

Towards Meaningful Connectivity: Insights from Asia-Pacific Case Studies



A4AI

ALLIANCE FOR
AFFORDABLE INTERNET



The Economic and Social Commission for Asia and the Pacific (ESCAP) is the most inclusive intergovernmental platform in the Asia-Pacific region. The Commission promotes cooperation among its 53 member States and 9 associate members in pursuit of solutions to sustainable development challenges. ESCAP is one of the five regional commissions of the United Nations.

The ESCAP secretariat supports inclusive, resilient and sustainable development in the region by generating action-oriented knowledge, and by providing technical assistance and capacity building services in support of national development objectives, regional agreements and the implementation of the 2030 Agenda for Sustainable Development



The shaded areas of the map indicate ESCAP members and associate members.

Disclaimer: The views expressed in this report should not be reported as representing the views of the United Nations, but as views of the authors. The report describes research in progress by the authors and is published to elicit comments for further debate. The report is issued without formal editing. The designations employed and materials presented do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. The United Nations bears no responsibility for the availability or functioning of URLs. Opinions, figures and estimates set forth in this report are the responsibility of the authors and should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. Any errors are the responsibility of the authors. Mention of firm names and commercial products does not imply the endorsement of the United Nations.

Correspondence concerning this report should be addressed to the email: escap-ids@un.org.

Contact:

Information and Communications Technology and Development Section
Information and Communications Technology and Disaster Risk Reduction Division
United Nations Economic and Social Commission for Asia and the Pacific
United Nations Building
Rajadamnern Nok Avenue
Bangkok 10200, Thailand
Email: escap-ids@un.org

Acknowledgements

This report was prepared by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the Alliance for Affordable Internet (A4AI) in support of the implementation of the Asia-Pacific Information Superhighway initiative. The drafting team included Jonathan Brewer, Siope Vakataki 'Ofa and Anju Mangal.

Substantive comments were provided by Tae Hyung Kim, Chief, Cristina Bernal Aparicio and Quynh Huong Nguyen of the Information and Communications Technology and Development Section, under the guidance of Tiziana Bonapace, Director, Information and Communications Technology and Disaster Risk Reduction Division of ESCAP.

In addition, substantive comments were provided by Teddy Woodhouse and Nathalia Foditsch, under the guidance of Eleanor Sarpong, Deputy Director and Policy Lead of A4AI.

The manuscript was edited by Christine Apikul. The graphic design and layout were prepared by Xiao Dong and Yin Qi. Administrative support on the issuance of the report was provided by Tarnkamon Chantarawat and Sakollerd Limkriangkrai.

September 2021

Photo Credit: Cover – Shutterstock 713649202



Abbreviations and Acronyms

A4AI	Alliance for Affordable Internet
ADB	Asian Development Bank
BAKTI	Badan Aksesibilitas Telekomunikasi dan Informasi (Telecommunications and Information Accessibility Agency)
BPPPTI	Balai Penyedia dan Pengelola Pembiayaan Telekomunikasi dan Informatika (Telecommunications and Informatics Financing Provider and Management Centre)
BTIP	Balai Telekomunikasi dan Informatika Perdesaan (Rural Telecommunications and Information Centre)
ENEA	East and North-East Asia
ESCAP	Economic and Social Commission for Asia and the Pacific
GNI	Gross National Income
GSMA	Global System for Mobile Communications Association
ICCC	Independent Consumer and Competition Commission
ICT	Information and Communications Technology
ITU	International Telecommunication Union
NCA	North and Central Asia
OECD	Organisation for Economic Co-operation and Development
PNG	Papua New Guinea
SEA	South-East Asia
SSWA	South and South-West Asia
USO	Universal Service Obligation
USOF	Universal Service Obligation Fund

Table of Contents

Acknowledgements	I
Abbreviations and Acronyms	II
Table of Contents	III
List of Tables	IV
List of Figures	V
Executive Summary	VII
1. Meaningful Connectivity	1
2. Progress towards Meaningful Connectivity in ESCAP Subregions	6
3. Asia-Pacific Country Case Studies	15
4. Conclusion	34
Appendix: 1 for 2 Calculations	38

List of Tables

Table 1: Concept of Meaningful Connectivity.....2

Table 2: Internet speed in the Philippines.....3

Table 3: Towards Meaningful Connectivity in Bhutan.....18

Table 4: Towards Meaningful Connectivity in Indonesia.....22

Table 5: Towards Meaningful Connectivity in Kyrgyzstan.....25

Table 6: Towards Meaningful Connectivity in Mongolia.....28

Table 7: Towards Meaningful Connectivity in PNG.....33

Table 8: Key findings of country studies.....35

List of Figures

Figure 1: GSMA Mobile Connectivity Index's 4G coverage score in ESCAP subregions	3
Figure 2: Fixed-broadband subscriptions and Internet traffic consumption in ESCAP subregions.....	4
Figure 3: Internet download speed in ESCAP subregions.....	7
Figure 4: GSMA Mobile Connectivity Index's Internet-enabled device affordability score in ESCAP subregions.....	7
Figure 5: Fixed-broadband access in ESCAP subregions.....	8
Figure 6: GSMA Mobile Connectivity Index's 4G coverage and affordability scores in ESCAP subregions.....	8
Figure 7: Socioeconomic indicators of East and North-East Asia.....	9
Figure 8: Socioeconomic indicators of North and Central Asia	10
Figure 9: Cost of mobile-broadband data (1Gb) and urbanization level in North and Central Asia	10
Figure 10: Socioeconomic indicators of the Pacific	11
Figure 11: GSMA Mobile Connectivity Index's infrastructure score in ESCAP subregions.....	12
Figure 12: Socioeconomic indicators of South-East Asia.....	12
Figure 13: Cost of mobile-broadband data (1Gb) and urbanization level in South-East Asia.....	13
Figure 14: Socioeconomic indicators of South and South-West Asia.....	14
Figure 15: GSMA Mobile Connectivity Index's gender gap in mobile ownership score in ESCAP subregions.....	14
Figure 16: ICT indicators of Bhutan.....	16

Figure 17: Mobile-broadband subscriptions per 100 inhabitants in Bhutan	18
Figure 18: GSMA Mobile Connectivity Index's infrastructure score and urbanization level in Bhutan	19
Figure 19: ICT indicators of Indonesia	19
Figure 20: Palapa Ring Project in Indonesia.....	20
Figure 21: GSMA Mobile Connectivity Index's infrastructure score for Indonesia	22
Figure 22: ICT indicators of Kyrgyzstan	23
Figure 23: Mobile-broadband subscriptions per 100 inhabitants in Kyrgyzstan	25
Figure 24: ICT indicators of Mongolia	25
Figure 25: GSMA Mobile Connectivity Index's mobile ownership and basic skills scores in Mongolia.....	27
Figure 26: Mobile-broadband subscriptions per 100 inhabitants in Mongolia...	28
Figure 27: ICT indicators of PNG	29
Figure 28: GSMA Mobile Connectivity Index score for PNG	32

Executive Summary

Around 60 per cent of the world's population lives in the Asia-Pacific region – most in emerging or developing economies. The COVID-19 pandemic has impacted every country in the region to some degrees. Social distancing, school and office closures, and complete lockdowns have disrupted the lives of billions.

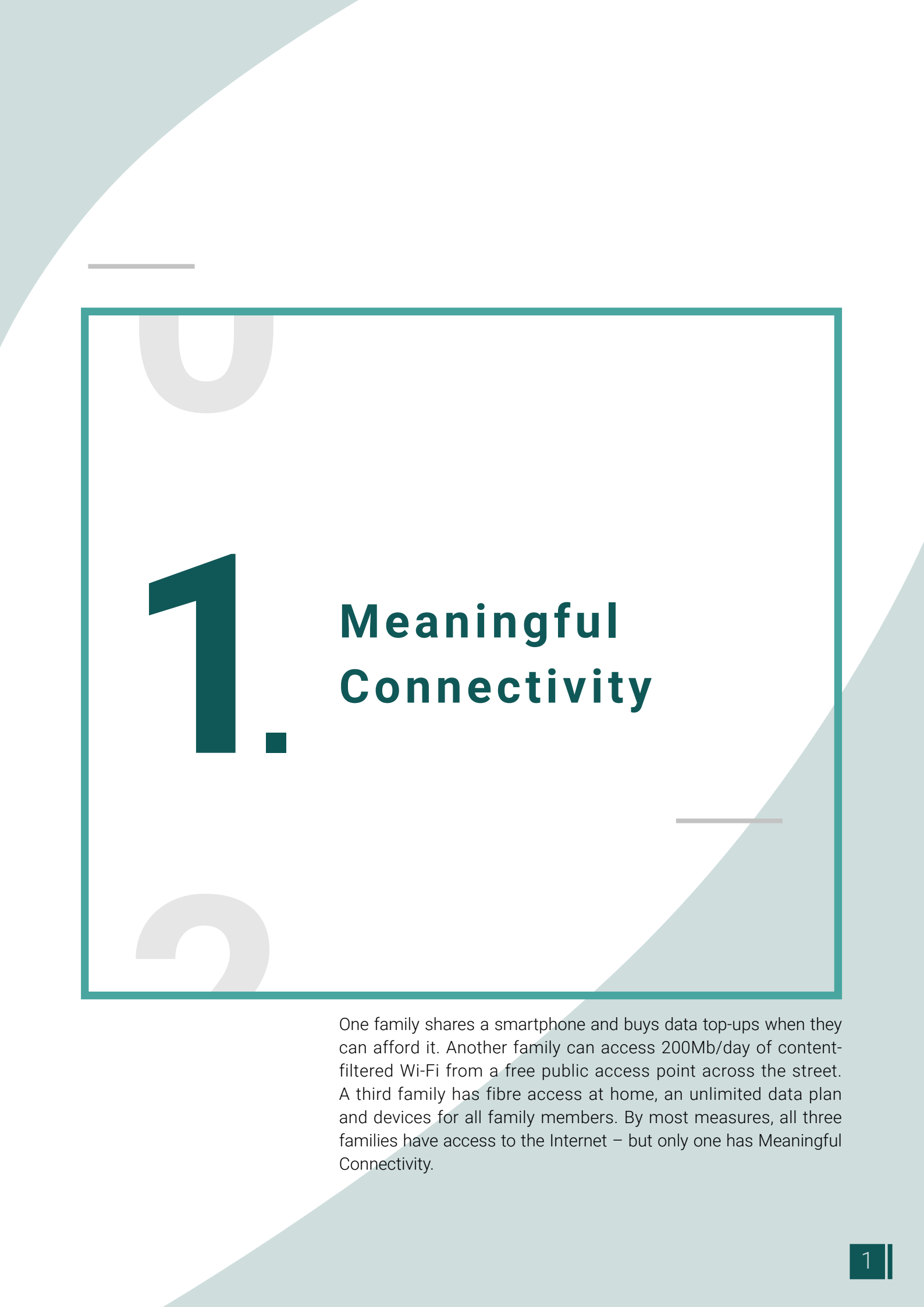
Access to the Internet has enabled many to continue to work, learn and socialize while living under some restrictions on movement and association. However, neither Internet services nor Internet accesses are universal, and not everyone has benefited. The World Bank's World Development Report 2021 has stated that more than 600 million people lived without access to the Internet in 2018.¹

Across the region, we find lower rates of infrastructure development in less urbanized countries, and lower rates of Internet utilization in low- and middle-income countries. Similar trends are visible at the subnational level even in high-income countries – digital inequalities based on wealth and geography still exist in most Asia-Pacific countries.

The objective of this report is to better understand the policy and regulatory environment for information and communications technology (ICT) in Asia-Pacific countries and its implication on Meaningful Connectivity to the Internet. The first section discusses the concept of Meaningful Connectivity developed by the Alliance for Affordable Internet (A4AI) with four measurable targets of: (1) access to a fast Internet connection; (2) access to an appropriate device; (3) access to enough data; and (4) regular Internet use. The second section assesses the state of digital connectivity in the subregions of the Economic and Social Commission for Asia and the Pacific (ESCAP) using the Meaningful Connectivity targets. This section also evaluates other ICT indicators to better understand the digital divide that exists between ESCAP subregions.

The third section analyses five country case studies – Bhutan, Kyrgyzstan, Indonesia, Mongolia and Papua New Guinea (PNG). It discusses the ICT policy and regulatory environment in each country and highlights the Meaningful Connectivity targets that have been achieved. Each country represents one of the ESCAP subregions, and country selection was based on the availability of data, and the development and implementation of a domestic policy that contributes to at least one of the Meaningful Connectivity targets. The fourth section concludes with highlights of good policies implemented that may be useful lessons learnt for other countries in the region.

The key findings of the report indicate that there are large variations in the availability and affordability of digital connectivity in the Asia-Pacific region. It highlights that domestic ICT policies, such as introduction of competition in the mobile market and higher investment in education that leads to higher digital literacy and Internet adoption, play an important role. It also highlights that favourable conditions for Meaningful Connectivity are not solely tied to a country's income level or population density – some countries significantly outperform their peers. These findings have important policy implications for Asia-Pacific countries in ensuring that quality and affordable broadband access is achieved for sustainable development.



1.

Meaningful Connectivity

One family shares a smartphone and buys data top-ups when they can afford it. Another family can access 200Mb/day of content-filtered Wi-Fi from a free public access point across the street. A third family has fibre access at home, an unlimited data plan and devices for all family members. By most measures, all three families have access to the Internet – but only one has Meaningful Connectivity.

1.1 The Alliance for Affordable Internet (A4AI)

A4AI is a technology sector alliance working on lowering the cost of broadband. A4AI has more than 80 members from private, public and non-profit organizations around the world. Their primary levers for influencing the cost of broadband are policy advocacy, direct engagement with governments and publication of research. A4AI asserts that good policy and regulatory practices can lower broadband costs, and that broadband access matters with respect to achievement of the Sustainable Development Goals. A4AI promotes open and competitive markets, policies that lower industry cost structures, and policies that promote Internet freedom and rights of free expression online.

1.2 The Meaningful Connectivity Concept

A4AI developed the concept of Meaningful Connectivity to raise the bar on the quality of Internet access. A set of thresholds across four dimensions was established (see Table 1) that should be met in order to ensure people not only just have Internet access, but useful and equitable Internet access.

The basis of A4AI's measurement for Meaningful Connectivity indicators is household surveys that can provide gender-disaggregated data for the four dimensions.

Table 1: Concept of Meaningful Connectivity

	Minimum threshold
A fast connection	4G mobile connectivity
An appropriate device	Access to a smartphone
Enough data	Unlimited broadband at home or a place of work or study
Regular Internet use	Daily use

Source: A4AI.

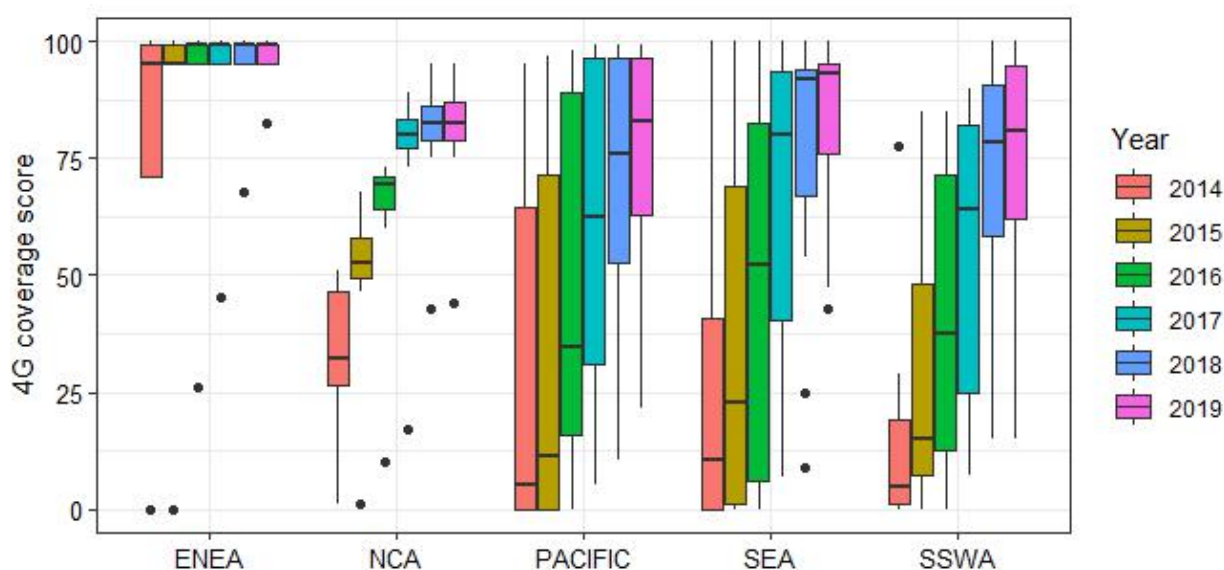
1.3 A Fast Connection

A fast connection is one that supports applications like streaming videos online, in addition to web browsing. Such applications require broadband connectivity, which the International Telecommunication Union (ITU) considers to be data speed rates greater than 2Mbps.² Fixed-line connections have been delivering broadband for more than twenty years with technologies like ADSL³ and DOCSIS,⁴ but mobile networks only began offering broadband after 3GPP Release 8⁵ in December 2008. LTE-based mobile broadband has been available for twelve years now, but it is by no means a universal service in all countries of the Economic and Social Commission for Asia and the Pacific (ESCAP), as illustrated by data from the Global System

for Mobile Communications Association (GSMA) in Figure 1.

A4AI's methodology guide for Meaningful Connectivity⁶ suggests measuring access to a fast connection via direct survey, which enables further disaggregation along gender and geography as may be relevant in certain markets. When that data is not available, broadband speed test data can be used as a proxy for this target to provide a general estimate of the national context, although this strategy may lack some of the disaggregation mentioned and will likely include a wider range of connection types. Such data is available directly from organizations like Ookla, Netflix, OpenSignal and Google, or via reports issued by organizations like GSMA and the Economist Intelligence Unit.

Figure 1: GSMA Mobile Connectivity Index's 4G coverage score in ESCAP subregions



Notes: Dots and whiskers (lines outside the box) are the outliers for each sample. The interquartile range (width of the box) is the midspread (50 per cent) of each sample with the line inside the box indicating the median value of the sample. ESCAP subregions include: East and North-East Asia (ENEA), North and Central Asia (NCA), Pacific (PACIFIC), South-East Asia (SEA), and South and South-West Asia (SSWA).

Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

Speed test data can suffer from quality issues including self-selected participants and skew, where a few fast connections influence the mean average of a group that contains many slow connections. Table 2 presents divergent speed test data sets for the Philippines in 2020 to illustrate the point.

This analysis considers Google's speed data when evaluating ESCAP subregions and countries, as Google presents a median result and publishes specific details on its sampling.

Table 2: Internet speed in the Philippines

Source	Measure	Samples	Speed
Ookla Q3-Q4 2020 ⁷	Average Mobile Speed	4m local	17.4 Mbps
Netflix Q3-Q4 2020 ⁸	ISP Speed Index Leaderboard	Unpublished	3.0 Mbps
OpenSignal May 2020 ⁹	Mobile Experience	87b global	8.5 Mbps
Google NDT 2020 ¹⁰	Median Speed	22m local	3.0 Mbps

Source: Authors' consolidation of different sources as detailed in each endnote.

1.4 An Appropriate Device

Before the advent of mobile broadband, Internet users had few options but laptops or desktop computers. Today the device of choice for Internet access is a smartphone. Affordability can be an adequate predictor of whether a population might have access to an appropriate device. GSMA considers smartphone affordability threshold to be 5 per cent of income.¹¹

Multiple surveys track entry-level or average smartphone pricing, but pricing is not always the only factor. Only a survey can capture whether economic and social barriers are also impacting access. Across low- and middle-income countries, women are 20 per cent less likely to own a smartphone or use the Internet on a mobile device compared to men.¹² Analysis later in the report identifies ESCAP subregions and countries where this challenge is acute.

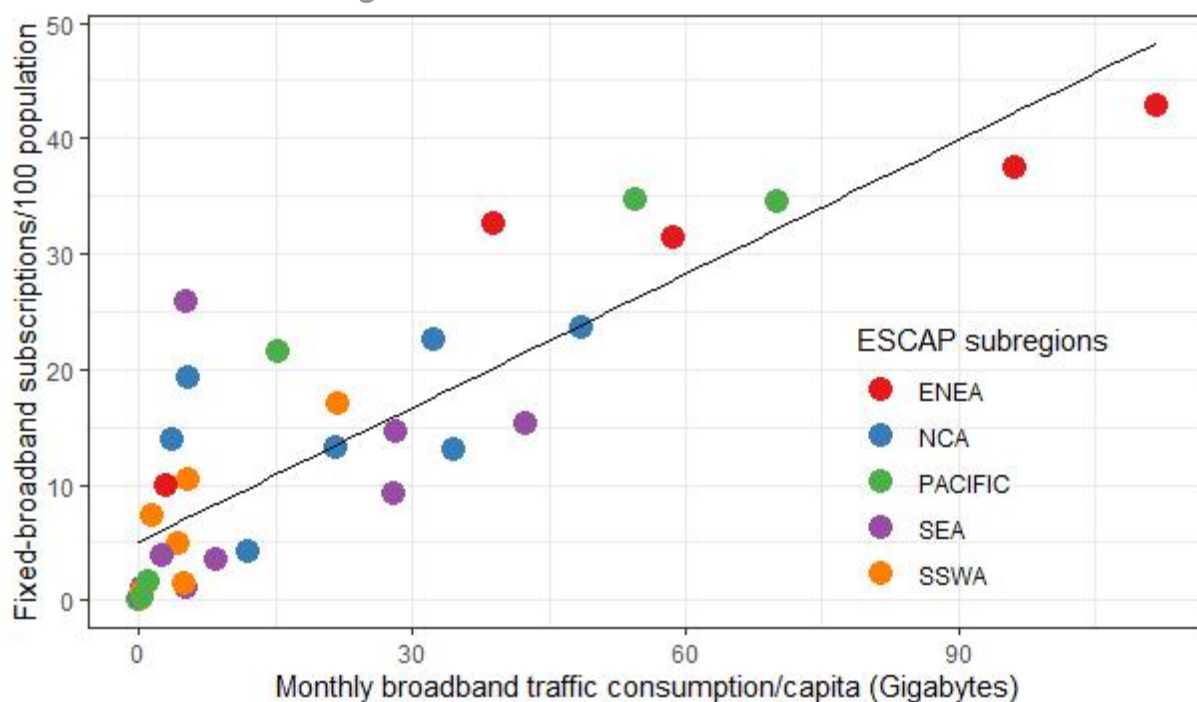
1.5 Enough Data

Mobile networks, based on the scarce resource of radio spectrum, rarely offer unlimited data connections, instead choosing to sell data in small bundles. Fixed networks have fewer resource restraints and most often offer unlimited connections. ITU reports on fixed-broadband connections around the world and on annual traffic consumption. When viewed together, these statistics show a clear association between higher levels of fixed-broadband connections and higher levels of traffic consumption (see Figure 2).

Access to fixed-line broadband at home, work or school satisfies A4AI's threshold of "enough data". High levels of fixed-broadband penetration in a country generally equal high levels of Meaningful Connectivity.

In countries with low levels of fixed-line infrastructure, mobile tariffs have an impact

Figure 2: Fixed-broadband subscriptions and Internet traffic consumption in ESCAP subregions



Source: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

on whether or not people might have enough data. ITU and A4AI have partnered to collect data and analyse affordability trends covering mobile- and fixed-broadband technologies. Affordability is measured using fixed- or mobile-broadband prices expressed as a percentage of monthly gross national income (GNI) per capita.¹³

A4AI uses a “1 for 2” threshold for affordable Internet,¹⁴ which posits that mobile data is affordable in a country if one gigabyte can be purchased for less than two per cent of the country’s monthly GNI per capita. A4AI’s 1 for 2 target was subsequently adopted by the United Nations Broadband Commission for Sustainable Development in 2018 as the new affordability target of the United Nations.¹⁵ The 1 for 2 target is referred to throughout

this report. The lower a country’s 1 for 2 score, the more likely its population is to have access to Meaningful Connectivity. A table of measurements for ESCAP countries with missing data from the A4AI data set has been calculated from ITU data and presented in the Appendix.

1.6 Regular Internet Use

A4AI’s final threshold for Meaningful Connectivity is that of regular use. Their recommendation is that people be able to use the Internet on a daily basis. Preconditions for daily use are generally a function of the framework’s first three dimensions: a fast connection, an appropriate device and enough data.

2. Progress towards Meaningful Connectivity in ESCAP Subregions

The secondary data described in the previous section allows us to draw some comparisons between ESCAP subregions and their likely progress towards several Meaningful Connectivity goals. After a brief review of general subregional statistics, this section explores each of the subregions in more detail.

2.1 ESCAP Subregions' Progress by Meaningful Connectivity Dimensions

2.1.1 Progress towards a Fast Connection

Based on data from Google's Measurement Lab, residents of East and North-East Asia (ENEA) and South-East Asia (SEA) are most likely to have connections meeting A4AI's entry-level threshold. Residents of other subregions are far less likely to have connection speeds meeting A4AI's fast connection threshold as demonstrated in Figure 3.

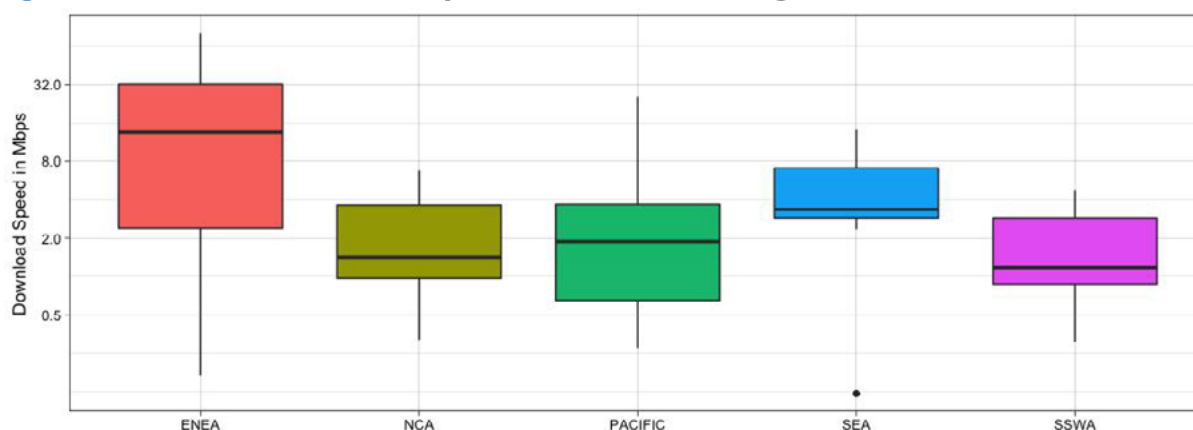
2.1.2 Progress towards an Appropriate Device

GSMA's comparative affordability statistics for Internet-enabled mobile devices find high device affordability in the ENEA subregion and below-average levels of affordability in other subregions. By this measure, residents of ENEA countries are more likely to have an appropriate device than residents of any other subregion (see Figure 4).

2.1.3 Progress towards Enough Data

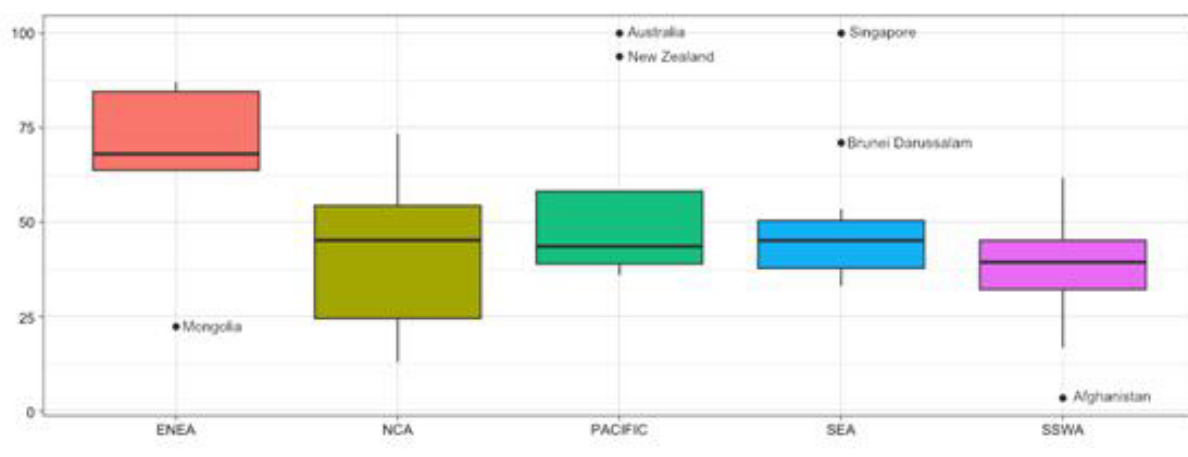
Mobile devices are most often used by a single individual, but fixed connections are generally shared by a household. This means

Figure 3: Internet download speed in ESCAP subregions



Source: Google, "mLab Global Dashboard, Median Download Speed 30 Dec 2019 – 25 Oct 2020". Available at <https://www.measurementlab.net/>.

Figure 4: GSMA Mobile Connectivity Index's Internet-enabled device affordability score in ESCAP subregions



Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

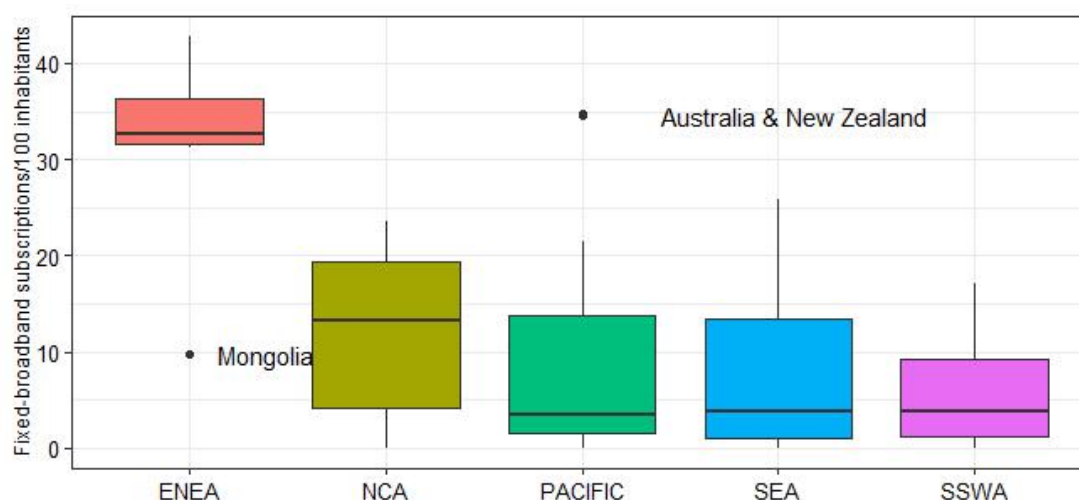
the impact of fixed-broadband subscriptions on a population is equal to the number of subscriptions multiplied by the population's household size. Based on ITU statistics, many people in North and Central Asia (NCA) and most in ENEA have access to enough data, while far fewer in other subregions have such access (see Figure 5).

regular use, is a statistic ideally measured through direct surveys or reported by mobile network operators. In the absence of specific statistics, regular use is often associated with coverage and affordability. The GSMA Mobile Connectivity Index shows that the ENEA subregion has the highest levels of both 4G coverage and affordability, while the South and South-West Asia (SSWA) subregion and the Pacific have the lowest (see Figure 6).

2.1.4 Progress towards Regular Internet Use

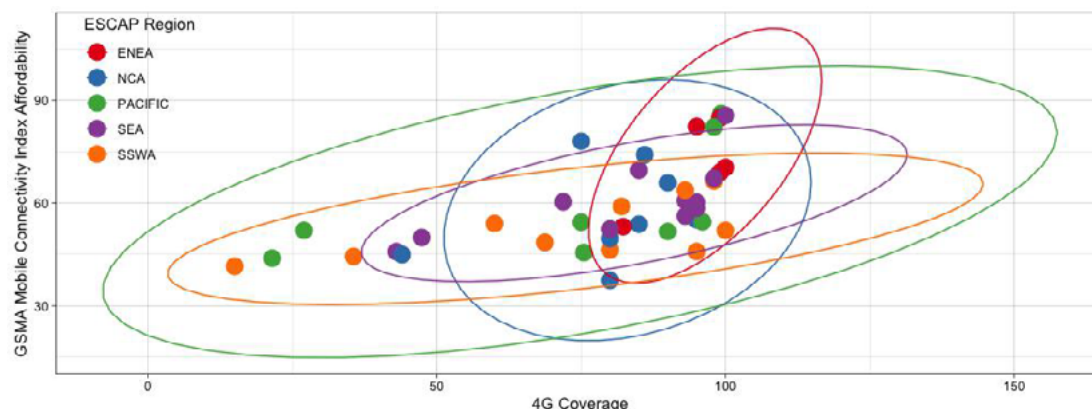
Daily use of the Internet, A4AI's threshold for

Figure 5: Fixed-broadband access in ESCAP subregions



Source: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Figure 6: GSMA Mobile Connectivity Index's 4G coverage and affordability scores in ESCAP subregions



Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

2.2 ICT Connectivity by ESCAP Subregions

2.2.1 East and North-East Asia

The ENEA subregion has exceptionally high levels of infrastructure development, and most of the world's leading telecommunications equipment and smartphone manufacturers are based in the subregion. With the exception of the Democratic People's Republic of Korea, all countries have mobile-broadband subscriptions nearly equal to or in excess of their population.¹⁶ All countries have mobile data rates of less than two per cent of GNI per capita for a gigabyte of data,¹⁷ and all have social media use exceeding 60 per cent of their populations.¹⁸

Fixed-broadband statistics are not available for the Democratic People's Republic of Korea and Mongolia is an outlier in the subregion for this category. Based on an average household size of 3.6 people, it is likely between 30-40 per cent of Mongolians have access to fixed-line broadband at home – a rate that is far lower than most countries in ENEA, but on par with countries in NCA and exceeding the median of other ESCAP subregions.

Widely available 4G services, low data charges, high levels of smartphone ownership and low gender gaps in smartphone ownership are good indicators that Meaningful Connectivity targets are being met in most ENEA countries.

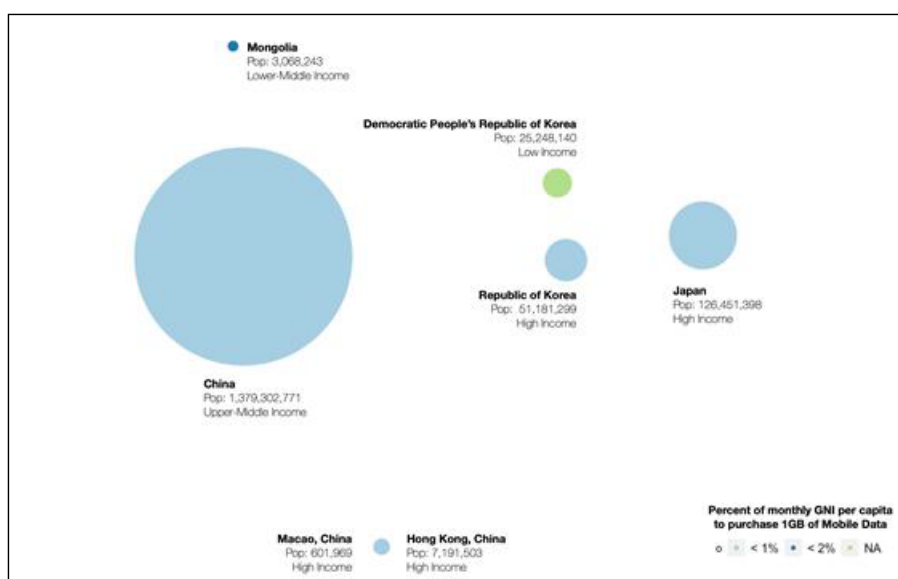
2.2.2 North and Central Asia

The GSMA Mobile Connectivity Index shows that all NCA countries have average levels of mobile infrastructure development, except Turkmenistan. ITU reports that regulatory quality¹⁹ is strong in Georgia, Armenia and Kyrgyzstan, but comparatively weak elsewhere.

Mobile broadband penetration is average to high outside of Tajikistan and Turkmenistan. Mobile data is affordable by A4AI's 1 for 2 threshold in most countries, but exceeds 2 per cent of GNI per capita in Tajikistan, Turkmenistan and Uzbekistan.

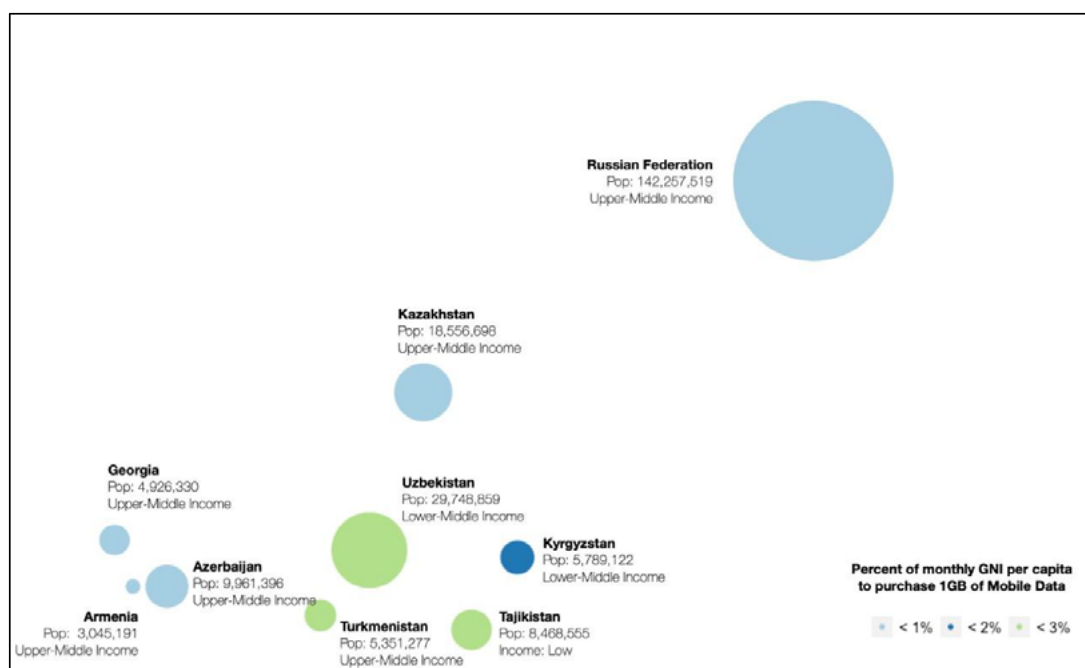
Affordability in the NCA subregion is closely tied to urbanization rates (see Figure 9). Gender equality in access to mobile communications is also strong in most countries, and levels of Meaningful Connectivity are likely high and growing in all but Tajikistan and Turkmenistan.

Figure 7: Socioeconomic indicators of East and North-East Asia



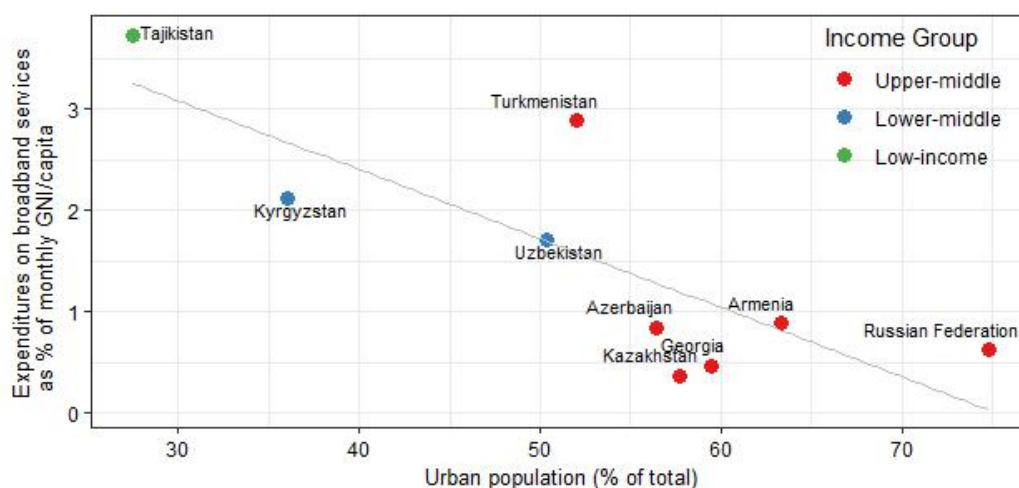
Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and Kelly O'Neill, "Harvard University World Map Country Centroids". Available at <http://worldmap.harvard.edu/profiles/koneill/>.

Figure 8: Socioeconomic indicators of North and Central Asia



Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and Kelly O'Neill, "Harvard University World Map Country Centroids". Available at <http://worldmap.harvard.edu/profiles/koneill/>.

Figure 9: Cost of mobile-broadband data (1Gb) and urbanization level in North and Central Asia



Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni.

2.2.3 The Pacific

The Pacific has more than a third of all ESCAP member countries but less than one per cent of its inhabitants. Residents of the Pacific live in vastly different circumstances: urbanization ranges from 13 to 100 per cent; countries range in population from 1,600 to 24 million; and at different levels of development (see Figure 10).

Tracking key indicators in United States, French and New Zealand associated territories can be difficult due to low availability of ITU statistics. With the exception of Guam, these economies have low levels of competition and high prices, but it is possible that their higher incomes enable some populations to enjoy Meaningful Connectivity and support from the United States, France and New Zealand.

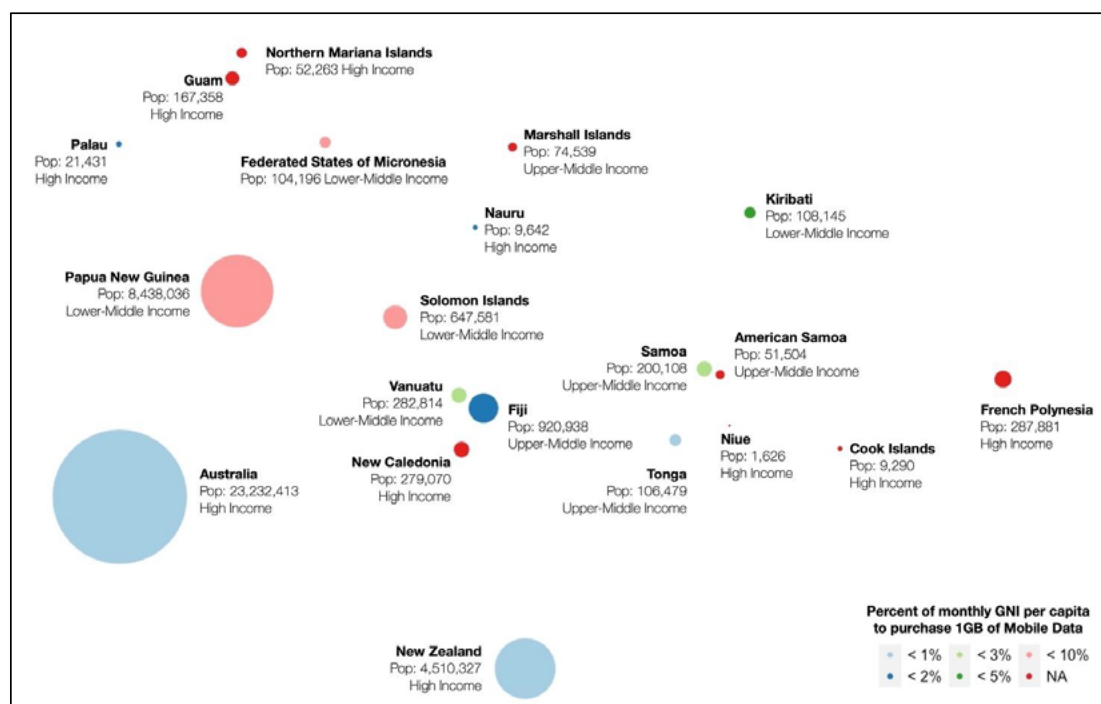
Pacific island countries are geographically dispersed and remote, difficult to connect to the world and service, and rarely have strong competition in their markets – while Australia and New Zealand are increasingly part of the world's global Internet infrastructure. As

a result, variations in mobile infrastructure levels between Pacific countries are greater compared to other ESCAP subregions. The infrastructure scores of the GSMA Mobile Connectivity Index illustrate the point well (see Figure 11). While median infrastructure scores in the Pacific are equal to those of SSWA, the interquartile range of scores (width of the box) in the Pacific is nearly double.

For the ESCAP Pacific island countries where data is available, a gigabyte of data ranges in cost from 0.25 per cent of GNI per capita in New Zealand up to 11.97 per cent of GNI per capita in the Solomon Islands. Levels of Meaningful Connectivity vary significantly, and PNG represents the most challenging situation of all ESCAP subregions.

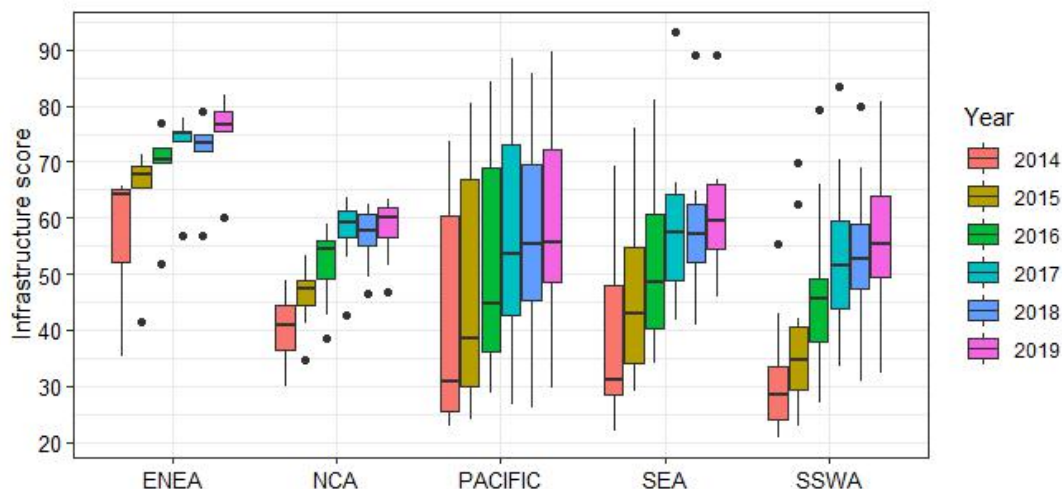
PNG has the lowest levels of urbanization and the least amount of infrastructure per capita in all of Asia-Pacific. About 70 per cent of its population lives in rural and remote areas and often without electricity. PNG's journey towards modernization will be discussed in the context of market reforms later in Section 3.5.

Figure 10: Socioeconomic indicators of the Pacific



Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and Kelly O'Neill, "Harvard University World Map Country Centroids". Available at <http://worldmap.harvard.edu/profiles/koneill/>.

Figure 11: GSMA Mobile Connectivity Index's infrastructure score in ESCAP subregions



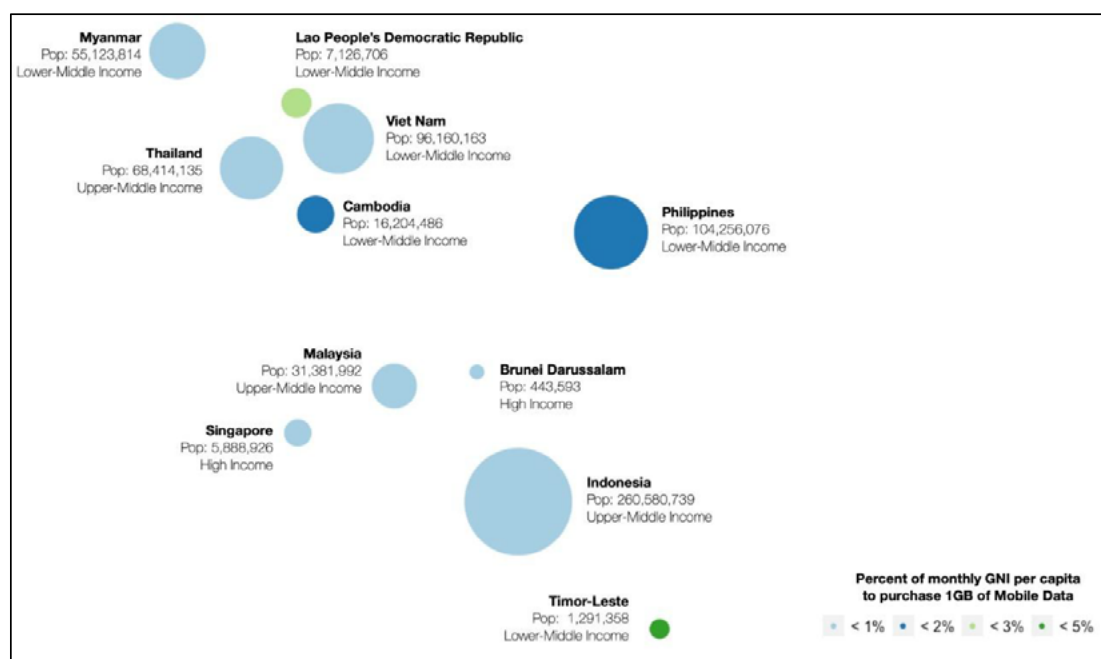
Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

2.2.4 South-East Asia

There are over half a billion residents in the SEA subregion, spread across the Greater Mekong Subregion and more than 8,000 inhabited islands.

SEA is a mobile-first subregion, and is behind the northern Asian subregion by ten years or more in the penetration of fixed-line broadband. With the exception of Timor-Leste, all countries in the subregion have median download speeds exceeding 2 Mbps, and all

Figure 12: Socioeconomic indicators of South-East Asia



Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and Kelly O'Neill, "Harvard University World Map Country Centroids". Available at <http://worldmap.harvard.edu/profiles/koneill/>.

meet A4AI's 1 for 2 affordability threshold, with higher rates of urbanization associated with lower cost of data (see Figure 13). Meaningful Connectivity is generally restricted to urban areas with 4G coverage.

Gender equality in SEA, an important component of Meaningful Connectivity, is comparable with the NCA subregion and the Pacific. However, gender equality in SEA trails the ENEA subregion, but far exceeds the SSWA subregion.

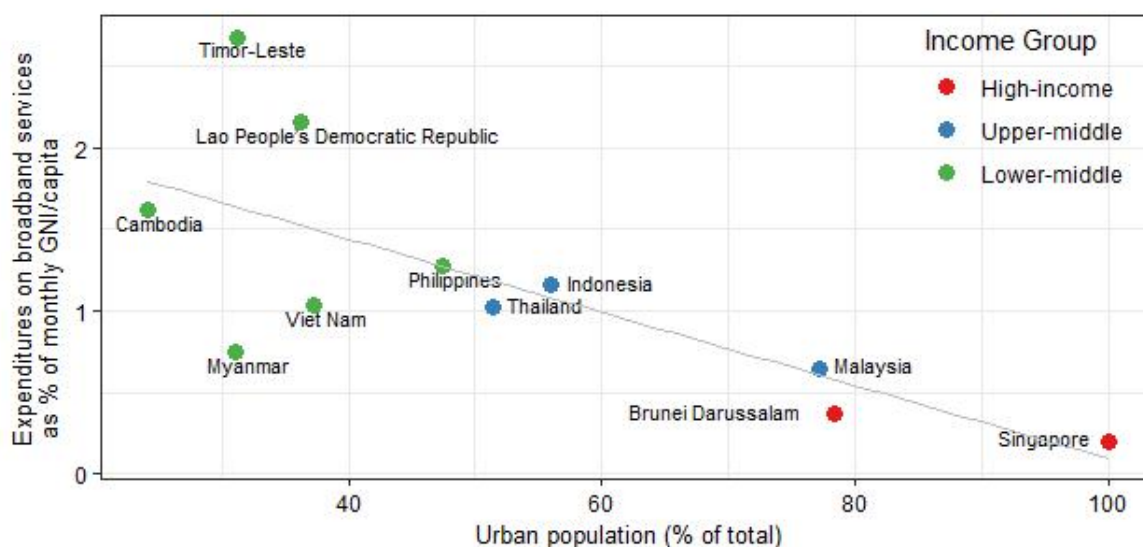
2.2.5 South and South-West Asia

A quarter of the world's population lives in the SSWA subregion. Outside Turkey and the Islamic Republic of Iran – the subregion's

two most developed countries, most of the population resides in rural areas. The past five years has seen affordability amongst less developed nations improve – especially in India, but SSWA still trails other subregions in access levels, notwithstanding highly affordable broadband in all countries but Afghanistan by A4AI's 1 for 2 threshold.

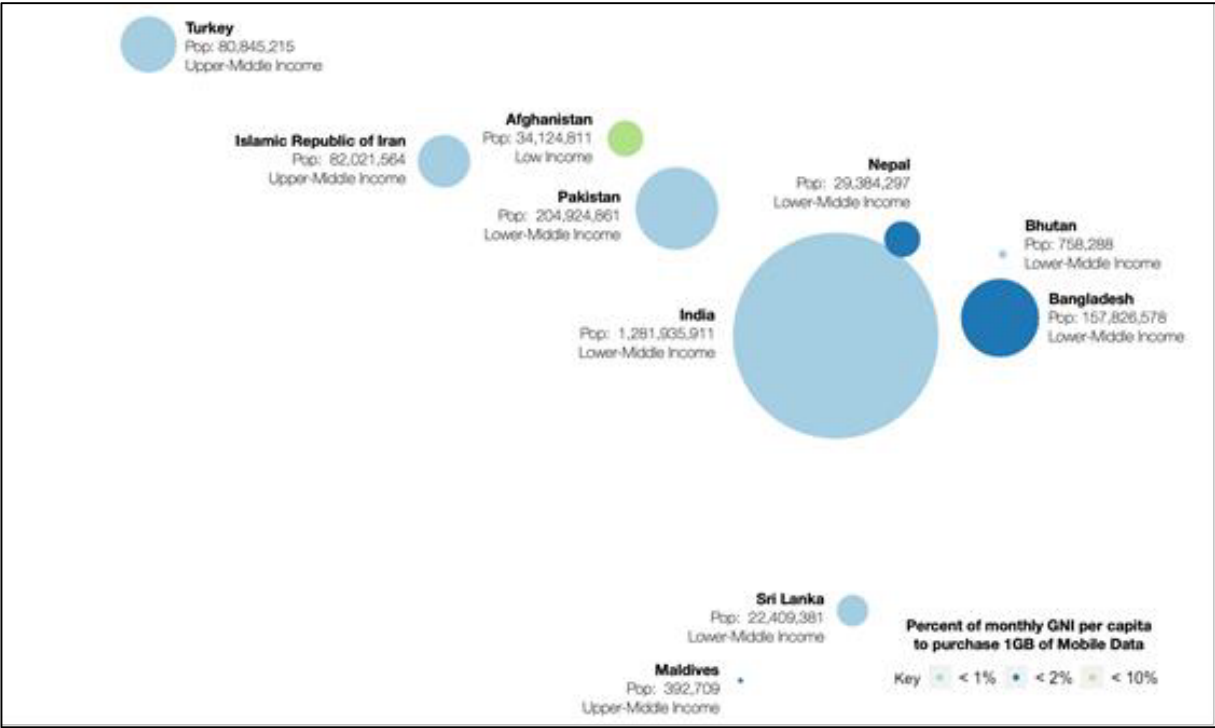
The SSWA subregion has the lowest rates of mobile ownership amongst women of all ESCAP subregions, with most high-performing countries not even reaching median scores seen in the rest of Asia-Pacific (see Figure 15). Increasing gender equality in the subregion is as important to promoting Meaningful Connectivity as building more infrastructure and lowering prices.

Figure 13: Cost of mobile-broadband data (1Gb) and urbanization level in South-East Asia



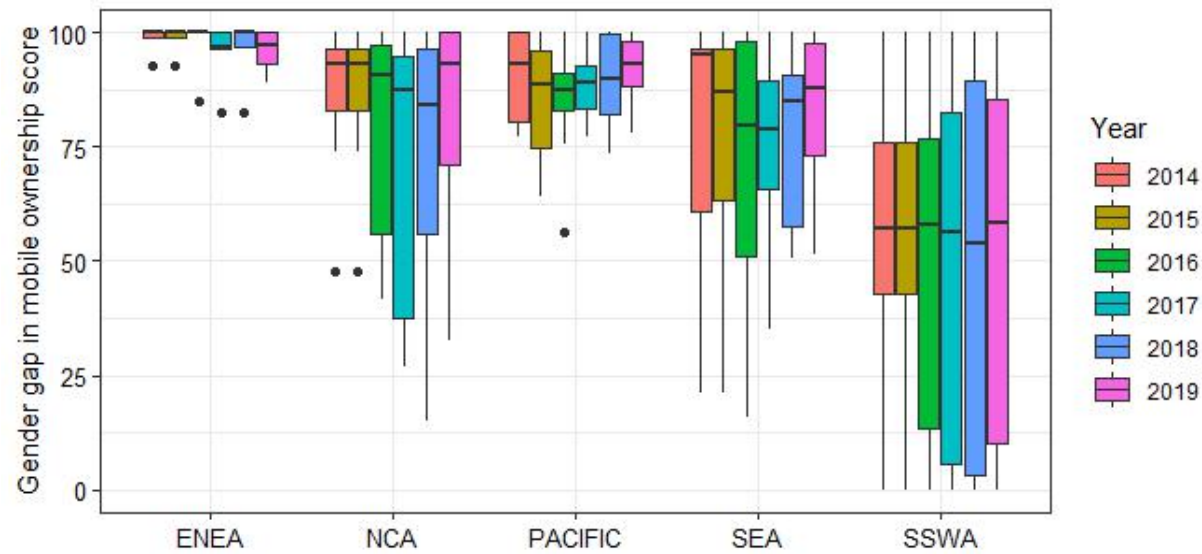
Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni.

Figure 14: Socioeconomic indicators of South and South-West Asia



Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and Kelly O'Neill, "Harvard University World Map Country Centroids". Available at <http://worldmap.harvard.edu/profiles/koneill/>.

Figure 15: GSMA Mobile Connectivity Index's gender gap in mobile ownership score in ESCAP subregions



Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex>.

3. Asia-Pacific Country Case Studies

According to A4AI studies, effective policy and regulatory practices can lower broadband costs. Recommendations on such practices come from a wide range of public, private and non-profit organizations. Some date from the early days of market liberalization, while others are a product of the Internet age.

A4AI encourages open and competitive markets, and policies that promote Internet freedom and rights of free expression. A4AI maintains a database of “good practices”,²⁰ which includes examples of national broadband plans and infrastructure sharing that are examined in this section on Kyrgyzstan and Bhutan, respectively. Open access networks are visited in the sections on Bhutan and PNG, and Universal Service Obligation Funds (USOFs) in the section on Indonesia.²¹ This section also looks at the countries’ performance in ITU’s ICT Regulatory Tracker that scores its member countries’ regulatory environments according to their regulatory authority, mandate, regulatory regime and competition frameworks.

One country has been chosen from each ESCAP subregion based on their clear implementation of an identified good policy practice, and the association of that policy practice in the literature with high-performing countries worldwide. Every country case reviewed aligns with at least one recommendation from the Broadband Commission. Bhutan, Kyrgyzstan and Mongolia in particular, have been singled out as leaders in mobile-broadband adoption amongst low- and lower-middle-income countries in their subregions. While it is not possible to draw a causal link between policies implemented long ago with performance today, it is worth considering that

implementation of recognized good practices could have contributed to their success.

Each country is introduced and described in terms of its population, regulatory environment, broadband adoption, cost of mobile data and median Internet speeds. The basis for evaluation of each country is statistics from ITU and GSMA, and urbanization data from the World Bank. GSMA statistics are given particular attention in this report as Meaningful Connectivity is dependent on mobile-broadband connectivity, and GSMA is one of the few studies that collects gender-disaggregated data. A4AI’s 1 for 2 data is from A4AI and missing data in certain countries are calculated using data from the ITU World Telecommunication/ICT Indicators Database, and reproduced in full in the Appendix.

3.1 Bhutan

Bhutan is a small, mountainous kingdom to the north of India’s Assam province and to the south of People’s Republic of China Tibet Autonomous Region. Its mainly rural population of around 760,000 is dwarfed by the 2.7 billion of its neighbours. Bhutan has one of the world’s younger telecommunications systems, its first national backbone was completed in 1998,²² with support from the Government of Japan.²³

Figure 16: ICT indicators of Bhutan



Note: Bhutan’s position is in red relative to statistics of ESCAP countries ranked from lowest to highest in each data point.

Sources: ITU, “World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)”. Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; ITU, “ICT Regulatory Tracker”. Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019>; World Bank, “World Development Indicators”. Available at <https://databank.worldbank.org/source/world-development-indicators>; and Google Measurement Lab, “mLab Global Dashboard 2020”. Available at <https://www.measurementlab.net/>.

3.1.1 Overview of ICT Regulations and Plans

Bhutan began telecommunications market liberalization in 1999 with the Bhutan Telecommunications Act 2006. The year 2007 brought more changes with the passing of the Information, Communications and Media Act and the awarding of a competitive telecommunications licence to Tashicell. The same year also saw the evolution of its regulator, the Bhutan InfoComm and Media Authority, into an autonomous organization.

By 2009, the government recognized, in respect to improvement of its national backbone and promotion of competition on a national basis, that: "Investment in the fibres cannot be commercially viable for any operator".²⁴ An executive order was issued consolidating the fibre assets of two government-owned companies – Bhutan Telecom and Bhutan Power Corporation.²⁵ A National Broadband Masterplan was created documenting an initiative to connect all twenty of its districts and 201 of its 205 groups of villages to a new fibre backbone built on electrical transmission assets.

Implementation of the plan was assigned to the Department of Information Technology, a division of the Ministry of Information and Communications, which outsourced the fibre backbone construction work through a competitive bidding process. Around USD11 million have been spent on the network.²⁶ Maintenance of the physical infrastructure has fallen to the national power corporation, who is granted use of six fibres in exchange for its work.

Uniquely amongst governments in the ESCAP region, if not in the world, the Ministry of Information and Communications has set the tariff for use of the national backbone by licenced telecommunications operators to zero – assigning universal service conditions to users of the fibre instead of collecting payment. The key condition for universal service is: "A lessee shall take managed services to all 20 dzongkhags using the fibre

infrastructure within a reasonable amount of time. This is to ensure a level playing field for all service providers and fair competition".²⁷

3.1.2 Framework for Infrastructure Sharing

In recognizing the need for a shared national backbone, the Government of Bhutan aligned to solve several well-known problems in utilities and telecommunications. National networks in mountainous rural nations like Bhutan are a monopolistic bottleneck²⁸ – a natural monopoly requiring considerable sunk costs with no economic possibilities for bypass. Dominant players owning critical infrastructure can abuse their positions.²⁹ Yet, infrastructure sharing can help reduce capital expenditure.³⁰

Backbone network enhancement has multiple motivations driving demand and investment.³¹ "Government has a key role to play in facilitating ... effective use of infrastructure assets and in identifying parts of the country where there are gaps and getting coverage extended to them".³²

The principle of infrastructure sharing for broadband networks has been put forward as a good practice numerous times since Bhutan started its project, notably in the Broadband Commission's recommendations. Bhutan's approach to granting access to the infrastructure through universal service commitments instead of payment is however unique.

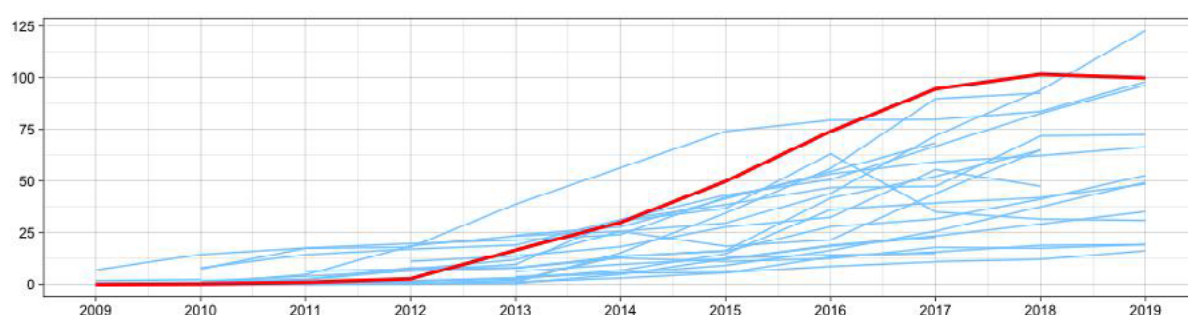
3.1.3 Infrastructure Sharing Policy Efficacy

As reported in the ITU World Telecommunication/ICT Indicators Database, the increase in mobile-broadband penetration in Bhutan since 2012 has been phenomenal. By this measure, Bhutan leads its region and is second only to Kyrgyzstan amongst low- and lower-middle-income ESCAP countries (see Figure 17).

Looking at GSMA's statistics and A4AI's 1 for 2 metrics, Bhutan excels at meeting Meaningful Connectivity targets in access to broadband and gender equality, compared with its neighbours (see Table 3). Although India has achieved greater 4G coverage and a lower cost for data, the high levels of inequality in India mean that a far smaller percentage of the population can participate.

The GSMA Mobile Connectivity Index's infrastructure score shows that Bhutan's performance is higher than a number of wealthier, more urbanized and developed countries (see Figure 18).

Figure 17: Mobile-broadband subscriptions per 100 inhabitants in Bhutan



Notes: Bhutan is represented by the red line. ESCAP low- and lower-middle-income countries are represented by the blue lines.

Source: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>

Table 3: Towards Meaningful Connectivity in Bhutan

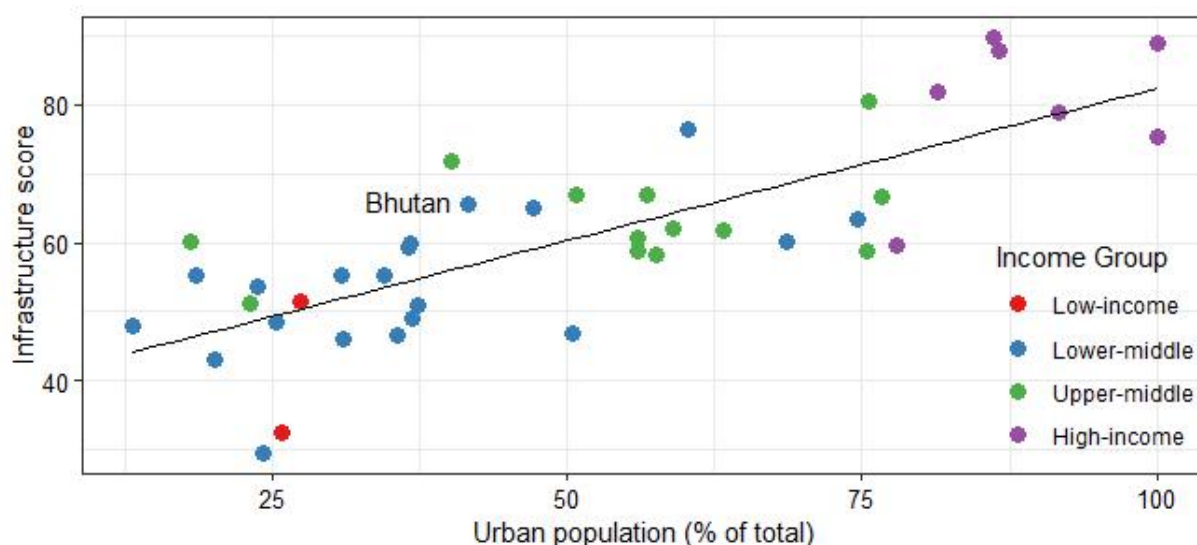
	GSMA mobile-broadband connection (% penetration)	GSMA 4G coverage score*	GSMA gender equality score*	A4AI affordability of mobile-broadband data (1 Gb) as % of GNI per capita
Bhutan	88	60.0	69.0	0.74**
Nepal	59	35.6	63.9	2.55
Bangladesh	50	80.0	35.8	1.39
India	53	98.0	43.9	1.05

Notes: * – All GSMA indicators with scores have been normalized to have a value within a range of 0 to 100 by GSMA.

** – Authors' estimation based on data from ITU.

Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni; and ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Figure 18: GSMA Mobile Connectivity Index's infrastructure score and urbanization level in Bhutan



Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; and World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>.

3.2 Indonesia

More than 5,000 kilometres separate the eastern and western most borders of Indonesia, the world's largest archipelagic nation. Its population of over 260 million people, the fourth largest in the world, is

spread across 6,000 of its 17,000 islands. In terms of complexity of delivering telecommunications services, Indonesia is in a class of its own, requiring a plethora of submarine cables, microwave towers and satellite links.

Figure 19: ICT indicators of Indonesia

Population		260,580,739
Urban population (% of total)		56%
Fixed-broadband subscriptions		3.48 per 100 inhabitants
Mobile-broadband subscriptions		81.2 per 100 inhabitants
Expenses as % GNI per capita		1.16% per month (1 Gb data)
mLab median speed download		3.16 Mbps
mLab median up speed download		1.91 Mbps
ITU regulatory authority score		16/20
ITU regulatory mandate score		13.5/22
ITU regulatory regime score		18/30
ITU competition framework score		25/28

Note: Indonesia's position is in red relative to statistics of ESCAP countries ranked from lowest to highest in each data point.

Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; ITU, "ICT Regulatory Tracker". Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and Google Measurement Lab, "mLab Global Dashboard 2020". Available at <https://www.measurementlab.net/>.

3.2.1 Overview of ICT Regulations and Initiatives

With its Telecommunications Law in 1999 (No. 36), Indonesia began liberalizing its telecommunications market. Article 16 of the law set out an obligation for telecommunications operators to contribute to universal services, but no mechanism was defined for the contribution. In 2003 (Decree No. 31), the Ministry of Communications created the Indonesian Telecommunications Regulatory Authority (Badan Regulasi Telekomunikasi Indonesia)³³ to act as regulator for both technical and competition issues. It became effective in January 2004 but encountered challenges due to its perceived lack of legal mandate and lack of independence from the Directorate General of Post and Telecommunications.³⁴

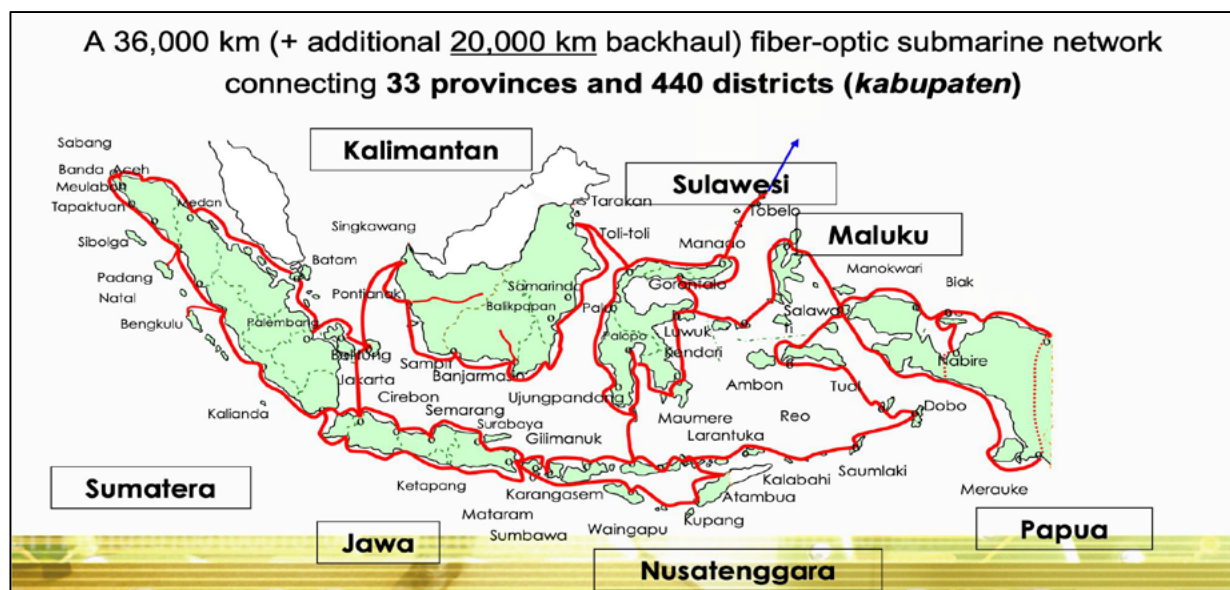
While Indonesia's Telecommunications Law did not explicitly define the universal service obligation (USO), a consultative process between government and industry eventually settled on a USOF based on a scheme of gross revenue-based contributions, codified in Regulation No. 28/2005. Governance of the USOF and design of the USO programme at establishment was initially criticized as weak,³⁵

which likely contributed to ITU's low scoring for Indonesia in its 2007 ICT Regulatory Tracker survey.

Administration of the USOF was addressed by the Ministry of Communications' Decree No. 35/2006, which created the Rural Telecommunications and Information Centre (Balai Telekomunikasi dan Informatika Perdesaan or BTIP).³⁶ The administrator, a unit within the Ministry of Communications, was tasked with ensuring the equal distribution of ICT networks throughout Indonesia. The most ambitious early initiative was the Palapa Ring Project, a national fibre-optic backbone that completed in 2019³⁷ (see Figure 20).

In 2010, BTIP was reformed as the Telecommunications and Informatics Financing Provider and Management Centre (Balai Penyedia dan Pengelola Pembiayaan Telekomunikasi dan Informatika or BPPPTI or BP3TI).³⁸ The centre began a number of projects aimed at providing rural and remote parts of Indonesia with access to public phones, mobile phones and broadband Internet. The framework for funding projects was based on least-cost subsidy of service-based contracts, with assets deployed,

Figure 20: Palapa Ring Project in Indonesia



Source: Basuki Yusuf Iskandar, "Indonesia's Initiatives to Deploy NGN", presentation made at the Global Symposium for Regulators, February 2007. Available at https://web.archive.org/web/20070221173649if_/http://www.itu.int:80/ITU-D/treg/Events/Seminars/GSR/GSR07/Documents_presentations/IndonesianitiavesdeployNGN-final.pdf

owned and managed by the operators. Funding arrangements took the form of five-year contracts with integral operations and maintenance, and management risk assigned to the operator.³⁹

In 2017, BPPPTI was reorganized again into the Telecommunications and Information Accessibility Agency (Badan Aksesibilitas Telekomunikasi dan Informasi or BAKTI), a government unit responsible for delivering infrastructure and ICT ecosystems to people in remote and rural areas of Indonesia. By this time, the USO programme included mobile base stations and satellite projects, in addition to the fibre backbone and other Internet projects.⁴⁰

3.2.2 Framework for USOs and USOFs

Generally, USOs and USOFs for telecommunications predate the widespread emergence of the Internet and broadband communications. Most were created as part of a market liberalization process. Prior to liberalization, governments could direct state-owned carriers to provide service where it was needed. Post liberalization, a legal framework was required to bind private, profit-driven companies delivering a public utility service.

USOs and USOFs are separate but related concepts. A USO might require an operator to offer fixed-line telephone services across an entire country at the same level of quality, availability and price. The USO might be a condition of licence, with the obligated operator expected to do its own internal cross-subsidization, applying profits from urban markets to unprofitable rural and remote ones, or providing accessibility services for the deaf and deaf-blind.

A USOF is intended to directly finance investments targeted by a government's universal service and access policies, often using performance-based subsidies to support service delivery by applying a minimum-subsidy action. In the case of infrastructure, a fund generally requires that a one-time subsidy results in a commercially viable, sustainable service.⁴¹ In a review of USOFs conducted in

2013, GSMA found a majority of 64 USOFs established in the 1990s or early 2000s. Chile was the earliest example cited – its USOF was established in 1982 to provide telephone service in 6,000 underserved locales.⁴²

USOFs have long been recognized as good practice by organizations including A4AI,⁴³ ITU,⁴⁴ USAID⁴⁵ and the World Bank.⁴⁶ The Broadband Commission noted approaches to universal service with its recommendations 2012 – 7.3, 2013 – 7.5, 2014 – 7.7, 2015 – 6.2 and 2016 – 6.4.

It is the consensus of most organizations that USOFs can have a positive impact on the development of telecommunications, however they are not free of criticism. GSMA found some USOFs to have poorly-conceived legal frameworks, while others have been subjected to political interference.⁴⁷ ESCAP noted weaknesses in some USOFs' design, structure and implementation.⁴⁸ They concluded that USOFs have been ineffective in expanding fixed-line broadband in middle-income countries, potentially due to their focus on expanding services in rural and remote areas, where fixed-line broadband is less practical than wireless.⁴⁹

3.2.3 USOF Policy Efficacy

Strong competition emerged early in Indonesia's mobile and fixed wireless markets. By 2007, there were nine mobile and five fixed wireless operators.⁵⁰ While the market has consolidated slightly in the intervening time, there were still seven active operators in 2021,⁵¹ with five publishing significant national coverage details on the GSMA website.⁵² Amongst developing and emerging economies in the region today, Indonesia has the most competitive market and the most affordable data.

Despite Indonesia's geographic challenges, it scores in the middle of the pack of its neighbours for affordability, 4G coverage and mobile-broadband penetration. From a Meaningful Connectivity perspective, gender equality is Indonesia's greatest challenge (see Table 4).

Table 4: Towards Meaningful Connectivity in Indonesia

	GSMA mobile-broadband connections (% penetration)	GSMA 4G coverage score*	GSMA gender equality score*	A4AI affordability of mobile-broadband data (1 Gb) as % of GNI per capita
Indonesia	113	95.0	71.3	1.16
Brunei Darussalam	100	85.0	78.4	0.37**
Malaysia	116	93.0	78.5	0.65
Singapore	149	100.0	90.3	0.20**
Thailand	135	98.0	88.5	1.02

Notes: * – All GSMA indicators with scores have been normalized to have a value within a range of 0 to 100 by GSMA.

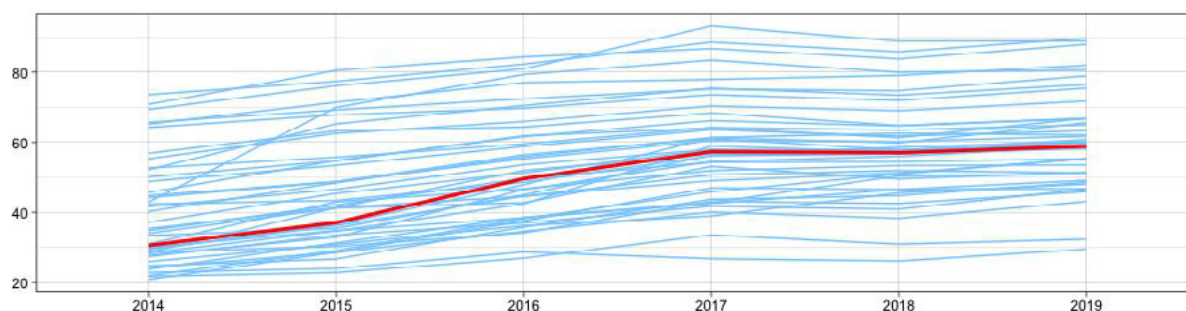
** – Authors' estimation based on data from ITU.

Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni; and ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

From an infrastructure perspective, the progressive deployment of the Palapa Ring Project has not significantly changed Indonesia's performance on the GSMA Mobile Connectivity Index relative to other middle-income countries (see Figure 21). However, for specific users of OpenSignal in remote areas, marked improvements in the availability

of 4G and the speed of their data connections have been measured.⁵³ While it may seem a disappointment given the USD1.5 billion price tag of the Palapa Ring Project,⁵⁴ it could be celebrated given Indonesia's unique challenges in delivering service to its more than 6,000 inhabited islands.

Figure 21: GSMA Mobile Connectivity Index's infrastructure score for Indonesia



Notes: Indonesia is represented by the red line. ESCAP countries are represented with blue lines.

Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

Figure 22: ICT indicators of Kyrgyzstan



Note: Kyrgyzstan's position is in red relative to statistics of ESCAP countries ranked from lowest to highest in each data point.

Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; ITU, "ICT Regulatory Tracker". Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and Google Measurement Lab, "mLab Global Dashboard 2020". Available at <https://www.measurementlab.net/>.

3.3 Kyrgyzstan

A landlocked nation, Kyrgyzstan borders the People's Republic of China, Kazakhstan, Uzbekistan and Tajikistan. Kyrgyzstan's bulk of exports are natural resources and its imports are mainly basic necessities.⁵⁵

3.3.1 Overview of ICT Regulations and Strategies

Liberalization of the telecommunications market in Kyrgyzstan began soon after its independence. Its independent regulator, the State Communications Agency, was established in 1997.⁵⁶ In joining the World Trade Organization in 1998, Kyrgyzstan committed to a fully open telecommunications market, with the exception of long-distance services and international communications, which were to be protected for the incumbent monopoly until 2003.⁵⁷ Otherwise, administrative licences were granted freely. The market was considered competitive in all segments by 2007,⁵⁸ and by 2008 the country had 293 licenced telecommunications providers, including nine with mobile network operator licences.⁵⁹

The ICT strategy in Kyrgyzstan had its genesis in President A. Akaev's 1998 declaration to the World Economic Forum at Davos that: "Kyrgyzstan chooses information society".⁶⁰ The idea of ICT as a mechanism for development was being promoted in the international community as essential, based on conclusions of the United Nations Commission on Science and Technology for Development Working Group on Information Technology and Development (1995-1997).⁶¹

The country's First National ICT Summit was held in April 2001. During the summit, Akaev set out the development framework with proposals for:⁶²

- A permanent agency in charge of implementing the National ICT Strategy
- A requirement for ministries and agencies to identify a person responsible for ICT
- Creation of an ICT development fund
- Ongoing monitoring of ICT development

A National ICT Strategy developed with assistance of the United Nations Development

Programme and the Global Internet Policy Initiative was published and entered into force in 2002 by Presidential Decree No. 54. The strategy, created in part based on the Okinawa Charter on Global Information Society, was comprehensive in its consideration of the organizational, economic and financial mechanisms required for its implementation.⁶³ In addition to adhering to best practices, the strategy was early in the context of world ICT strategies. By 2006, only 44 per cent of developing and emerging nations had adopted one.⁶⁴

3.3.2 Framework for National ICT Strategies and National Broadband Plans

The term “National Broadband Plan” had not yet come into use when Kyrgyzstan adopted its National ICT Strategy, and was not widely used until around 2006, when it was seen in the Philippine⁶⁵ and Malaysian⁶⁶ national discourse.

The 2004 Global Symposium for Regulators identified and produced a set of best practice guidelines for countries to create “an enabling regulatory regime that encourages broadband deployment and Internet connectivity”.⁶⁷ The Organisation for Economic Co-operation and Development (OECD) also made similar recommendations in 2004.⁶⁸ Liberalization, competition, technological neutrality, universal access and primacy of the private sector were common themes. The Broadband Commission has suggested national broadband plans or strategies multiple times, with recommendations 2013 – 7.4, 2017 – 5.2 and 2018 – 5.1.

National broadband plans can be part of a wider framework of information transport infrastructure and related services, which can itself be part of a wider focus on increasing national competitiveness or economic development.⁶⁹ A4AI discusses a wide variety of plan structures, noting they can vary in timeframe and lifespan; they are occasionally politically vulnerable; and that at median lifespan of five years, they are not short-lived, but not permanent laws. Whether a broadband

plan is stand-alone or part of a greater strategy or policy, the same principles apply.

Regardless of the name applied to a national ICT strategy or a national broadband plan, the efficacy of following best practice guidelines is undisputed. ITU’s 2018 Global ICT Regulatory Outlook noted the development of national broadband plans as the top regulatory reform trend between 2007 and 2017. ITU’s State of Broadband 2016 report stated that: “Adopting or introducing a national broadband plan is associated with a 2.5 per cent point increase in fixed-broadband penetration”. ESCAP found that: “On the whole, the national broadband plans that have been implemented in all the examined countries seem to have a substantial impact on fixed-broadband adoption”.⁷⁰

3.3.3 National ICT Strategy Efficacy

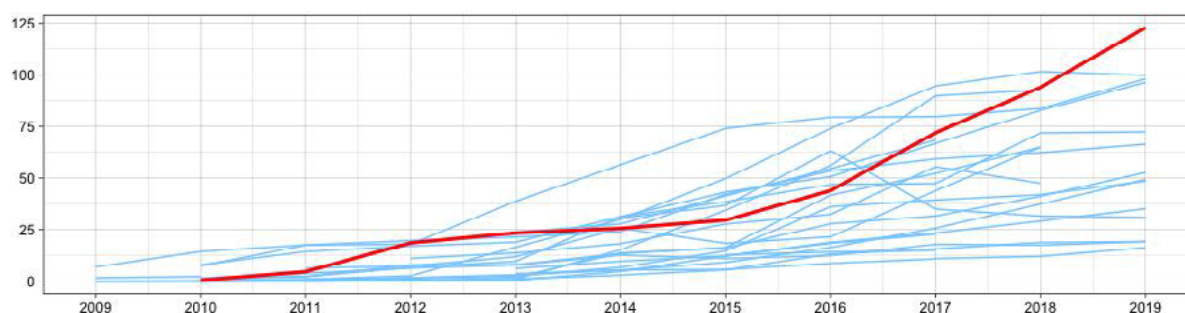
The growth of Internet access in Kyrgyzstan remained slow until 2010. In December 2011, Saima Telecom turned on the country’s first LTE network.⁷¹ Subsequently, according to the ITU World Telecommunication/ICT Indicators Database, mobile-broadband penetration rates in Kyrgyzstan have since 2012 not just caught up with its neighbours but surpassed them, and all other low- and lower-middle-income ESCAP countries (see Figure 23).

Based on the GSMA Mobile Connectivity Index, Kyrgyzstan still trails its wealthier neighbour, Kazakhstan, in penetration, but leads its neighbouring low-income economies (see Table 5).

3.4 Mongolia

Landlocked between the Russian Federation and the People’s Republic of China, Mongolia is a vast country of mountains, forest, steppe and desert. Half the nation’s population lives in its capital city, Ulaanbaatar. Outside the capital, Mongolia is defined by its sparse population. It has only two cities exceeding 50,000 people, with the balance of its population living in rural towns and villages. In an area roughly twice the size of Pakistan, Mongolia has fewer than 0.04 per cent of the world’s population.

Figure 23: Mobile-broadband subscriptions per 100 inhabitants in Kyrgyzstan



Notes: Kyrgyzstan is represented by the red line. ESCAP low- and lower-middle-income countries are represented by the blue lines. Source: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Table 5: Towards Meaningful Connectivity in Kyrgyzstan

	GSMA mobile-broadband connection (% penetration)	GSMA 4G coverage score*	GSMA gender equality score*	A4AI affordability of mobile-broadband data (1 Gb) as % of GNI per capita
Kyrgyzstan	86	80	83.8	2.12
Kazakhstan	106	75	84.5	0.36
Tajikistan	55	80	51.6	3.73
Uzbekistan	50	44	72.2	1.71

Note: * – All GSMA indicators with scores have been normalized to have a value within a range of 0 to 100 by GSMA. Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni; and ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Figure 24: ICT indicators of Mongolia

Population		3,068,243
Urban population (% of total)		68.7%
Fixed-broadband subscriptions		9.83 per 100 inhabitants
Mobile-broadband subscriptions		98.1 per 100 inhabitants
Expenses as % GNI per capita		1.95% per month (1 Gb data)
mLab median speed download		2.39 Mbps
mLab median up speed download		2.32 Mbps
ITU regulatory authority score		17/20
ITU regulatory mandate score		17.5/22
ITU regulatory regime score		21/30
ITU competition framework score		19/28

Note: Mongolia's position is in red relative to statistics of ESCAP countries ranked from lowest to highest in each data point. Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; ITU, "ICT Regulatory Tracker". Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and Google Measurement Lab, "mLab Global Dashboard 2020". Available at <https://www.measurementlab.net/>.

3.4.1 Overview of ICT Regulations and Plans

Compared with many of its peer economies, Mongolia began its journey into market liberalization early. Reforms started in 1990 shortly after a transition to democracy. A draft plan for telecommunications development was created in 1993, with assistance from international experts and the Asian Development Bank (ADB).⁷² Its first Law on Telecommunications promulgated in November 1995.⁷³ Privatization and partial-divestment of its government-owned carrier followed, and Korea Telecom acquired 40 per cent of Telecom Mongolia in an international competitive bidding process.

Planning for ICT development in Mongolia has benefited from the country's long history as a centralized economy, its historic association with managed communications,⁷⁴ and its close work with international development agencies. Long-term plans with specific, time-bound goals have been crafted, implemented and regularly reviewed over Mongolia's entire modern history. Highlights of ICT development and ICT education planning in Mongolia include the following:

- 1998 – Mongolian Telecommunications Sector Policy for 2010
- 1999 – Establishment of the National ICT Council
- 2000 – National ICT Vision 2010
- 2000 – Action Plan to Implement Vision 2010 in the Education Sector
- 2001 – Law of Mongolia on Communications, establishing its USOF
- 2001 – Transition of the National ICT Council into a new non-governmental organization, the Mongolian Information Development Association
- 2005 – e-Mongolia National Programme (2005-2012)
- 2006 – Master Plan to Develop Education of Mongolia in 2006-2015

- 2012 – Policy of ICT in the Education Sector (2012-2016)
- 2012 – Action Plan of ICT in Education Policy
- 2012 – e-Government National Programme (2012-2016)

Mongolia's government recognized early on that its highly literate population faced challenges preparing for entry into the global information society, including language skills, lack of local language content and lack of ICT skills.⁷⁵ The Action Plan to Implement Vision 2010 in the Education Sector (Decree No. 151) set out plans and budgets for addressing these challenges,⁷⁶ including education not just for students, but also training in ICT skills for teachers.

Special support for rural teachers was provided between 2004 and 2006 by the Government of Japan via ADB's ICT for Innovating Rural Education in Mongolia Project.⁷⁷ This project was found to be particularly effective in changing teaching behaviours, improving collaboration amongst teachers and improving job satisfaction, even though text-based emails and forums used over dial-up modems were the primary communications methods.⁷⁸

In a 2009 survey of teachers, 38 per cent of respondents said that teaching of ICT at their institution had been in place for more than three years, and 50 per cent said their schools had introduced ICT in the past 1-3 years. A longitudinal study of teachers conducted between 2012 and 2016 by the Tokyo Institute of Technology found increases in professional competency in educational use of ICT, in levels of collaboration between teachers, and in the perceived benefits of ICT use in education. Analysis of the study attributed increases in competency to hands-on experiences that were provided through in-school trainings.⁷⁹

3.4.2 Framework for ICT Education

The primary mission of Mongolia's National ICT Vision 2010, now a two-decade-old document, was to develop a knowledge-based

society. Its human development framework recognized that ICT could be used to promote equal opportunity and participation for citizens regardless of where they lived. Successive Action Programmes in support of the national vision had a major focus on education.

Mongolia's attempt to transform its society follows the success of Finland, which transformed from a raw materials and manufacturing society in the 1990s to a high-tech society focused on telecommunications. Finland's strategy involved: "Investments in technological infrastructure, education, and research and development, emphasizing the creation and sharing of new knowledge".⁸⁰

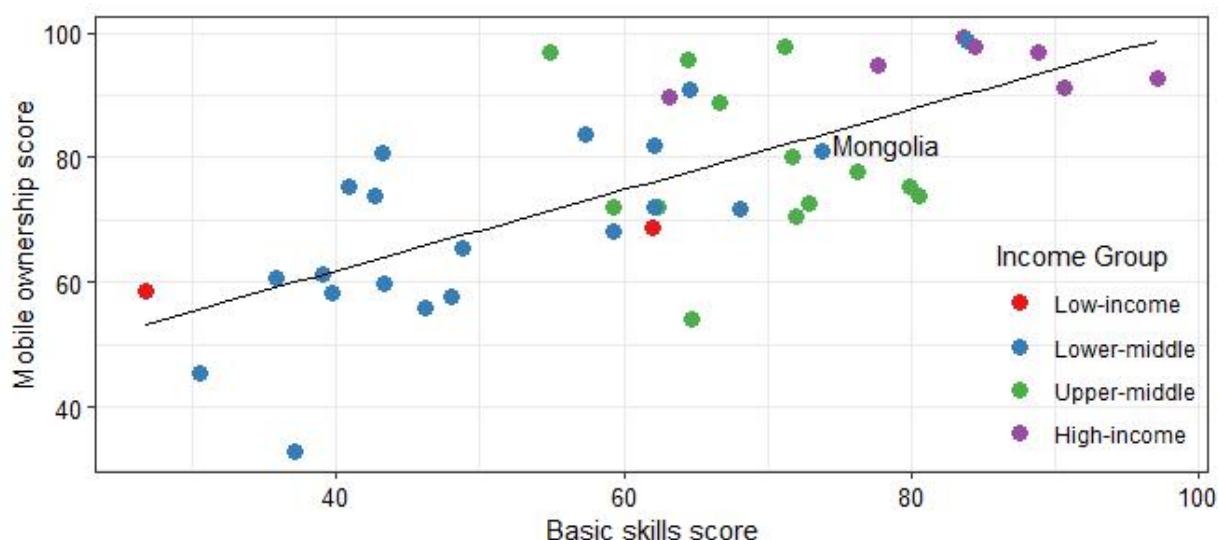
The principle of capacity building to promote societal development has been recommended by the Broadband Commission in 2012 – 7.12, 2014 – 7.2, 2015 – 6.7, 2016 – 6.8, 2018 – 5.2 and 2018 – 5.5, and it is apparent Mongolia understood these recommendations far before they were issued.

3.4.3 ICT Education Policy Efficacy

No measure or study specifically addresses the impact of ICT in education on use of broadband. However, Ünver has found: "An empirical positive relation between education level and Internet penetration in a country".⁸¹ The GSMA Mobile Connectivity Index has an education-focused basic skills dimension, built on a set of education statistics of the United Nations Development Programme and the United Nations Educational, Cultural and Scientific Organization. GSMA considers educational preparation to be a significant component of consumer readiness when it comes to use of telecommunications services. Mongolia scores higher on this dimension than any low- or lower-middle-income country in the region.

Considering ESCAP countries, it is clear there is an association between education and mobile ownership. Using the most current data, Mongolia's level of mobile ownership is higher than all countries in its income group, and higher than two-thirds of countries in the next higher income group (see Figure 25).

Figure 25: GSMA Mobile Connectivity Index's mobile ownership and basic skills scores in Mongolia



Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

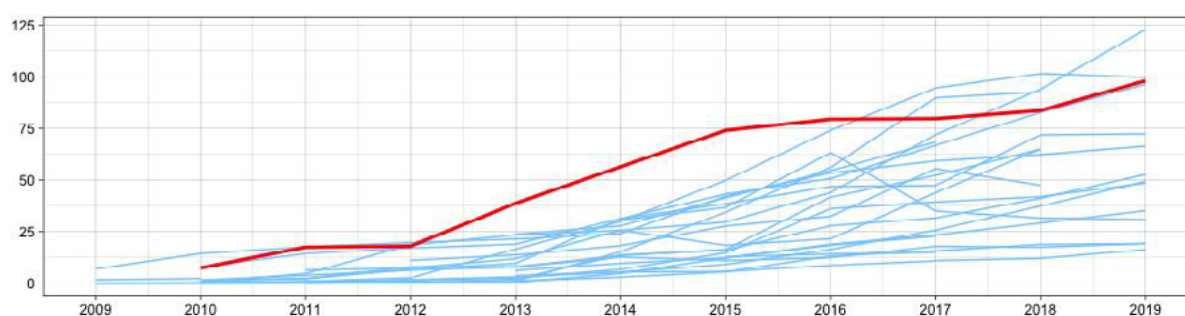
For mobile-broadband penetration, Mongolia's performance amongst lower-middle-income countries has been outstanding since 2010. Mongolia is now in third place by ITU's measurements and have settled at 98 mobile-broadband connections per 100 population (see Figure 26). Ahead of Mongolia in terms of mobile-broadband penetration are only Bhutan, Cambodia and Kyrgyzstan, according to ITU's data.

Mongolia's performance in mobile-broadband penetration is laudable given its low levels of urbanization, low population density outside its capital city, and relatively unaffordable device prices as illustrated in Section 2.1.2,

Figure 4. Despite these challenges, Mongolia still tops its income category peers in terms of mobile-broadband penetration, and well exceeds its peers in gender equality, while still meeting A4AI's 1 for 2 affordability threshold (see Table 6).

Mongolia's long-term commitment to education could be an influencing factor with respect to its high level of broadband uptake, especially as its uptake exceeds that of many countries with less expensive data. High penetration, good 4G coverage, affordable pricing and excellent gender equality are good indications that Mongolia is performing well on Meaningful Connectivity targets.

Figure 26: Mobile-broadband subscriptions per 100 inhabitants in Mongolia



Notes: Mongolia is represented by the red line. ESCAP low- and lower-middle-income countries are represented by the blue lines.

Source: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Table 6: Towards Meaningful Connectivity in Mongolia

	GSMA mobile-broadband connection (% penetration)	GSMA 4G coverage score*	GSMA gender equality score*	A4AI affordability of mobile-broadband data (1 Gb) as % of GNI per capita
Mongolia	90	82.3	93.7	1.71**
Bhutan	88	60.0	69.0	0.74**
Cambodia	89	93.0	68.7	1.62
Kyrgyzstan	86	80.0	83.8	2.12

Notes: * – All GSMA indicators with scores have been normalized to have a value within a range of 0 to 100 by GSMA.

** – Authors' estimation based on data from ITU.

Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; A4AI, "Mobile Broadband Pricing Data for 2020". Available at <https://a4ai.org/extra/baskets/A4AI/2020/mobile-broadband-pricing-gni>; and ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

3.5 Papua New Guinea

An independent nation since 1975, PNG is complex culturally and geographically. Its population speaks over 800 languages. Its central mountain ranges and jungles are unpenetrated by modern infrastructure like

roads or power grids. The majority of its population is rural, with more than 80 per cent living in traditional villages.⁸² Minerals and petroleum extraction, the backbone of its export-based economy, are of little benefit to the majority of its population.⁸³

Figure 27: ICT indicators of PNG



Note: PNG's position is in red relative to statistics of ESCAP countries ranked from lowest to highest in each data point.

Sources: ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; ITU, "ICT Regulatory Tracker". Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019>; World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>; and Google Measurement Lab, "mLab Global Dashboard 2020". Available at <https://www.measurementlab.net/>.

3.5.1 Overview of ICT Regulations and Plans

Telecommunications was corporatized in PNG with the Post and Telecommunication Corporation Act 1982,⁸⁴ though only independent of postal services since 1996 when the Corporation was split into Telikom PNG, Post PNG and the PNG Telecommunications Authority⁸⁵ through a set of acts of parliament. The latter, known then as PANGTEL, was PNG's first telecommunications regulator⁸⁶ and had a staff of 70 across engineering, policy and corporate services.⁸⁷ Subsequently, the Telecommunications Act 1996 established a Rural Development Fund, intended to be fed by operator levies, and accessible for infrastructure projects by universal service carriers.⁸⁸ In 2002, another act of parliament established PNG's competition regulator, the Independent Consumer and Competition Commission (ICCC).⁸⁹

Through the corporatization of PNG's telecommunications industry and the dawn of the Internet age, its carrier, Telikom, remained government-owned, with a legal monopoly on all domestic and international communications until 2007.⁹⁰ A December 2005 decision by the National Executive Committee to allow competition in mobile telephony was the first step towards opening PNG's market. A tender process concluded with PANGTEL issuing a spectrum licence to challenger, Digicel, in March 2007. Pricing dropped by 60 per cent on Digicel's entry into the market,⁹¹ and Digicel quickly acquired a dominant position, even though it faced strong political opposition from the incumbent and its supporters.

The National ICT Act 2009 established the National ICT Authority, mainly from PANGTEL staff and assets,⁹² and allowed for a reset in regulatory activities. The new organization, funded by licence fee revenue, took all of PANGTEL's functions, and also

took regulations of telecommunications away from ICCC, making them both technical and economic regulators.⁹³

Immediately upon its establishment, the National ICT Authority had to handle complaints from both the new entrant, Digicel, and the incumbent, Telikom. Two of National ICT Authority's significant actions were 2011 determinations⁹⁴ to cap Digicel's charges to its customers for out-of-network calls, and to require Telikom to provide Digicel access to its international gateway services on a non-discriminatory basis.

Structural separation of the incumbent Telikom started in 2014 when the National Executive Council established PNG DataCo,⁹⁵ a new state-owned enterprise intended to act as a wholesale layer 2 and layer 3 network provider for the country's national networks. Its mission was to provide backbone and international gateway services to the market on a non-discriminatory basis.⁹⁶ Its remit included management of existing and planned terrestrial and submarine fibre assets, associated transmission points and landing stations, and government or Telikom-owned satellite earth stations.⁹⁷ DataCo's parent company and administrator on behalf of the state was to be a new super-corporation of state-owned enterprises called Kumul Consolidated Holdings created in an act of parliament in August 2015.

The two most important submarine assets DataCo was created to manage were planned submarine cables. One was the Kumul Submarine Cable Network, a debt-funded 5,400km domestic submarine cable to connect all 14 of PNG's provinces for the first time.⁹⁸ The other was the Coral Sea Cable Network, a link to Sydney from a grant by the Government of Australia. DataCo's activities eventually expanded to include construction of shared radio towers, some to be paid for by the country's USOF.⁹⁹

In an interview with Business Advantage PNG, DataCo's Founding Chairman, Reuben Kautu, explained the rationale behind the new company: "To provide a reliable, cost-effective wholesale infrastructure that rationalizes

the government's investment while allowing greater competition in the retail segment of the market".¹⁰⁰

3.5.2 Framework for Structural Separation

Structural separation of a utility market is useful when vertically-integrated companies in regulated industries have competitive activities, like the provision of retail services, that are linked to non-competitive activities, like transmission lines or submarine cables. An early example can be found in New Zealand's electricity market. The Industry Reform Act passed in 1998 forced the unbundling of electricity transmission (national grid) and distribution (local lines providers) from power generation and retail sales. This reform meant that local lines providers (a mix of commercial, cooperative and local-government-owned companies) were no longer the only choice when it came to consumers purchasing electricity.

The result of a structurally-separated industry is generally open access to the non-competitive infrastructure, an approach noted in the Broadband Commission's recommendations 2013 – 7.3, 2015 – 6.3, 2016 – 6.5 and 2017 – 5.5.

One useful framework to consider is the recommendation of the OECD Council concerning structural separation in regulated industries, approved in April 2001.¹⁰¹ Some of its points applicable to PNG's telecommunications market include the following:

- Firms often operate in non-competitive and competitive activities –
 - » Installing utility poles and hanging cables on them is typically a non-competitive activity, but providing Internet or long-distance service over those cables is a competitive one.
 - » Building towers on sensitive sites like mountaintops is typically a non-competitive activity, but adding mobile

base stations to them to provide mobile service is a competitive one.

- A firm can restrict competition by restricting the terms or quality at which rival firms are granted access to a non-competitive activity –
 - » The terms Telikom offered to Digicel for access to its monopoly-controlled submarine cable assets made it expensive for Digicel to compete in the retail mobile data market.
- Behavioural policies, unlike structural policies, do not eliminate the incentive for a firm to restrict competition –
 - » The National ICT Authority's requirement for Telikom to provide Digicel non-discriminatory access to its international services was a behavioural policy.
- Regulatory controls of a behavioural nature may result in less competition than would be the case if the regulated firm had no incentive to restrict competition –
 - » Forced to provide access to international connectivity on regulated terms it did not like, Telikom had no incentive to promote use of that access. An independent operator would be incentivized to maximize the use of its limited lifespan, depreciating asset.
- Separation limits need for difficult, costly and only partially effective regulation.

It is important to note that structural separation is a step beyond functional separation, which can be achieved by creating different business units within a company to provide wholesale and retail services. The motivations for discrimination are still present even when a wholesale business unit is required to provide equal terms to both internal and external customers.

New Zealand saw the structural separation of its telecommunications market with the breakup of its former monopoly incumbent,

Telecom New Zealand, in 2011. It was split into retail and wholesale companies that are now separate entities, both traded on the local share market. In the Czech Republic, O2 separated in 2014, and TDC Denmark followed suit in 2018.¹⁰² The United Kingdom saw the structural separation of its former monopoly incumbent in 2018 when the BT Group was required to create a separate company for its Openreach wholesale business unit.¹⁰³ Openreach had acted as a functionally-separated entity since its creation in 2006.

In a 2016 monitoring report, OECD found its 2001 recommendation on structural separation in regulated industries still important and relevant, with substantial evolution of policies since the initiation of the recommendation.¹⁰⁴

3.5.3 Structural Separation Policy Efficacy

By 2018, DataCo was established as the manager of wholesale connectivity as intended by the separation, with a staff of around twenty. Assets included most terrestrial fibre cables, wave division multiplexing equipment, satellite links, submarine cable access and a point of presence in Sydney. DataCo had taken control of Telikom's autonomous system number, but ownership was not officially transferred until February 2019.¹⁰⁵ DataCo's largest customer for bandwidth was Digicel, but DataCo was also providing services to Telikom and a number of small Internet service providers in Port Moresby, Lae and Goroka.

While DataCo was being established, a fight for its control was going on in the background. Applications were made in 2017 by its parent company, the state-owned Kumul Consolidated Holdings, to undo the separation and merge DataCo with Telikom. A determination by PNG's competition regulator, ICCC, officially released in May 2018, approved the merger as being "likely to result in more benefits to the society". In the same document, the ICCC found the merger was likely to have the following negative effects:¹⁰⁶

- The merged firm would have increased potential to increase prices and profit margins because it would control the essential network infrastructures.
- Although satellite is an available substitute, usage of fibre-optic cables is a more efficient and better means of carrying traffic.
- There is a real likelihood of the merged entity engaging in discriminatory pricing (a view also supported by the National Research Institute).
- The merger would result in serious detriments, substantially lessening competition and wasting public funds if claimed benefits and efficiencies are not realized post-merger.

During the consultation process around the proposed merger, submissions to the ICCC by Digicel, National Research Institute and National ICT Authority all raised the potential for negative effects along the lines of ICCC's points above.¹⁰⁷

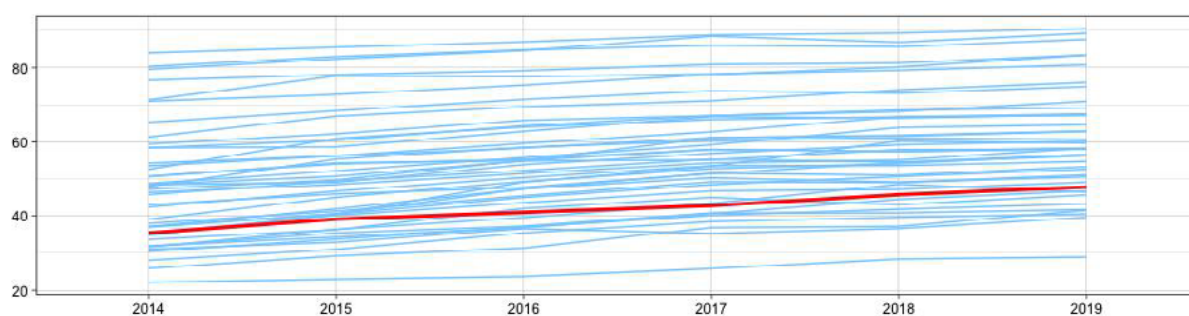
A PNG study found that: "Power exerted by the government as both regulator and owner of the incumbent, and the extent to which political actors have been able to exert direct influence in both sector regulation and the day-to-day operation of the incumbent, have resulted in impediments to the development of effective competition in both the fixed and mobile sectors".¹⁰⁸

PNG's performance on the GSMA Mobile Connectivity Index improved steadily between 2014 and 2019, but its position relative to other ESCAP countries remained unchanged (see Figure 28).

From a Meaningful Connectivity perspective, PNG faces significant challenges, with low broadband penetration, low levels of 4G coverage and high data charges (see Table 7).

While it is a highly profitable market for its dominant mobile network carrier, Digicel, the majority of mobile phone users are still using 2G networks.¹⁰⁹ Improvement for PNG might not come until competition arrives, perhaps in the form of Fiji's Amalgamated Telecom Holdings Group.¹¹⁰

Figure 28: GSMA Mobile Connectivity Index score for PNG



Notes: PNG is represented by the red line. ESCAP countries are represented with blue lines.

Source: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>.

Table 7: Towards Meaningful Connectivity in PNG

	GSMA mobile-broadband connections (% penetration)	GSMA 4G coverage score*	GSMA gender equality score*	A4AI affordability of mobile-broadband data (1 Gb) as % of GNI per capita
PNG	16	27.0	67.9	10.69
Solomon Islands	39	21.5	75.0	11.97
Vanuatu	49	75.5	77.9	2.26**
Tonga	45	75.0	80.4	0.86**

Notes: * – All GSMA indicators with scores have been normalized to have a value within a range of 0 to 100 by GSMA.

** – Authors' estimation based on data from ITU.

Sources: GSMA, "Mobile Connectivity Index 2020". Available at <https://www.mobileconnectivityindex.com/>; A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni; and ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

4.

Conclusion

Meaningful Connectivity is achieved when a population can regularly use an appropriate device with a fast connection and enough data to support web browsing, social media applications, video chat and video streaming. While achievement of Meaningful Connectivity targets is best assessed via direct users' survey, many existing reports and data on telecommunications performance allow us to identify where conditions are ideal.

The available data on ESCAP countries and regions shows that there are large variations in the availability of connectivity, adequacy of connectivity, and affordability of devices and connectivity. It also shows that favourable conditions for Meaningful Connectivity are not solely tied to a country's income levels or population density – some countries significantly outperform their peers.

Five countries and their implementations of good regulatory practices were examined in the case studies, three of which exhibited outstanding performance in achieving conditions that promote Meaningful

Connectivity. Each of the good practices discussed could have an impact on Meaningful Connectivity if introduced to other ESCAP countries.

Bhutan's model of shared and open access backbone and its offering of infrastructure to operators in exchange for universal service commitments is worth considering for any economy where existing electrical utility infrastructure can be leveraged to increase rural and remote coverage. However, with a requirement for a terrestrial electrical grid, Bhutan's solution is inapplicable to many Pacific island countries, except

Table 8: Key findings of country studies

Country	Key findings
Bhutan	Bhutan reformed the telecommunications sector, including liberalization of mobile services, establishment of an independent regulator and implementation of an infrastructure sharing policy for fibre-optic networks along the electricity grid. Bhutan's performance excels when compared to a number of wealthier, more urbanized and developed countries, according to the GSMA Mobile Connectivity Index's infrastructure score. Bhutan's shared and open access backbone, its network's deep penetration into rural areas, and its model of offering infrastructure to operators in exchange for universal service commitments is unique and effective.
Indonesia	Indonesia reformed the telecommunications sector, including liberalization of mobile services, establishment of a competent regulator and implementation of a USOF policy. Indonesia has the most competitive market and the most affordable data amongst developing and emerging economies in the region. Despite Indonesia's geographic challenges, it scores in the middle of the pack of its neighbours for affordability, 4G coverage and mobile-broadband penetration.
Kyrgyzstan	Kyrgyzstan undertook liberalization of its telecommunications market in the early 1990s, including the establishment of an independent regulator and adoption of a National Broadband Plan. Since 2012, the mobile-broadband penetration rates in Kyrgyzstan have not just caught up with its neighbours but surpassed them, and all other low- and lower-middle-income ESCAP countries. The GSMA Mobile Connectivity Index data shows that Kyrgyzstan still trails its wealthier neighbour, Kazakhstan, in penetration but leads its neighbouring low-income economies.
Mongolia	Mongolia undertook liberalization of its telecommunications market, including privatization of the state-owned telecommunications operator, implementation of several ICT legislations and special attention paid to ICT in the national education system. Mongolia leads its income group in the GSMA Mobile Connectivity Index's basic skills dimension. Mongolia's long-term commitment to education could be an influencing factor for the high level of broadband uptake.
PNG	PNG reformed the telecommunications sector, including liberalization of mobile services, establishment of an independent regulator and implementation of a USOF policy. From a Meaningful Connectivity perspective, while its GSMA Mobile Connectivity Index has slightly improved since 2014, PNG faces significant challenges, with low broadband penetration, low levels of 4G coverage and high data charges.

PNG. Infrastructure sharing could make a significant difference in Pakistan, Nepal and Turkmenistan, where 4G coverage and competition outside urban areas are limited, but electrification is nearly universal.

USOFs like Indonesia's have been implemented widely in South Asia. The Maldives stands out as the only SSWA country where a USOF has not yet been implemented. In the Pacific, countries without a USOF are generally dependent on a more developed country or have markets too small to reasonably sustain an industry-contributed fund. South-East Asia is the subregion where implementation of USOFs would result in the most benefit. The Lao People's Democratic Republic, Myanmar, the Philippines and Timor-Leste are all potential candidates for intervention. All are lower-middle-income countries, lack active USOFs, and face challenges with achieving Meaningful Connectivity that are related more to a lack of infrastructure development than to social or capacity development reasons.

Kyrgyzstan's early implementation of an ICT development plan made it clear to the people and their government that ICT was critical to their development. In a 2019 survey, ITU found several ESCAP nations without active national broadband plans, including Kiribati, Lao People's Democratic Republic, the Marshall Islands, Myanmar, the Solomon Islands, Timor-Leste, Tajikistan, Turkmenistan, Tuvalu and Uzbekistan. All could benefit from the commitment to best practices, which encourage the drafting and approval of a national ICT strategy or national broadband plan.

Mongolia has made general and ICT education a priority for decades, and today the country leads its income group in the GSMA Mobile Connectivity Index's basic skills dimension. Its level of mobile-broadband uptake and mobile ownership is high, considering relatively unaffordable mobile devices and tariffs. In an analysis of Mongolia's ICT education framework, Yamamoto and Yamaguchi made two recommendations that could raise Meaningful Connectivity in other nations if transferred:¹¹¹ School-based teacher training activities and management-level trainings

on the pedagogical value of ICT in schools. Emulating Mongolia's ICT education policies could boost Meaningful Connectivity in most ESCAP countries.

An easy test for the potential of structural separation is whether there is a non-competitive utility bundled with a competitive activity like retail telecommunications services. In Pakistan, for example, there is ample competition in the fibre backhaul markets between major cities, but in rural areas backhaul is only available from the incumbent. Lack of backhaul competition could be a factor influencing the fact that rural areas generally have little to no competition when it comes to mobile networks. Separation of the incumbent's backhaul assets from its retail division could instigate significant change – a policy that could work in any country where a full-service retail organization controls non-competitive infrastructure assets.

The COVID-19 pandemic has re-shaped the world in terms of its requirements for Internet connectivity. Work, education and socialization have all been inextricably altered. Social inclusion now demands equitable Internet access. A4AI's Meaningful Connectivity targets is a useful framework for evaluating whether equity is being achieved. For those countries with more work to be done, the implementing policy and regulatory good practices discussed in this report could be a step on that journey.

The findings of this report raise two important messages for future research. First, while telecommunications regulatory reforms have generally been positive in the selected Asia-Pacific countries, their impact on Meaningful Connectivity has varied. Further research is needed on other factors that are hindering the telecommunications sector from fully realizing its full potential despite well-intentioned policies. Second, the impact on Meaningful Connectivity targets is best understood through assessing user-level information (compared to the national/subregional-level data used in this report). Hence, conducting a national survey at the country level would yield more useful insights for policymakers.

Appendix: 1 for 2 Calculations

The 1 for 2 score is an A4AI threshold for affordability. Countries where 1Gb of mobile data costs less than 2 per cent of monthly GNI per capita meet the threshold. The table below was extracted from A4AI's "Mobile Broadband Pricing Data for 2020" and ITU's "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)".

Country	Subregion	Development status	Income level	1.5 Gb in USD	1 Gb in USD	Annual GNI/capita	Monthly GNI	1 for 2 score (%)
Afghanistan	SSWA	LDC and LLDC	Low					5.46
American Samoa	PACIFIC	Developing	Upper middle					
Armenia	NCA	LLDC	Upper middle	5.18	3.45	4680	390.00	0.88*
Australia	PACIFIC	Developed	High	21.67	14.45	55100	4591.67	0.31*
Azerbaijan	NCA	LLDC	Upper middle	4.71	3.14	4480	373.33	0.84*
Bangladesh	SSWA	LDC	Lower middle					1.39
Bhutan	SSWA	LDC and LLDC	Lower middle	2.91	1.94	3140	261.67	0.74*
Brunei Darussalam	SEA	Developing	High	14.83	9.88	32230	2685.83	0.37*
Cambodia	SEA	LDC	Lower middle					1.62
People's Republic of China	ENEAS	Developing	Upper middle					0.34
Cook Islands	PACIFIC	Developing	High	..	..	..	..	..
Democratic People's Republic of Korea	ENEAS	Developing	Low	..	..	..	..	..
Fiji	PACIFIC	SIDS	Upper middle					2.72
French Polynesia	PACIFIC	SIDS	High	..	..	..	..	..
Georgia	NCA	Developing	Upper middle					0.46
Guam	PACIFIC	SIDS	High	..	..	..	..	..
Hong Kong, China	ENEAS	Developing	High	12.25	8.16	50800	4233.33	0.19*
India	SSWA	Developing	Lower middle					1.16
Indonesia	SEA	Developing	Upper middle					1.05
Iran (Islamic Republic of)	SSWA	Developing	Upper middle	3.40	2.27	5300	441.67	0.51*
Japan	ENEAS	Developed	High	34.23	22.82	41710	3475.83	0.66*
Kazakhstan	NCA	LLDC	Upper middle					0.36
Kiribati	PACIFIC	LDC and SIDS	Lower middle	14.94	9.96	3350	279.17	3.57*
Korea (Republic of)	ENEAS	Developed	High	11.24	7.50	33790	2815.83	0.27*
Kyrgyzstan	NCA	Developing	Lower middle					2.13
Lao People's Democratic Republic	SEA	LDC and LLDC	Lower middle					2.16
Macao, China	ENEAS	Developing	High	12.14	8.09	78640	6553.33	0.12*
Malaysia	SEA	Developing	Upper middle					0.65
Maldives	SSWA	Developing	Upper middle	15.84	10.56	9680	806.67	1.31*
Marshall Islands	PACIFIC	SIDS	Upper middle	..	..	..	..	..
Micronesia (Federated States of)	PACIFIC	SIDS	Lower middle	30.00	20.00	3400	283.33	7.06*
Mongolia	ENEAS	LLDC	Lower middle					1.95
Myanmar	SEA	LDC	Lower middle					0.75

Nauru	PACIFIC	SIDS	High	23.16	15.44	14230	1185.83	1.3*
Nepal	SSWA	LDC	Lower middle					2.55
New Caledonia	PACIFIC	SIDS	High	..	..	..	..	..
New Zealand	PACIFIC	Developed	High	13.15	8.76	42760	3563.33	0.25*
Niue	PACIFIC	SIDS	High	..	..	..	..	..
Northern Mariana Islands	PACIFIC	SIDS	High	..	..	..	..	..
Pakistan	SSWA	Developing	Lower middle					0.51
Palau	PACIFIC	SIDS	High	25.00	16.67	16490	1374.17	1.21*
Papua New Guinea	PACIFIC	SIDS	Lower middle					10.69
Philippines	SEA	Developing	Lower middle					1.27
Russian Federation	NCA	Developing	Upper middle	8.78	5.85	11260	938.33	0.62*
Samoa	PACIFIC	SIDS	Upper middle	15.46	10.31	4190	349.17	2.95*
Singapore	SEA	Developed	High	14.83	9.89	59590	4965.83	0.2*
Solomon Islands	PACIFIC	LDC and SIDS	Lower middle					11.97
Sri Lanka	SSWA	Developing	Lower middle	2.15	1.43	4020	335.00	0.28*
Tajikistan	NCA	LLDC	Low					3.73
Thailand	SEA	Developing	Upper middle					1.02
Timor-Leste	SEA	LDC and SIDS	Lower middle					2.68
Tonga	PACIFIC	SIDS	Upper middle	5.37	3.58	5000	416.67	0.86*
Turkey	SSWA	Developing	Upper middle					0.71
Turkmenistan	NCA	LLDC	Upper middle	24.29	16.19	6740	561.67	2.88*
Tuvalu	PACIFIC	LDC and SIDS	Upper middle	..	..	5620	468.33	..
Uzbekistan	NCA	LLDC	Lower middle					1.71
Vanuatu	PACIFIC	SIDS	Lower middle	9.08	6.05	3210	267.50	1.04*
Viet Nam	SEA	Developing	Lower middle					1.036

Notes: Data on 1 for 2 is from the A4AI's "Affordability of 1Gb of mobile data as % of GNI per capita".

* – Missing values for certain countries were estimated by the authors; .. – Data not available;

LLDC – Landlocked Developing Countries; LDC – Least Developed Countries; and SIDS – Small Islands Developing States.

Sources: A4AI, "Mobile Broadband Pricing Data for 2020". Available at https://a4ai.org/extra/baskets/A4AI/2020/mobile_broadband_pricing_gni; ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>; and World Bank, "World Development Indicators". Available at <https://databank.worldbank.org/source/world-development-indicators>.

- 1 World Bank, World Development Report 2021: Data for Better Lives (Washington, DC, 2021). Available at <https://wdr2021.worldbank.org/stories/connecting-the-world/>.
- 2 Rachel Gong, "Digital Inclusion: Assessing Meaningful Internet Connectivity in Malaysia", Khazanah Research Institute Discussion Paper 11/20, 7 September 2020. Available at <http://krinstitute.org/assets/contentMS/img/template/editor/20200907%20Inclusion%20v4.0.pdf>.
- 3 ITU, "Asymmetric digital subscriber line (ADSL) transceivers". Available at <https://www.itu.int/rec/T-REC-G.992.1-199907-I/en> (accessed on 19 April 2021).
- 4 ITU, "Transmission systems for interactive cable television services". Available at <https://www.itu.int/rec/T-REC-J.112-199803-I/en> (accessed on 19 April 2021).
- 5 3GPP, "Release 8". Available at <https://www.3gpp.org/specifications/releases/72-release-8> (accessed on 19 April 2021).
- 6 A4AI, "Methodology Guide: Quantitative Measures of Meaningful Connectivity", May 2021. Available at <https://docs.google.com/document/d/1dA6E91CUtzp8rQSNs0ZoJ6YjCoedM9qaeDZmy0EVCZk/edit#heading=h.bx8e38ypwsg3>.
- 7 Speedtest, "Philippines: Q3-Q4 2020". Available at https://web.archive.org/web/20210126095549if_/https://www.speedtest.net/awards/philippines/2020/?award_type=carrier&time_period=q3-q4.
- 8 Internet Archive Wayback Machine, "PH ranking". Available at <https://web.archive.org/web/20210202063803/https://ispspeedindex.netflix.net/api/v1/rankings/current-summary/countries/PH/csv> (accessed on 2 February 2020).
- 9 Sam Fenwick and Hardik Khatri, "The state of mobile network experience 2020: One year into the 5G era", Opensignal, May 2020. Available at https://www.opensignal.com/sites/opensignal-com/files/data/reports/pdf-only/data-2020-05/state_of_mobile_experience_may_2020_opensignal_3_0.pdf.
- 10 Authors' calculation based on problematic citation – Google's citation.
- 11 GSMA, "Accelerating affordable smartphone ownership in emerging markets", July 2017. Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/08/Accelerating-affordable-smartphone-ownership-in-emerging-markets-2017_we.pdf.
- 12 GSMA, "The Mobile Gender Gap Report 2020", March 2020. Available at <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/05/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf>.
- 13 ITU and A4AI, "Data-Only Mobile-Broadband Basket", 2020. Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/ICTprices/ICTPricesVisualization.aspx>.
- 14 A4AI, "Affordable Internet is '1 for 2'". Available at <https://a4ai.org/affordable-internet-is-1-for-2#:~:text=Changing%20how%20we%20define%20affordability,less%20of%20average%20monthly%20income>.
- 15 ITU, "UN Broadband Commission sets global broadband targets to bring online the world's 3.8 billion not connected to the Internet", Press Release, 23 January 2018. Available at <https://www.itu.int/en/mediacentre/Pages/2018-PR01.aspx>.
- 16 Statistics from ITU, "World Telecommunication/ICT Indicators Database 2020 (24th Edition/December 2020)". Available at: <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.
- 17 Authors' calculation, available in the Appendix.
- 18 Datareportal, "More than half of the people on earth now use social media", 21 July 2020. Available at <https://datareportal.com/reports/more-than-half-the-world-now-uses-social-media>.
- 19 ITU, "ICT Regulatory Tracker". Available at <https://www.itu.int/net4/itu-d/irt/#/tracker-by-country/regulatory-tracker/2019> (accessed on 19 April 2021).
- 20 A4AI, "A4AI Good Practices Databases". Available at <https://a4ai.org/good-practices-database/>.
- 21 GSMA advises that Wholesale Open Access Networks and Universal Service and Access Funds are both ineffective strategies – but this position is countered by ITU and OECD.
- 22 Ministry of Information and Communications, Government of Bhutan, "Information, Communications and Transport Sectors in Bhutan: A Special Report", July 2007. Available at <https://www.unapcict.org/sites/default/files/2019-01/Bhutan-moicreport.pdf>.
- 23 Gopi Pradhan, "Study of the Development of ICT in the Kingdom of Bhutan", International Development Research Centre, 2001. Available at <https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/28546/117775.pdf?sequence=1>.

-
- 24 Ministry of Information and Communications, Government of Bhutan, "Bhutan Telecommunications and Broadband Policy", 2014. Available at https://www.moic.gov.bt/wp-content/uploads/2016/05/bhutan_telecommunications_and_broadband_policy_pdf_16764.pdf.
- 25 ESCAP, "ICT Co-Deployment with the Electricity Infrastructure: The Case of Bhutan", Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, May 2019. Available at <https://www.unescap.org/sites/default/files/ICT%20Co-Deployment%20with%20the%20Electricity%20Infrastructure%2C%20The%20Case%20of%20Bhutan.pdf>.
- 26 Ibid.
- 27 Ministry of Information and Communications, Government of Bhutan, "Bhutan Telecommunications and Broadband Policy", 2014. Available at https://www.moic.gov.bt/wp-content/uploads/2016/05/bhutan_telecommunications_and_broadband_policy_pdf_16764.pdf.
- 28 Christian Jaaga and Urs Trinkner Bottleneck, "Regulation in telecommunications, railways and post", Network Industries Quarterly (September 2009). Available at https://www.researchgate.net/profile/Urs-Trinkner/publication/242575262_Bottleneck_regulation_in_telecommunications_railways_and_post/links/02e7e52a0226845ae9000000/Bottleneck-regulation-in-telecommunications-railways-and-post.pdf.
- 29 Sriganesh Lokanathan, "Creating an open access national backbone network: The case of Afghanistan", August 2012. Available at <https://www.unescap.org/resources/creating-open-access-national-backbone-network-case-afghanistan-mr-sriganesh-lokanathan#>.
- 30 Louay Abou Chanab and others, "Telecom Infrastructure Sharing: Regulatory Enablers and Economic Benefits", Booz Allen Hamilton, 2007. Available at https://web.archive.org/web/20110927102903if_/http://www.boozallen.com/media/file/Telecom_Infrastructure_Sharing.pdf.
- 31 ITU, "ICT Regulation Toolkit: Providing practical advice and concrete best practice guidelines to enable access to ICTs for all", no date. Available at <https://www.itu.int/itudoc/gs/promo/bdt/flyer/87876.pdf>.
- 32 Tracy Cohen and Russell Southwood, "Extending Open Access to National Fibre Backbones in Developing Countries", paper presented at the ITU 8th Global Symposium for Regulators, March 2008. Available at https://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/discussion_papers/Cohen_Southwood_web.pdf.
- 33 International Law Office, "Telecommunications Regulatory Board is Established", 10 September 2003. Available at <https://web.archive.org/web/20210224095746/https://www.internationallawoffice.com/Newsletters/Tech-Data-Telecoms-Media/Indonesia/Mochtar-Karuwin-Komar/Telecommunications-Regulatory-Board-is-Established> (accessed on 20 April 2021).
- 34 Chanuka Wattegama, Juni Soehardjo and Nilusha Kapugama, "Telecom Regulatory and Policy Environment in Indonesia: Result and Analysis of the 2008 TRE Survey", 18 March 2008. Available at https://lirneasia.net/wp-content/uploads/2009/07/TRE_Indonesia_2009Mar18.pdf.
- 35 World Bank, "Indonesia: Connecting the Archipelago", no date. Available at <http://documents1.worldbank.org/curated/pt/595101468269398183/pdf/690880WP0P10930update0October02006v2.pdf> (accessed on 20 April 2021).
- 36 Vera Yuwantari and others, "Evaluation of BTIP's Performance after the Implementation of PPK-BLU Policy in Indonesia", Journal of Asian Finance, Economic and Business, vol. 7, no. 10 (2020). Available at <http://koreascience.or.kr/article/JAKO202029062616534.pdf>.
- 37 Gayatri Suroyo, "Indonesia completes fiber-optic network to bring internet to remote east", Reuters, 14 October 2019. Available at <https://www.reuters.com/article/us-indonesia-infrastructure-idUSKBN1WT0XC>.
- 38 Al Imami, "Pengepuloan Internet dalam mewujudkan desa broadband terpapu di desa Wonosari Kapupaten Bengkalis", JOM FISIP, vol. 6 (2019). Available at <https://jom.unri.ac.id/index.php/JOMFISIP/article/download/23104/22369>.
- 39 Koesmarihati Sugondo, "Implementation of USO in Indonesia", LIRNEasia, 2013. Available at https://lirneasia.net/wp-content/uploads/2013/10/Universal-service-subsidies-Theory-practice_KS.pdf.
- 40 Broadband Commission for Sustainable Development, The State of Broadband: Broadband as a Foundation for Sustainable Development (Geneva, 2019). Available at https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.20-2019-PDF-E.pdf.
- 41 ITU, "ICT Regulation Toolkit: Providing practical advice and concrete best practice guidelines to enable access to ICTs for all", no date. Available at <https://www.itu.int/itudoc/gs/promo/bdt/flyer/87876.pdf>.
- 42 GSMA, "Universal Service Fund Study", April 2013. Available at https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf.
-

-
- 43 A4AI, "Universal Access and Service Funds in the Broadband Era: The Collective Investment Imperative", May 2015. Available at http://a4ai.org/wp-content/uploads/2015/06/A4AI-USAF_06.2015_FINAL.pdf.
- 44 ITU, "Universal Service Fund and Digital Inclusion for All", September 2013. Available at https://www.itu.int/en/ITU-D/Regulatory-Market/Documents/USF_final-en.pdf.
- 45 USAID, Managing Universal Service Funds for Telecommunications: An ASEAN Manual for Output-Based Aid", September 2009. Available at https://pdf.usaid.gov/pdf_docs/pnaeb219.pdf.
- 46 Arturo Munte-Kunigami and Juan Navas-Sabater, "Option to Increase Access to Telecommunications Services in Rural and Low-Income Areas", World Bank Working Paper No. 178, 2010. Available at <http://documents1.worldbank.org/curated/ar/277671468330886996/pdf/518390PUB0REPL101Official0Use0Only1.pdf>.
- 47 GSMA, "Universal Service Fund Study", April 2013. Available at https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf.
- 48 ESCAP, "The Impact of Universal Service Funds on Fixed-Broadband Deployment and Internet Adoption in Asia and the Pacific", Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, October 2017. Available at <https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf>.
- 49 Ibid.
- 50 Chanuka Wattegama, Juni Soehardjo and Nilusha Kapugama, "Telecom Regulatory and Policy Environment in Indonesia: Result and Analysis of the 2008 TRE Survey", 18 March 2008. Available at https://irneasia.net/wp-content/uploads/2009/07/TRE_Indonesia_2009Mar18.pdf.
- 51 HBR radiofrequency technologies, "Indonesia". Available at <https://halberdbastion.com/intelligence/countries-nations/indonesia> (accessed on 20 April 2021).
- 52 GSMA, "Network Coverage Maps". Available at <https://www.gsma.com/coverage/> (accessed on 20 April 2021).
- 53 Hardik Khatri, "Palapa Ring has successfully improved mobile connectivity in remote Indonesian islands", Opensignal, 26 November 2020. Available at <https://www.opensignal.com/2020/11/26/palapa-ring-has-successfully-improved-mobile-connectivity-in-remote-indonesian-islands>.
- 54 Ayman Falak Medina, "Indonesia's Palapa Ring: Bringing Connectivity to the Archipelago", ASEAN Briefing, 28 January 2020. Available at <https://www.aseanbriefing.com/news/indonesias-palapa-ring-bringing-connectivity-archipelago/>.
- 55 Observatory of Economic Complexity, "Kyrgyzstan". Available at <https://oec.world/en/profile/country/kgz> (accessed on 20 April 2021).
- 56 A. Kadyrkulov, "Telecommunications regulation in Kyrgyz Republic: today & tomorrow", presented at the 10th Anniversary Caspian Telecom Conference and Showcase, April 2011. Available at <https://static.caspianworld.com/speech/casptel/2011/day1/session1/Almazbek-Kadyrkulov.ppt>.
- 57 World Trade Organization, "Telecommunications commitments and exemptions". Available at https://www.wto.org/english/tratop_e/serv_e/telecom_e/telecom_commit_exempt_list_e.htm (accessed on 20 April 2021).
- World Trade Organization, "The Kyrgyz Republic: Schedule of Specific Commitments", 22 April 1999. Available at https://www.wto.org/english/tratop_e/serv_e/telecom_e/sc125.doc.
- 58 Civil Initiative on Internet Policy, "Telecommunications Market Overview in the Kyrgyz Republic", 2015. Available at <https://internetpolicy.kg/wp-content/uploads/2017/01/%D0%9E%D0%91%D0%97%D0%9E%D0%A0-%D0%A0%D0%AB%D0%9D%D0%9A%D0%90-%D0%A2%D0%95%D0%9B%D0%95%D0%9A%D0%9E%D0%9C%D0%9C%D0%A3%D0%9D%D0%98%D0%9A%D0%90%D0%A6%D0%98%D0%99-%D0%92-%D0%9A%D0%AB%D0%A0%D0%93%D0%AB%D0%97%D0%A1%D0%9A%D0%9E%D0%99-%D0%A0%D0%95%D0%A1%D0%9F%D0%A3%D0%91%D0%9B%D0%98%D0%9A%D0%95.docx>.
- 59 ESCAP, "Broadband for Central Asia and the road ahead", ESCAP Technical Paper, October 2009. Available at <https://www.unescap.org/sites/default/files/Broadband%20for%20Central%20Asia%20and%20the%20road%20ahead.pdf>.
- 60 Statistical Commission and Economic Commission for Europe, "The impact of government's information policy on the data dissemination by national statistical offices", Working Paper No. 11, paper presented at the Conference of European Statisticians, October 2002. Available at <https://unece.org/fileadmin/DAM/stats/documents/ece/ces/2002/10/infmedia/11.e.pdf>.
- 61 Robin Mansell and Uta Wehn, "Knowledge Societies: Information Technology for Sustainable Development", Oxford University Press for UN Commission for Science and Technology for Development, January 1998. Available
-

at https://www.researchgate.net/publication/246620449_Knowledge_Societies_Information_Technology_for_Sustainable_Development.

62 United Nations Economic Commission for Europe, *Towards a Knowledge-Based Economy: Kyrgyzstan – Country Readiness Assessment Report* (New York and Geneva, 2002). Available at <https://unece.org/fileadmin/DAM/ie/enterp/documents/coverpagkyrgyz.pdf>.

63 Ibid.

64 Michelle Afifa Harris, “Cargo Cult; The Search for Development through ICTs”, Institute for Sustainable Development, 2009. Available at <https://sta.uwi.edu/conferences/09/salises/documents/M%20Harris.pdf>.

65 FMA, “Philippine ICT body presents roadmap, civil society takes a stand”, Association for Progressive Communications, 25 July 2006. Available at <https://www.apc.org/en/news/hr/world/philippine-ict-body-presents-roadmap-civil-society>.

66 Ministry of Housing and Local Government, Government of Malaysia, “National Urbanisation Policy”, 8 August 2006. Available at <https://www.planmalaysia.gov.my/index.php/agensi/penerbitan-planmalaysia/agensi-dokumen-dasar/1944-dasar-perbandaran-negara-bi/file>.

67 ITU, “Best Practice Guidelines for the Promotion of Low-Cost Broadband and Internet Connectivity”, 2004. Available at http://www.itu.int:80/ITU-D/treg/bestpractice/2004/best_practice_e.pdf.

68 OECD, “Recommendation of the OECD Council on Broadband Development”. Available at <https://www.oecd.org/digital/ieconomy/recommendationoftheoecdouncilonbroadbanddevelopment.htm> (accessed on 20 April 2021).

69 Simon Lacey, “Implementation of National Broadband Plans: Agreed Regulatory Principles and Their Evolution”, SSRN Electronic Journal (December 2011). Available at https://www.researchgate.net/publication/255726515_Implementation_of_National_Broadband_Plans_Agreed_Regulatory_Principles_and_Their_Evolution.

70 ESCAP, “The Impact of Universal Service Funds on Fixed-Broadband Deployment and Internet Adoption in Asia and the Pacific”, Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, October 2017. Available at <https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf>.

71 Civil Initiative on Internet Policy, “Telecommunications Market Overview in the Kyrgyz Republic”, 2015. Available at <https://internetpolicy.kg/wp-content/uploads/2017/01/%D0%9E%D0%91%D0%97%D0%9E%D0%A0%D0%A0%D0%AB%D0%9D%D0%9A%D0%90-%D0%A2%D0%95%D0%9B%D0%95%D0%9A%D0%9E%D0%9C%D0%9C%D0%A3%D0%9D%D0%98%D0%9A%D0%90%D0%A6%D0%98%D0%99-%D0%92-%D0%9A%D0%AB%D0%A0%D0%93%D0%AB%D0%97%D0%A1%D0%9A%D0%9E%D0%99-%D0%A0%D0%95%D0%A1%D0%9F%D0%A3%D0%91%D0%9B%D0%98%D0%9A%D0%95.docx>.

72 Japan International Cooperation Agency, “JICA Telecom Study: Volume IV – History of Mongolian Telecommunications Sector”, no date. Available at https://openjicareport.jica.go.jp/pdf/11305547_02.pdf.

73 ITU, “The Law of Mongolia on Telecommunications”, 16 November 1995. Available at https://www.itu.int/ITU-D/treg/Legislation/Mongolia/Mongolia_law.htm.

74 Andrew McLaughlin, “IT Regulation for Mongolia’s Future”, Harvard University Law School, 19 June 2003. Available at <https://cyber.harvard.edu/mclaughlin/presentations/mclaughlin-itregformongoliasfuture-19jun03.pdf>.

75 Japan International Cooperation Agency, “JICA Telecom Study: Volume V – Policy Document (The Government of Mongolia: Good Governance for Human Security Programme)”, January 2001. Available at https://openjicareport.jica.go.jp/pdf/11721487_003.pdf.

76 Lkhagvasuren Ariunaa, “Information and Communication Technology Policy in Mongolia”, Research on ICT Policy in Mongolia, Mongolian Foundation for Open Society, 2007. Available at <https://spacejournal.ohio.edu/issue5/pdf/ariunaa.pdf>.

77 ADB, “Grant Assistance to Mongolia for Information and Communication Technology (ICT) for Innovating Rural Education”, April 2004. Available at <https://www.adb.org/sites/default/files/project-document/70013/jfcit-mon-36245.pdf>.

78 Ibid.

79 Shengru Li and others, “The Influence of Teachers’ Professional Development Activities on the Factors Promoting ICT Integration in Primary Schools in Mongolia”, *Education Sciences*, vol. 9, no. 2 (April 2019). Available at https://www.researchgate.net/publication/332388985_The_Influence_of_Teachers'_Professional_Development_Activities_on_the_Factors_Promoting_ICT_Integration_in_Primary_Schools_in_Mongolia.

80 Robert B. Kozma, “ICT, Education Reform, and Economic Growth: A Conceptual Framework”, Intel White Paper,

April 2008. Available at <https://www.intel.com/content/dam/www/public/us/en/documents/brochures/kozma-wp1-conceptual-framework.pdf>.

81 Halit Ünver, "Explaining Education Level and Internet Penetration by Economic Reasoning – Worldwide Analysis from 2000 through 2010", *International Journal for Infonomics*, vol. 7, no. 1/2 (March/June 2014). Available at <https://infonomics-society.org/wp-content/uploads/iji/published-papers/volume-7-2014/Explaining-Education-Level-and-Internet-Penetration.pdf>.

84 Ronald Duncan, "Telecommunications in Papua New Guinea", *World Scientific Studies in International Economics, Priorities and Pathways in Services Reform – Part II*, 2013. Available at https://www.worldscientific.com/doi/abs/10.1142/9789814504690_0002.

85 Oxford Business Group, "New operators and reforms in Papua New Guinea set to transform telecoms sector". Available at <http://www.oxfordbusinessgroup.com/overview/competitive-bet-new-operators-and-government-reforms-are-set-transform-telecoms-industry> (accessed on 20 April 2021).

86 Papua New Guinea – PNG Buai Digital Information Project, "Papua New Guinea Telecommunication Authority (PANGTEL)". Available at <http://www.pngbuai.com/600technology/information/waigani/pangtel/WS97-sec24-PANGTEL.html> (accessed on 21 April 2021).

87 Structure of Papua New Guinea Telecommunication Authority. Available at https://web.archive.org/web/20010302183747fw_/http://www.pangtel.gov.pg/pangtel/struc.html (accessed on 21 April 2021).

88 Ronald Duncan, "Telecommunications in Papua New Guinea", *World Scientific Studies in International Economics, Priorities and Pathways in Services Reform – Part II*, 2013. Available at https://www.worldscientific.com/doi/abs/10.1142/9789814504690_0002.

89 Andrew Wasina, "Competition Law and Independent Consumer and Competition Commission in Papua New Guinea", paper presented at the 4th APEC Training Course on Competition Policy, August 2004. Available at <https://www.jftc.go.jp/eacpf/05/APECTrainingProgramAugust2004/png.wasina.pdf>.

90 Oxford Business Group, "New operators and reforms in Papua New Guinea set to transform telecoms sector". Available at <http://www.oxfordbusinessgroup.com/overview/competitive-bet-new-operators-and-government-reforms-are-set-transform-telecoms-industry> (accessed on 20 April 2021).

91 Masalai Blog, "Digicel announces full interconnection across Papua New Guinea", 19 June 2008. Available at <http://masalai.wordpress.com/2008/06/19/digicel-announces-full-interconnection-across-papua-new-guinea/>.

92 Ronald Duncan, "Telecommunications in Papua New Guinea", *World Scientific Studies in International Economics, Priorities and Pathways in Services Reform – Part II*, 2013. Available at https://www.worldscientific.com/doi/abs/10.1142/9789814504690_0002.

93 Felix Rupokei, "Papua New Guinea QoS Regulatory Framework", presented at the ITU Workshop on Telecommunication Service Quality as Enabler of the Digital Economy, August 2019. Available at https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201908/Documents/Felix_Rupokei_Presentation.pdf.

94 National ICT Authority, PNG, "Determinations". Available at <https://www.nicta.gov.pg/legislative/determinations/> (accessed on 20 April 2021).

95 John Fallon, "State Owned Enterprises in Papua New Guinea: Public Policies and Performance", *Economic Insights*, 20 October 2015. Available at <https://img1.wsimg.com/blobby/go/64c2b0a3-2ddc-4fb7-89bd-b4542ecc4b8e/downloads/EconomicInsightsPNGSOEsNRIRReport.pdf?ver=1622334409683>.

96 Oxford Business Group, "New operators and reforms in Papua New Guinea set to transform telecoms sector". Available at <http://www.oxfordbusinessgroup.com/overview/competitive-bet-new-operators-and-government-reforms-are-set-transform-telecoms-industry> (accessed on 20 April 2021).

97 Joseph Kim Suwamaru, "Beneath the veil of the Kumul Submarine Cable Network", *Electronic Journal of Informatics*, vol. 2 (June 2020). Available at <https://www.dwu.ac.pg/en/images/1-Suwamaru-Beneath-the-veil-of-the-Kumul-Submarine-Cable-Network.pdf>.

98 Ibid.

99 National ICT Authority, PNG, "Universal Access and Service Projects for 2020", May 2019. Available at https://uas.nicta.gov.pg/images/2020_public_CFP/ProposalDataCo.pdf.

100 Lae Chamber of Commerce, "PNG Dataco looks to build PNG's communications infrastructure", January 2015. Available at <https://www.lcci.org.pg/2015/01/png-dataco-looks-to-build-pngs-communications-infrastructure/>.

101 OECD, "Recommendation of the Council concerning Structural Separation in Regulated Industries", April 2001.

Available at <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0310>.

102 Gustav Grundin and others, “Can telcos create more value by breaking up?” McKinsey & Company, 22 January 2020. Available at <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/can-telcos-create-more-value-by-breaking-up>.

103 Georgina Hutton, “BT and Openreach”, House of Commons Library Briefing Paper Number CBP 7888, 11 January 2019. Available at <https://researchbriefings.files.parliament.uk/documents/CBP-7888/CBP-7888.pdf>.

104 OECD, “Structural separation in regulated industries: Report on implementing the OECD recommendation”, 2016. Available at <https://www.oecd.org/daf/competition/Structural-separation-in-regulated-industries-2016report-en.pdf>.

105 APNIC, “Whowas”. Available at <https://www.apnic.net/static/whowas-ui/#AS17828> (accessed on 21 April 2021).

106 ICCC, “Determination and Reasons on Authorization Application by Kumul Consolidated Holdings Limited and Telikom PNG Limited in respect of a Proposed Merger of PNG DataCo Limited and Telikom PNG Limited”, 2018. Available at <https://www.iccc.gov.pg/public-register-documents-h/competition/authorization-request/a2017-datacor-03-april-2017-kchl-and-telikom-png-limited-acquisition/06-draft-determination-18/648-telikom-and-dataco-merger-authorization-determination-non-confidential-f/file>.

107 Ibid.

108 Bronwyn E. Howell, Petrus H. Potgieter and Ronald Sofo, “Regulating for telecommunications competition in developing countries: Papua New Guinea”, *Asian-Pacific Economic Literature*, vol. 33, no. 1 (May 2019). Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/apel.12248>.

109 Shane McLeod, “Debt threatens Digicel’s Pacific dominance”, Lowy Institute, 22 June 2020. Available at <https://www.lowyinstitute.org/the-interpreter/debt-threatens-digicel-s-pacific-dominance>.

110 ADB, “ADB Approves \$25 Million Cornerstone Investment to Improve Telecom Services in PNG”, . Available at <https://www.adb.org/news/adb-approves-25-million-cornerstone-investment-improve-telecom-services-png>.

111 Yukiko Yamamoto and Shinobu Yamaguchi, “A Study on Teacher’s Self-Efficacy for Promoting ICT Integrated Education in Primary School in Mongolia”, CICE Hiroshima University, *Journal of International Cooperation in Education*, vol. 18, no. 2 (2016). Available at https://www.researchgate.net/profile/Yukiko-Yamamoto/publication/312059616_A_study_on_teacher%27s_self-efficacy_for_promoting ICT_integrated_education_in_primary_schools_in_Mongolia/links/586db64508aebf17d3a73119/A-study-on-teachers-self-efficacy-for-promoting-ICT-integrated-education-in-primary-schools-in-Mongolia.pdf.

