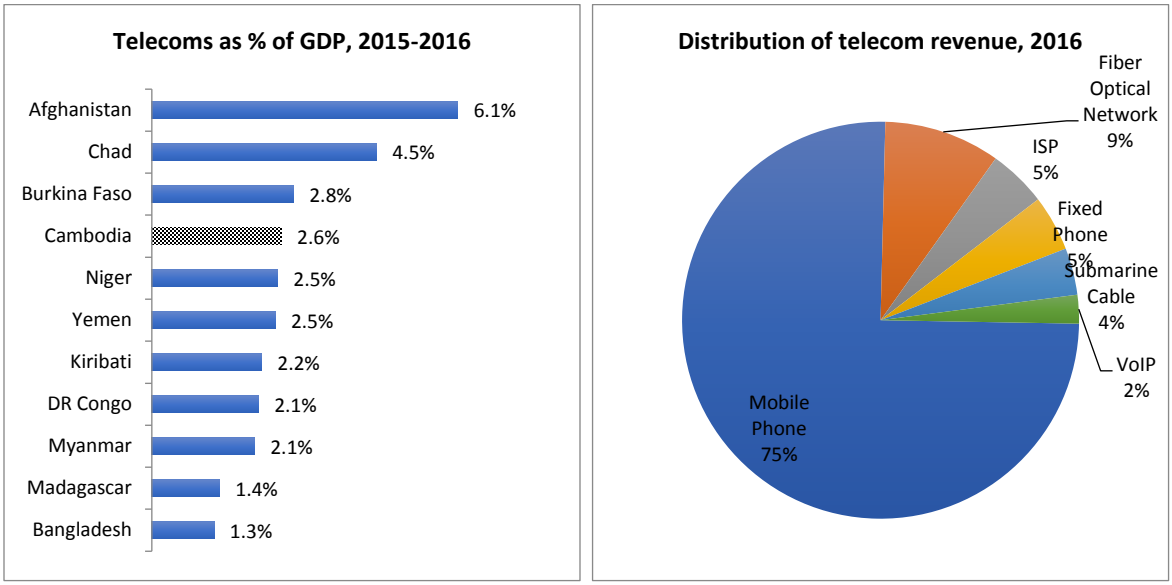
This chapter looks at connectivity status and its impact across various sectors of the economy. The analysis is constrained by a lack of evidence-based data in most instances. Timely and disaggregated macroeconomic statistics are limited as are impact assessments. Statistics compilation and dissemination will need significant enhancement to clearly gauge the evolution and impact of Cambodia's broadband economy.

1.11 Economy

Data limitations make it impossible to meaningfully assess the economic impact of the ICT sector in Cambodia. National accounts data are not available at a sufficient level of disaggregation to formally determine the size of the sector and its contribution to the economy. This serious data shortcoming merits attention as it makes it impossible to gauge the size, structure and dynamics of Cambodia's digital economy.

Despite the lack of formal national accounts data, there are other statistics that give some idea of the economic and employment dynamics of ICT subsectors (Box 0-1). The Telecommunications Regulator of Cambodia collects data on telecommunications sector revenue reporting US$ 521 million in 2016 equivalent to 2.6% of GDP. This figure is slightly above the median for other LDCs that publish telecommunications value-added data (Figure 0.1, left). Mobile accounted for 75% of the total (Figure 0.1, right).

Figure 0.1: Telecommunications revenue as % of GDP, selected LDCs and breakdown of telecommunications revenue, Cambodia, 2016



Note: In the left chart, data refer to current value-added for Posts and Telecommunications in ISIC 3.0 for LDCs that publish this statistic. The latest year available (2015 or 2016) is shown.
Source: UN and TRC.

There are no regular ongoing surveys of employment in the ICT sector or occupation statistics of those with ICT skills. A 2011 Economic Census found 12,173 people working in the

telecommunications and computer software and information services sectors, equivalent to 0.7% of total employment (excluding agriculture and public services).[46] Availability of ICT employment data might be improved through efforts by sector trade associations.

There are no official time series data of overall investment by ICT firms in Cambodia. Most of the enterprises operating in this sector are privately held and do not publish public reports nor do government agencies collect this data on a regular basis. There are a few sources of investment data but they are not comprehensive.

While the lack of precise investment data is unfortunate, another way of looking at whether sufficient investment is being made is to look at the results in terms of network infrastructure. This is particularly relevant given that investment data can be misleading since the volume of capital expenditure may not be a relevant benchmark. Investment figures can differ widely due to geographies, infrastructure sharing and dynamics of wholesale backbone networks.

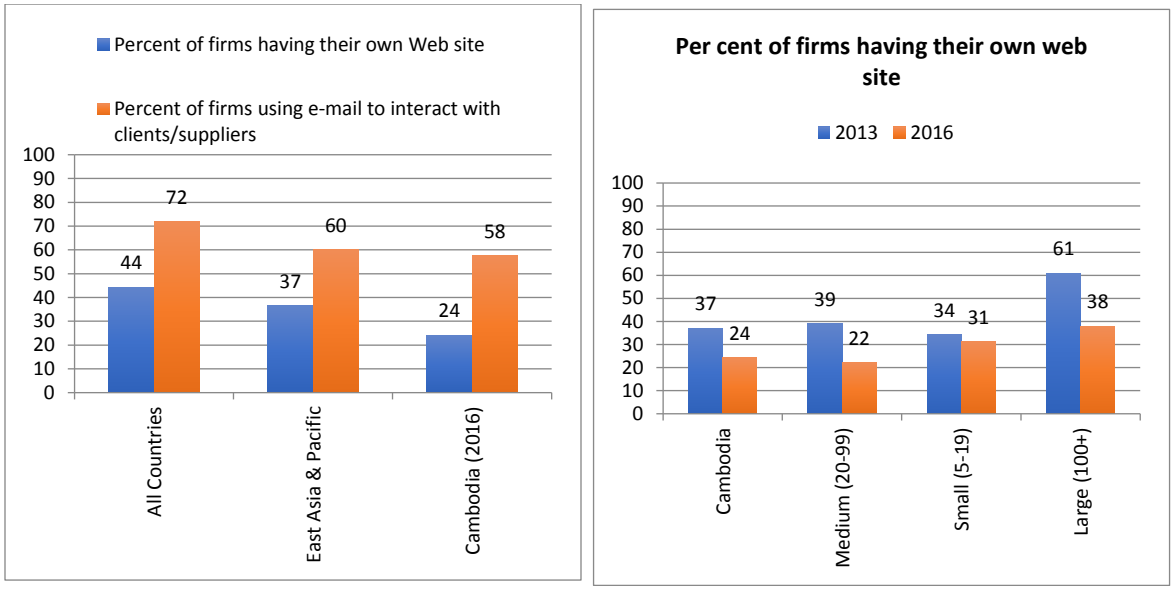
The economy wide impact of increased broadband penetration remains largely unrealized. While ICTs benefit large industries important for the economy such as the garment industry and tourism, use among enterprises is low according to available data.[47] [48] Ownership of a web site was 24% among the Cambodian firms surveyed in 2016, less than the East Asia and the Pacific and world averages (Figure 0.2, left). Similarly, use of e-mail to interact with suppliers and customers, 57% in 2016, was also less than regional and global averages. Further, the proportion of enterprises with their own web site declined between 2013 and 2016 (Figure 0.2, right), possibly due to a preference for a company Facebook page instead.

[46] This encompasses divisions 61 - Telecommunications, 62 - Computer programmeming, consultancy and related activities and 63 - Information service activities in the International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4. See: National Institute of Statistics. 2012. *Economic Census of Cambodia 2011*.

[47] infoDev. 2008. *The Global Textile and Garments Industry: The Role of Information and Communication Technologies (ICTs) in Exploiting the Value Chain*. http://www.infodev.org/articles/global-textile-and-garments-industry

[48] Bory Seng. 2012. *The Introduction of ICT for Sustainable Development of the Tourism Industry in Cambodia*. https://ideas.repec.org/p/snv/dp2009/201287.html

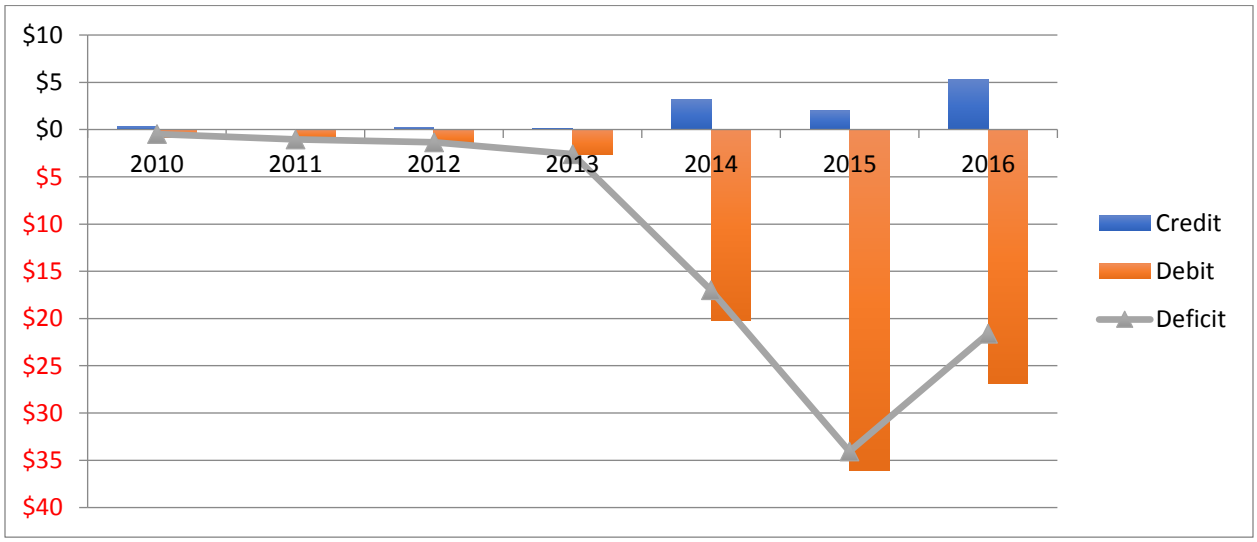
Figure 0.2: Enterprise use of ICTs



Note: In 2013, 472 firms were surveyed. In 2016, 373 firms were surveyed. World and region averages based on latest available data for each country in the group whereas data for Cambodia refer to 2016.
Source: World Bank Entreprise Surveys.

Cambodia imports far more in computer and information services than it exports. According to 2016 data from the National Bank of Cambodia, the country's computer and information services exports were US$ 5.3 million compared to US$ 26.9 million of imports resulting in a net deficit is US$ 21.6 million (Figure 0.3).

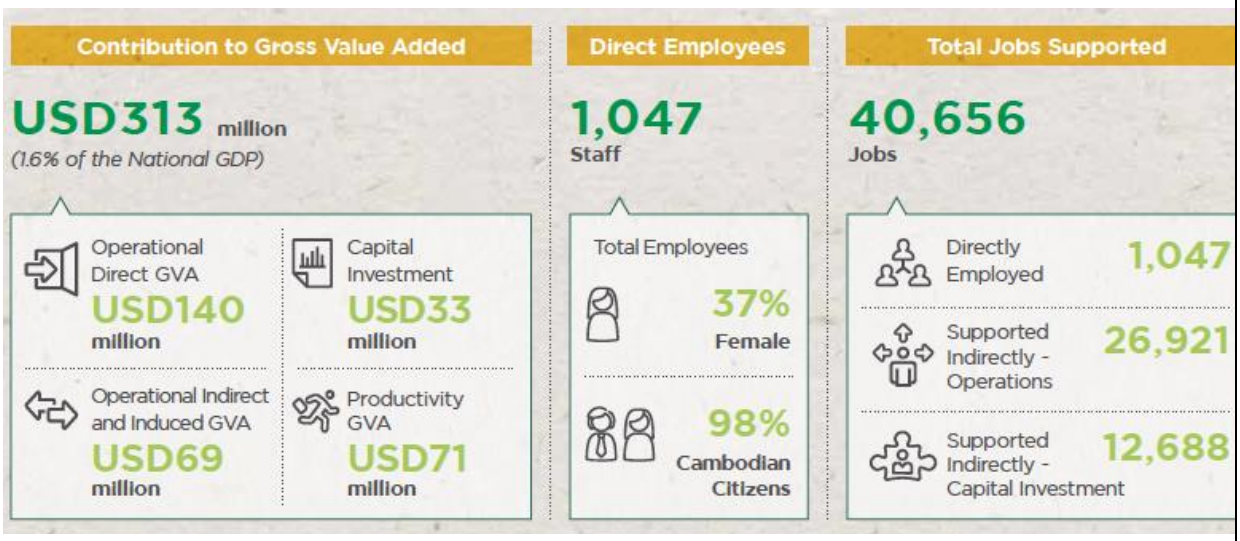
Figure 0.3: Trade in computer and information services, US$ million



Source: National Bank of Cambodia, Balance of Payments Statistics Bulletin.

Box 0-1: Economic impact of Smart

Smart is the only telecommunication operator in Cambodia that publishes information about its economic impact in the country. By its measure of Gross Value Added, which includes direct, indirect and induced value-added as well as capital expenditure and productivity gains, Smart contributed 1.6% of Cambodia's GDP in 2016. Smart estimates that every US$ 1 it spends on operations and investment generates US$ 1.4 for the economy. It had 1,047 employees but reckons it supports over 40,000 jobs indirectly though its operations and investment. It paid US$ 65 million in taxes and regulatory fees, a figure equal to 3.6% of the country's total tax revenue.



Source: Axiata. 2017. "Smart." In *Sustainability & National Contribution Report 2016*.

1.12 Government

The National ICT Development Authority (NiDA) was created in 2000 as the agency responsible for the implementation of e-government in the country. Chaired by the Prime Minister, NiDA was instrumental in efforts to connect ministries in Phnom Penh. It also developed four key applications as part of the Government Administrative Information System (GAIS) project: 1) Electronic Approval System to support the flow of digital documents within government; 2) Real Estate registration; 3) Resident Registration; and 4) Vehicle Registration.

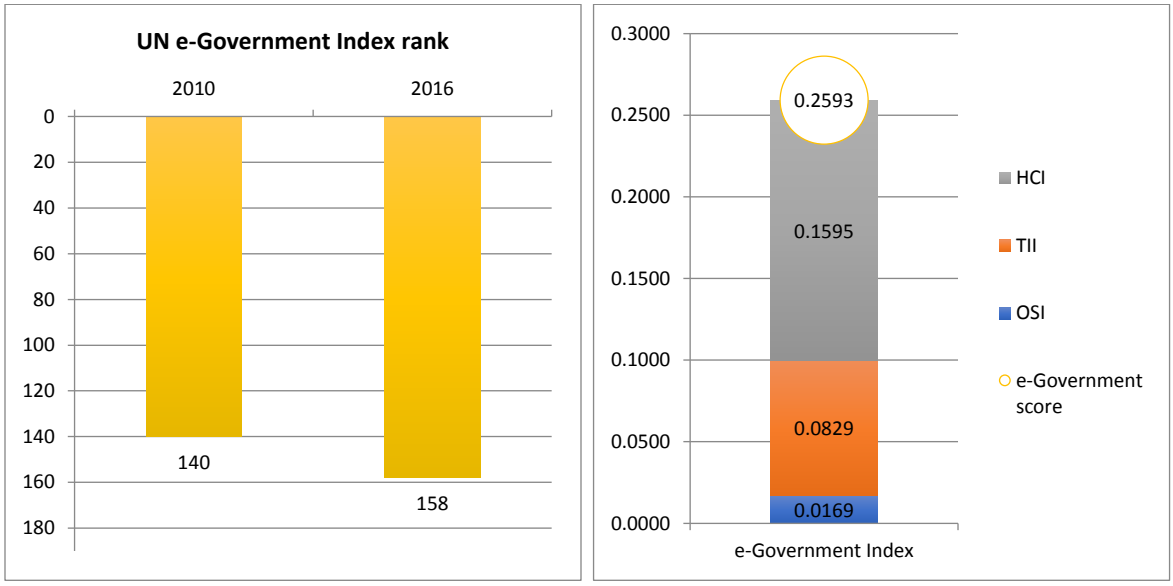
Development of e-services has stalled. According to the United Nations Division for Public Administration and Development Management, Cambodia has been losing ground in e-government compared to other countries. Between 2010 and 2016, its world rank in the E-Government Development Index fell from 140 to 158 (Figure 0.4, left).[49] In 2016, it ranked 17th among LDCs. Further, when just the online services component of the index is considered, Cambodia fares even worse, ranking 40th among LDCs. The online services component only constitutes 6% of Cambodia's total e-government score (Figure 0.3, right).

NiDA was abolished in 2013 when it was merged into the MPTC who is now responsible for e-government. The 2016 *ICT Policy* calls for developing an e-government strategy and a common technical framework; prioritizing software applications; establishing a Chief Information Officer

[49] UN E-Government Knowledge DataBase, UN-DESA, https://publicadministration.un.org/egovkb/Data-Center

across ministries; developing human resource, administrative and financial management systems as well as a single window system for trade; and establishing a national data center with a government cloud.[50] [51] The ICT Masterplan 2020 also has a section devoted to e-government development.

Figure 0.4: UN e-Government Index, Cambodia



Note: In the right chart, OSI = Online service index; TII = Telecommunication infrastructure index and HCI = Human Capacity Index. The figures reflect the contribution of each component to the overall score.
Source: UN E-Government Knowledge DataBase.

1.13 Education

Education is one of the few sectors with an ICT plan. The 2009-2013 *Master Plan for Information and Communication Technology in Education* operationalizes the ICT strategy in Cambodia's *National Education Plan*:

> *ICT policies will include a) expansion of ICT as a teaching and learning tool b) as a means of improving education service productivity and management through improved information sharing, communication and knowledge management and c) expansion of distance learning opportunities especially for disadvantaged groups in remote areas. The overarching goal will be to ensure Cambodia's international competitiveness in an increasingly global and interconnected knowledge-based economy.*[52]

The goals of the Master Plan are:

- *To increase access to basic education, tertiary education and life-long learning, both formal and non-formal, by using ICT as alternative education delivery media.*

[50] This would eventually tie into the ASEAN Single Window project. For more information see: http://asw.asean.org/about-asw
[51] Tum Yousos. February 2017. "Telecommunication and ICT Development Policy." http://www.cicc.or.jp/japanese/kouenkai/pdf_ppt/pastfile/h28/170201-3MPTC.pdf
[52] Ministry of Education, Youth and Sport. 2003. *Education for All (EFA) National Plan 2003-2015*. http://planipolis.iiep.unesco.org/en/2003/education-all-efa-national-plan-2003-2015-3643

> *• To improve the relevance and effectiveness of basic education by harnessing the potential of ICT as a major tool to enhance the quality of teaching and learning.*
>
> *• To develop the ICT-based Professional skills needed by graduates for employment in a knowledge-based society and in order to ensure that Cambodia can compete and cooperate in an increasingly interconnected world.*
>
> *• To increase the effectiveness and efficiency of Ministry and school management. (MoEYS, 2010)*

A new ICT in education plan is under development.

A 2009 Memorandum of Understanding (MoU) between the Ministry of Education, Youth and Sport (MoEYS) and telecommunications operator Metfone, to provide Internet access in all schools with electricity resulted in some 500 schools being connected. Metfone stated that its contribution for connecting schools was US$ five million. The wired connections use either fiber optic or ADSL with speeds of between 1 - 5 Mbps. However, this is only twelve per cent of the some 4,000 schools in the country. The agreement was renewed in 2015 that would extend free broadband access to all public schools in the Kingdom over the next five years as part of the operator's corporate social responsibility initiatives.[53] Once again, Metfone cites a figure of US$5 million for this second phase of the initiative.

Electricity has been a major barrier in connecting schools to the Internet. The first MoU with Metfone only covered schools with electricity, which according to a 2012 survey, amounted to just 24% of secondary schools and 7% of primary schools (UIS, 2014).[54] Even though the Metfone MoU included free Internet access, some electrified schools could not take advantage because they could not afford the cost of electricity (Richardson et al., 2015). Some schools that had electricity restricted access to computers to reduce electrical costs.

Mobile operator Smart has a corporate social responsibility programme in conjunction with UNESCO and the ministry.[55] This includes support for research and development in the use of ICT in education for(?) online learning and development of digital content. Open Institute has also partnered with the ministry to create a senior secondary year ICT textbook as well as other initiatives.[56]

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[53] MetFone. 2016, "Education Minister Hails MetFone's Move to Expand Internet Access to More Schools." *Press Release*, July 8. http://www.metfone.com.kh/en/news/event/education-minister-hails-metfone's-move-to-expand-internet-access-to-more-schools.

[54] UNESCO Institute of Statistics. 2014. *Information and Communication Technology ((ICT) In Education in Asia*. http://uis.unesco.org/sites/default/files/documents/information-communication-technologies-education-asia-ict-integration-e-readiness-schools-2014-en_0.pdf

[55] "Cambodia's leading mobile telecommunications provider Smart signs long-term partnership with UNESCO in the name of education and becomes UNESCO's exclusive telecom partner on quality education in Cambodia." *Press Release*, 16 August 2016. http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Phnom_Penh/pdf/press_release-smart-axiata_signs_long-term_partnership_w.pdf

[56] MOEYS. "Meeting with Open Institute". 8 July 2014. http://www.moeys.gov.kh/en/minister-page/771.html#.WjwReK3MyB0

MoEYS launched a New Generation Schools policy in 2016, aiming to improve outcomes using new methods of learning.[57] This includes an emphasis on the innovative use of ICT in education and a focus on STEM subjects. Several pilot schools have been established.

Digital materials can be exchanged through a portal created by MoEYS (Figure 0.5). This includes interactive multimedia, posters, digital lesson plans and video clips. The material is arranged by different categories and grade levels.

Figure 0.5: Ministry of Education, Youth and Sport Open Educational Resources portal

Source: http://krou.moeys.gov.kh/kh/

Since early 2017, twelfth grade students (i.e., last year of secondary education) can practice for final exams using an online application. Students can use smartphones, tablets and PCs for practice tests in math, physics, chemistry, biology and history, and get immediate results.[58]

[57] MOEYS. 2016. *Policy Guidelines for New Generation Schools*. http://www.moeys.gov.kh/en/policies-and-strategies/2468.html#.Wfxv6a3MyIY

[58] Sen David and Yesenia Amaro. 2012. "Practice for grade-12 test goes online." *The Phnom Penh Post*, 9 February. http://www.phnompenhpost.com/national/practice-grade-12-test-goes-online

Khmer Academy (khmeracademy.org) provides online university and secondary school study materials in Khmer.[59] Launched in 2015 with the support of the Korea Software HRD Center, content includes video tutorials and discussion forums. The portal won the Cambodia ICT Award 2015-2016 in the category of digital content.

The Cambodian Research and Education Network (CamREN) connects five higher education institutions: The Institute of Technology, University of Health and Science, National University of Management, Royal University of Culture and Fine Arts and School of Fine Arts of Cambodia. CamREN offers online learning materials in both English and Khmer and courses in chemical, electrical and energy engineering and computer science, together with access to an online library. It is also connected to the international research and education community through the Trans-Eurasia Information Network (TEIN).[60] ISP Ezecom has been supporting connectivity in higher education by providing free Internet access to nine universities in Phnom Penh.[61]

1.14 Health

The Ministry of Health (MoH) was one of the earliest government institutions to have networking through a WHO project. Today the ministry compound in Phnom Penh is connected to fiber optic cable and its buildings are wired with Ethernet to each office. The speed however is restricted due to the cost and limited budget.

ICT applications in the health sector are decentralized. Initiatives are often donor-driven and related to specific issues. There are also several different web sites for various parts of the MoH.

- The National Health Information System (NHIS) in Cambodia was launched in 1993, reaching full country coverage by 1995 with support from the United Nations Children's Fund (UNICEF). NHIS has been progressively updated and today is a web-based application allowing health facilities to enter the data online.[62] NHIS is connected to 990 health centers, 55 referral hospitals, 24 provincial hospitals, 8 national hospitals and 2 NGO supported hospitals. The Ministry received assistance from USAID to upgrade to the web-based system.
- Cambodia's Communicable Disease Control (CDC) Department uses mobile phones for crowdsourcing reporting of disease outbreaks.[63] This includes both SMS reporting and a hotline reached by dialing 115.[64] The project is supported by the Skoll Foundation, a philanthropy launched by Jeff Skoll, the first president of online shopping site e-Bay.[65]

[59] Va Sonyka. 2016. "Website Offers Students E-Learning in Khmer." *Khmer Times*, 16 March.http://www.khmertimeskh.com/news/22828/website-offers-students-e-learning-in-khmer/
[60] "Asian connectivity growing stronger." *In the Field*, August 2016. https://www.inthefieldstories.net/asian-connectivity-growing-stronger/
[61] Western University, University of Health Science, Build Bright University, Royal University of Phnom Penh, Cambodian Mekong University, Financial Institute of Cambodia, Institute of Foreign Languages, Pannasastra University of Cambodia and Passerelles numériques. See: https://www.ezecom.com.kh/our-partnership
[62] Cambodia Ministry of Health, Cambodia Health Management Information System, http://www.hiscambodia.org
[63] Cambodia Ministry of Health, Communicable Disease Control Department, 2018, http://www.cdcmoh.gov.kh
[64] InSTEDD. 2015. "Enhance CDC Cambodia's Hotline for Improved Participatory Surveillance." *Blog*, 28 October. http://ilabsoutheastasia.org/how-we-help-enhance-cdc-cambodias-hotline-for-improved-participatory-surveillance-system/
[65] Cambodia 115 Hotline, http://endingpandemics.org/projects/cambodia-115-hotline/

- The Siem Reap Provincial Referral Hospital has been testing a Patient Management and Registration System since 2011.[66] Patient records containing diagnosis, payment and other details are digitized and stored in the system. Hospital staff can then access the information for follow up visits. There are plans to introduce the scheme in other referral hospitals potentially leading to a national electronic medical records system.
- Operation Village Health, an e-mail based telemedicine project was introduced in 2001 at a health center in Rovieng and a referral hospital in Ban Lung. Harvard-affiliated physicians provided diagnosis to Cambodian health workers based on images received via email. Recommendations were sent back to health staff within hours. There have been around 700 consultations. The project won the Stockholm Challenge in the category of health and has resulted in a falling rate of referral to facilities outside the village and a decrease in the duration of chronic medical problems among villagers.[67]
- The National Centre for Health Promotion (NCHP) supplements its media campaigns with information on its website (http://www.nchp.gov.kh) and Facebook page.

NGOs have also developed ICT-based health interventions. One example is People in Need's Village Baby Care where automatic phone calls are made weekly to recent mothers for the first month following birth. The calls offer maternal health information and have resulted in mothers and babies visiting health centers more often and led to a reduction in harmful behavior. Newborns had fewer medical problems. Since its launch in 2013, over 20,000 mothers have signed up. The project won the Gold Medal in the ASEAN ICT Awards in the Corporate Social Responsibility category.[68] The high level of mobile phone penetration and use of voice to overcome literacy challenges have been key success factors for the mHealth application.[69]

1.15 Agriculture

ICT interventions of the Ministry of Agriculture, Forestry and Fisheries (MAFF) are made on a decentralized basis according to the needs of different departments. The Agricultural Information and Documentation Center collects and disseminates policy, decision making, planning, technical and other information to the public through its web site and Facebook page. Facebook messaging is the most popular method for citizens to contact MAFF. It also manages the ministry's overall web site (http://www.maff.gov.kh).

- MAFF has a Geographic Information System (GIS) with a public interface providing provincial agricultural synopsis.
- The Department of Agricultural Extension has been involved in a market-pricing project supported by the Canadian International Development Agency (CIDA), and recently the

[66] Annear PL, Grundy J, Ir P, Jacobs B, Men C, Nachtnebel M, et al. *The Kingdom of Cambodia Health System Review*. Vol.5 No.2. Manila: World Health Organization, Regional Office for the Western Pacific, 2015. http://www.wpro.who.int/asia_pacific_observatory/hits/series/cambodia_health_systems_review.pdf

[67] "Telemedicine project improving health in rural Cambodia." http://www.mtbeurope.info/content/ft609003.htm

[68] "People in Need and Open Institute receive top ASEAN ICT Award." http://www.open.org.kh/?q=en/people-need-and-open-institute-receive-top-asean-ict-award#.WelX3a3MzYI

[69] Jenn Lonzer, 2015, "Neonatal mHealth Program, Village Baby Care, Brings Messages to New Parents in Rural Cambodia." *News*, 18 January. https://innovatemedtec.com/content/neonatal-mhealth-program-village-baby-care-brings-messages-to-new-parents-in-rural-cambodia

European Union.[70] The agricultural market information system (AMIS) collects prices of various commodities and transmits the results through radio, a web site and SMS.[71] AMIS can increase revenues for farmers by reducing information asymmetry allowing them to obtain better prices.

- The Rural Farm Information Center is a web site for farmers providing a variety of relevant information including pricing and learning materials and an extensive video library.[72]
- The MAFF has also developed a smartphone application that currently provides news feeds produced by the ministry. It is planned to enhance this with links to relevant parties such as provincial agricultural offices, cooperatives, traders and agribusinesses.

1.16 Financial inclusion

Mobile technology has contributed to financial inclusion in the country. Wing Limited Specialised Bank was the first provider launching its mobile money service in 2009. Its services allow users to transfer money, add credit to their mobile phone, pay bills and make online payments. Since then, mobile operators have launched mobile money services such as SmartLuy and Metfone e-money as well as a few other specialized banks totaling six payment providers.[73] Financial inclusion has expanded, as noted by a 2014 survey finding that 13% of Cambodians had a mobile money account.[74] Of those, 10% had only a mobile money account compared to 13% with a formal account at a financial institution. Another survey conducted in 2015 reported that 36% of Cambodian adults used mobile money (Finmark Trust, 2016).

Financial technology is spreading to online payments. Paygo has partnered with local bank ABA to introduce a digital wallet that can be used for a variety of purchases. However, effort will be needed to overcome Cambodians resistance to paying online. Just 4% of Cambodians paid a bill or bought a product online in 2015 with the vast majority using mobile money for remittances (Finmark Trust, 2016). Nevertheless, digital finance is seen as a transformational opportunity for Cambodia to advance financial inclusion.[75]

[70] For more information see "Cambodia Agricultural Market Information Project (CAMIP): January 2006–October 2009" at: http://www.agriteam.ca/projects/profile/cambodia-agricultural-market-information-project-camip/
[71] Cambodia Ministry of Agriculture, Forestry and Fisheries, http://www.agriculturalmarketinformation.org.kh
[72] http://aginfo.org.kh
[73] https://www.nbc.org.kh/english/payment_systems/non_bank_institutions.php
[74] Global Findex Database at: http://datatopics.worldbank.org/financialinclusion/
[75] Asian Development Bank. 2017. *Accelerating Financial Inclusion in South-East Asia with Digital Finance*. https://www.adb.org/sites/default/files/publication/222061/financial-inclusion-se-asia.pdf

Conclusions

With a highly competitive market, Cambodia has achieved a high rate of Internet coverage and access with the cheapest mobile Internet prices in the world. The unregulated market, combined with dollarization of the economy, no foreign ownership restrictions, auction free spectrum and lack of influence of an incumbent operator, has attracted significant investment into the broadband sector. In contrast, markets in many LDCs are highly regulated with exchange rate risks, foreign investment caps, spectrum auctioned and influential incumbent operators. Another factor is Cambodia's relatively large Khmer speaking population of almost 16 million, 19th largest among the LDCs.

Cambodia's level of Internet penetration is high for an LDC, and especially impressive given that the Khmer language is unique to the country and uses non-Latin characters. At the same time, Cambodia is a highly cohesive linguistic market with Khmer understood by 97% of the population, maximizing the spread of online content and services developed in the official language. There is a vibrant tech industry and startup community with evidence of software exports, development of local apps and small but growing venture capital flows.

Anecdotal indications suggest the country's improved connectivity is attracting investment and allowing businesses to expand beyond Phnom Penh and into the provinces. Undoubtedly broadband Internet has contributed to the efficiency of key sectors such as garments and tourism. However, little of these results are quantifiable, making evidence-based analysis of the impact difficult. What is known is that much of Internet is used to access social networks and entertainment, and that impactful applications are largely narrowband (e.g., mobile money, health alerts, etc.). High-speed services to support applications such as online learning and real time remote medical consultation are not deployed. Enterprise use of advanced applications such as a web site and e-government online applications are low compared to other LDCs.

One challenge is reliance on overseas computer software and information services. In addition, vast amounts of personal data are going abroad, earning digital advertising revenues for foreign IT firms. These factors are constraining the development of Cambodia's ICT sector, negatively affecting the balance of payments and depriving the government of tax revenue. Heavy reliance on Facebook for company, government and news pages is risky given that the platform can be changed with no advanced notice. In October 2017, with no warning, Facebook modified the placement of news feeds in six countries including Cambodia, causing a dramatic fall in their reach. This was particularly perilous for Cambodia where Facebook is the number one news source.[76]

The country's expanded broadband connectivity has thus far not been largely leveraged for productive applications and services benefitting national development. Government can be catalytic in encouraging the use of broadband for national development. However, it is constrained by a lack of resources and human capacity. While the industry makes significant contributions to the government in forms of taxes and revenue sharing, much of this is used for other purposes. Hence, resources are limited for development of e-government services. The lack

[76] Alexis C. Madrigal. 2017. "When the Facebook Traffic Goes Away". *The Atlantic*, 24 October. https://www.theatlantic.com/technology/archive/2017/10/when-the-facebook-traffic-goes-away/543828/

of a high-level government champion means that the outlook of broadband as a crosscutting general purpose technology is not wholly embraced. Instead, broadband is perceived as an infrastructure largely pertaining to the ICT sector, reducing its potential for national development.

As the MPTC moves to a more regulated telecommunications sector, it will be interesting to see if the same dynamism that has propelled the market can be sustained, particularly low prices. The new law includes obligations to contribute a proportion of revenues for new universal service and R&D undertakings. Further, spectrum will now be auctioned. These actions will raise costs for operators, which will be passed on to consumers. Government needs to play a more active role in facilitating network rollout to rural areas. The new Telecommunications Law calls for a universal service fund to facilitate infrastructure deployment in underserved areas. However, a more significant action is accelerating the switchover to digital broadcasting. This would free up low frequencies thereby lowering the cost of deploying wireless broadband infrastructure in underserved areas.

Many ICT programmes in government are donor-driven or assisted through corporate social responsibility initiatives. Cambodia needs to take stock of these initiatives, many of which stop after the donors cease funding them. They also result in duplication and often have limited impact. Government needs to identify its own ICT priorities across different sectors and then make the case to donors to support them. This should include specific sector digital strategies for health and agriculture, similar to the one prepared for education. The ICT Masterplan highlights important areas for intervention, yet remains largely unfunded and sporadically implemented.

Developing public e-services for businesses and citizens will lower costs for government and create awareness of other types of applications besides social media and entertainment. Government should also increase awareness among MSMEs about the benefits for broadband through training programmes and facilitating the purchase of computers and Internet service charges. Use of the .kh domain name can be encouraged through media advertisements, which would also help develop the local hosting and data center industry.

Funding and training will be essential in order for government to play a more meaningful role in delivery of e-services. It is not clear that sufficient resources have been devoted to the ICT Masterplan of 2014, or that much progress has been made in implementing it. Scattered applications across ministries need to be consolidated to lower costs through shared resources, common protocols and standard applications. Impactful public e-services need to be deployed, including some immediate quick wins, that positively affect business and citizens. Electronic transactions, data privacy, consumer protection and computer crime legislation needs to be enacted in order to create greater confidence in developing and using online applications. National statistics need urgent support to begin compiling data based on international frameworks for the information and communication sector. This is essential for planning and monitoring the evolution of the digital economy and matching labor output to industry requirements.

Given the high level of broadband connectivity for an LDC, Cambodia has much of the infrastructure in place necessary for developing a digital economy. It needs to seize the unrealized potential of greater broadband connectivity to have a greater impact on national development and the economy.

Table 0.1: Cambodia broadband for national development SWOT

Strengths	Weaknesses
▪ Competitive telecom market with low prices ▪ High Internet penetration for LDC ▪ Strong connectivity for LDC with relatively high level of mobile coverage and robust backbone network ▪ Vibrant startup and tech community ▪ Homogenous language market	▪ Low level of digital literacy ▪ Lack of ICT vision at highest level of government ▪ Limited government investment in ICT for public e-services ▪ Lack of low frequency spectrum for better wireless broadband coverage in rural areas ▪ Limited macroeconomic statistics on the sector
Opportunities	**Threats**
▪ Business connectivity market ▪ E-government / e-services ▪ Computer services exports ▪ Diversify economy ▪ ASEAN market	▪ Growing ICT-related data and services trade deficit ▪ Loss of competitiveness

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Organizations Consulted

The information from the organizations consulted during the field visit 16-20 October 2017 is highly appreciated. Organizations and persons consulted are shown below.

Organization	Person	Title
Cambodian Network Exchange	Mike Gaertner	Founder
ICT Federation of Cambodia	Steven Path	President
Ministry of Agriculture, Forestry and Fisheries	Hong Narit	Director Agricultural Information and Documentation Center
Ministry of Education, Youth and Sport	Sok Tha	Director Department of Information Technology
Ministry of Health	Ph. Hem Monirith	Deputy Director of Administrative Department
	Suy Rith	Deputy Chief of Information and Computerization Office
Ministry of Posts and Telecommunications (MPTC)	Kan Channmeta	Secretary of State
	Mao Neang	Deputy Director General
National Institute of Statistics	Keo Chettra	Director National Accounts Department
Open Institute	Javier Sola	Programme Director
	Phong Kimchhoy	Research Manager
Phnom Penh Post	Matthieu de Gaudemar	Reporter
Smart	Jonathan Yap	Head of Regulatory & Corporate Affairs
	Sary Yusos	Senior Principal, Regulatory and Government Affairs
Telecom Cambodia	Meng Songkeng	Deputy Director General
	Heng Sok Vises	ICT Director
Telecommunication Regulator of Cambodia (TRC)	Tep Bunboren	Director
United Nations Conference on Trade and Development (UNCTAD)	Sven Callebaut	Trade Adviser