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Development Sector

Giga: Empowering communities in Asia and the Pacific through school connectivity

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Executive summary

Broadband connectivity and ICTs are powerful enablers that accelerate progress towards all 17 United Nations Sustainable Development Goals (SDGs). However, some 3.7 billion people in the world do not have access to the Internet. The absence of meaningful Internet connectivity means exclusion, marked by the lack of access to the wealth of information available online, fewer resources to learn and to grow, and limited opportunities for the most vulnerable children and youth to fulfil their potential.

The COVID-19 pandemic has highlighted many of the inequalities in the world, including the digital divides between and within countries. Countries with strong digital ecosystems are more resilient to shocks and emergencies and have been better able to respond to the COVID-19 pandemic. The learning of a whole generation of young people has been impacted by school closures brought about by COVID-19. According to UNICEF, 1.6 billion children in 188 countries have been affected by school closures. However, children have not been affected equally. Children in poorer countries without an inclusive digital infrastructure and comprehensive digital learning practices have been more disadvantaged than children in richer countries. Many of the countries in Asia and the Pacific had to rely on low tech distance learning solutions due to lacking connectivity.

Giga, a joint collaboration between ITU and UNICEF, is an initiative to connect every young person in the world to information, opportunity and choice. Devised before the onslaught on COVID-19, the project addresses the underlying inequities in access to the Internet. However, it is also a platform for creating the infrastructure necessary to provide digital connectivity to an entire country, for every community and for every citizen. With schools as a focal point, Giga seeks to build robust digital ecosystems, so communities everywhere can cope with shocks such as COVID-19 and ensure that no one is left behind. To achieve this goal, Giga builds on four pillars: map, finance, connect, empower.

Map. Mapping of schools helps identify the connectivity problems and gauge the magnitude of the challenge in each country. Top-down and bottom-up approaches to mapping school connectivity support this endeavour. Challenges in data collection can be tackled by blending top-down and bottom-up mapping approaches, leading to the identification of connectivity gaps and optimum allocation of resources. In potential Giga countries across Asia and the Pacific the study revealed varying levels of data on school connectivity. To date, mapping of school connectivity has been limited indicating significant scope to engage in mapping exercises to understand country specific connectivity gaps.

Connect. There are various infrastructure and technology solutions available that could bring affordable connectivity to the unconnected schools identified by the mapping exercise, including established technologies such as Wi-Fi, satellite, and fibre. Emerging solutions such as TV white space, Li-Fi, and Open RAN also offer promise. In Asia and the Pacific, private and public sector actors have deployed a variety of solutions. There is significant scope for scaling up these solutions to deliver greater school connectivity. However, they must be evaluated within the local context and fit-for-purpose solutions deployed. Giga continuously explores best case policy approaches that support greater school connectivity through particular investment infrastructure projects.

Finance. The selection of appropriate financing mechanisms depends on the magnitude of the challenge. The costing analysis can only take place after mapping connectivity gaps and determining fit-for-purpose connectivity solutions. Government budgets or universal service funds (USFs) could address small- to medium-sized connectivity gaps. All countries studied have established USFs, however few include schools in their universal service policies. Meanwhile, more significant challenges may require multilateral development banks, blended finance solutions, and the leveraging of financial instruments such as bonds. Furthermore, sustainable business models are needed to ensure the long-term financial viability of school connectivity initiatives while bringing affordable access to schools and communities. Various countries in Asia and the Pacific have established policy frameworks that nurture blended finance approaches, the region further presents various successful case studies of innovative business models for sustainable connectivity.

Empower. Bringing connectivity to schools will have a limited impact if e-learning solutions are not in place and if educators do not have the digital skills to empower learners. There are many case studies from Asia and the Pacific of initiatives that aim to empower digital learning. Integrating digital skills development into the policies of ministries of education is crucial for ensuring that connectivity leads to empowerment. Giga partners with programmes such as the Digital Public Goods Alliance, Reimagine Education and GenU to ensure that every young person has access to information, opportunity and choice. The region further boasts a wide range of dynamic initiatives with existing partners that could expand with the support of Giga and the connectivity it can facilitate. However, these initiatives may not currently be reaching the most vulnerable and in need due to the connectivity gaps that Giga will address.

Progress of Giga in Asia and the Pacific. Giga has made significant progress since its launch. It is already active in 17 countries in three regions. Countries in Asia and the Pacific are next to join the Giga initiative. Several countries have expressed interest, including Bhutan, Pakistan, Mongolia, Bangladesh, Papua New Guinea, Vanuatu and Fiji. Each country has its own opportunities and challenges in terms of extending connectivity. The review of policies, regulatory environment, school connectivity initiatives and availability of connectivity data in potential Giga countries and the assessment of use cases strongly indicate that there is significant promise for the expansion of Giga in the region. The countries identified have most of the foundational elements to move along the Giga implementation pathway.

The way forward. To move forward and to bring great connectivity to schools in Asia and the Pacific, a comprehensive approach for mapping a school's connectivity that engages a wide range of stakeholders is crucial. Existing government policies need to be leveraged to deliver greater connectivity. This would include the effective utilization of universal service obligations (USOs) and USFs to connect schools. However, there is much to understand. There is a need to pilot and evaluate connectivity solutions and business models for long-term sustainability. Finally, digital empowerment is not only a grass-roots mission. Education ministries must also embrace the importance of digital skills and have ownership of connectivity and empowerment initiatives to generate the conditions for long-term connectivity in disadvantaged communities and rural and remote regions.

Abbreviations and acronyms

ADB	Asian Development Bank
BDT	Telecommunication Development Bureau
CAPEX	capital expenditure
EMIS	education management information system
FAO	Food and Agriculture Organization of the United Nations
FDI	foreign direct investment
GAVI	Global Alliance for Vaccines and Immunization
GDP	gross domestic product
GNI	gross national income
IBRD	International Bank for Reconstruction and Development
ICT	information and communication technology
IoT	Internet of Things
ISP	Internet service provider
IT	information technology
ITU	International Telecommunication Union
LDC	least developed country
LLDC	landlocked developing country
MoU	memorandum of understanding
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
OPEX	operational expenditure
QoS	quality of service
RAN	radio access network
SDGs	Sustainable Development Goals
SIDS	small island developing State
STEM	science, technology, engineering and mathematics
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme

(continued)

UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USF	universal service fund
USO	universal service obligation
WHO	World Health Organization

1 Introduction

Source: @UNICEF/UN0403415/Stephen Infinity Images

1.1 Leaving no one behind: Broadband and the Sustainable Development Goals

Broadband connectivity and ICTs are powerful enablers that accelerate progress towards all 17 United Nations Sustainable Development Goals (SDGs). Mobile and fixed-line broadband penetration have a positive impact on gross domestic product (GDP) growth[1]. Broadband can support ending poverty and promoting inclusive and sustainable economic growth; improving food security and promoting inclusive and equitable education; improving health care and health information systems; and building resilient infrastructure while fostering innovation. Underpinning the 2030 Agenda for Sustainable Development is the pledge to "leave no one behind". COVID-19 has demonstrated that now, more than ever, this means leaving no one offline.

However, some 3.7 billion people in the world do not have access to the Internet. The absence of meaningful Internet connectivity means exclusion, marked by the lack of access to the wealth of information available online, fewer resources to learn and to grow, and limited opportunities for the most vulnerable children and young people to fulfil their potential. Gaps in Internet connectivity are most striking in the least developed countries (LDCs), landlocked developing countries (LLDCs) and small island developing States (SIDS). Asia and the Pacific are not immune

[1] ITU, *Economic Impact of Broadband in LDCs, LLDCs, and SIDS: An Empirical study* (2019), https://www.itu.int/dms_pub/itu-d/opb/ldc/D-LDC-BROAD_IMP.01-2019-PDF-E.pdf.

to this. While the region has many success stories in terms of broadband connectivity, there remain many gaps within and between countries, especially among landlocked and island States.[2]

According to ITU, there has been significant growth in access to mobile broadband in Asia and the Pacific, which increased from 61.7 to 76.6 per 100 inhabitants between 2017 and 2020. However, many economies continue to have low rates below 50 per 100 inhabitants, including Afghanistan, India, Lao P.D.R., Pakistan, Papua New Guinea, Republic of Nepal, and Timor-Leste as well as several small island States such as Kiribati, Samoa and the Solomon Islands. There are also persistent disparities in access to fixed-line broadband in Asia and the Pacific. While fixed-line subscriptions stand at 15 per 100 inhabitants, which is nearly on par with the world average of 15.2 per cent, the average is skewed by some countries in the region with exceptionally high rates of access to fixed-line broadband, such as the Republic of Korea (42.76 per cent), Australia (34.73 per cent), New Zealand (34.72 per cent), Japan (33.5 per cent) and China (31.34 per cent). Many economies have less than five subscriptions per 100 and some have less than one. Thus, while there has been some progress in closing the digital divide, much remains to be done.[3]

There are many barriers to building the necessary infrastructure to support broadband and access to ICTs, particularly vast geographical distances, rugged and inhospitable terrain, and widely dispersed island communities. Rural and remote communities are often left cut off from the Internet due to the high cost and low return associated with network deployment in sparsely populated areas. Therefore, a concerted effort combining private and public resources to bridge the digital divide and bring the underserved online is as important as ever.

However, just extending network coverage is not enough to ensure the benefits of increased broadband penetration. In addition to the coverage gap, there remains a large affordability gap that leaves many individuals unconnected, particularly in LDCs, LLDCs, and SIDS, even though they live within broadband coverage. In many LDCs, LLDCs, and SIDS, the average cost of mobile packages as a per cent of gross national income (GNI) is significantly higher than the 2 per cent affordability target.[4] This underlines the importance of holistic connectivity initiatives that go beyond coverage and bring affordable connectivity opportunities to the unconnected.

1.2 The digital divide and the impact of the COVID-19 pandemic

The COVID-19 pandemic has highlighted many of the inequalities in the world, including the digital divides between and within countries. Countries with strong digital ecosystems are more resilient to shocks and emergencies and have been better able to respond to the COVID-19 pandemic. On the other hand, countries with weak digital infrastructure have struggled to respond adequately, leaving their citizens further behind.[5] The difference between having and not having meaningful Internet connectivity has been particularly evident in terms of the impact of COVID-19 on children's education.

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2 UNESCAP, "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific," Asia-Pacific Information Superhighway (AP-IS) Working Paper Series (Bangkok, Thailand, 2020). https://www.unescap.org/sites/default/files/Connecting_Last_Miles_broadband_ids.pdf.

3 ITU, *Digital Trends in Asia and the Pacific 2021* (2021), https://www.itu.int/en/myitu/Publications/2021/03/08/09/13/Digital-Trends-in-Asia-Pacific-2021.

4 ITU, *The affordability of ICT services 2020* (2020), https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2020/ITU_A4AI_Price_Briefing_2020.pdf.

5 "Digital Resilience against Covid-19," 2020, https://www.unescap.org/blog/digital-resilience-against-covid-19.

The learning of a whole generation of young people has been impacted by school closures brought about by COVID-19. According to UNICEF, 1.6 billion children in 188 countries have been affected by school closures.[6] However, the impact has been uneven, compounding pre-existing inequities within and between countries. Digital learning has been fundamental for the continuation of education during the pandemic, but at least an estimated 31 per cent – 463 million school children – could not be reached by digital and broadcast remote learning programmes. As a result, school children in the poorest countries are falling further behind.

In Asia and the Pacific, the response to school closures highlights the limitations of countries with low rates of school and household connectivity. To ensure the continuation of learning, the education sector scrambled to establish means of distance learning utilizing various modes of delivery. Due to the lack of human capital, resources and Internet connectivity, developing countries often had to rely on low-tech or no-tech solutions. A common mode of delivery has been TV and/or radio. For example, Afghanistan[7], Mongolia[8], Pakistan[9], Lao P.D.R.[10], and Papua New Guinea[11] developed and broadcasted lessons over TV networks. Although TV penetration is high in many countries, not all children have access to a TV, leading to a reliance on completely analogue modes of distance learning in some cases. With its low TV penetration rate, Papua New Guinea's response plan depended on the distribution of printed materials to students.[12] While also relying on printed materials, Lao P.D.R. with support from UNICEF developed a plan to provide satellite dishes to remote locations to increase access to TV lessons[13].

To develop and execute COVID-19 responses, developing countries relied heavily on financial and technical support from international organizations. In some cases, partnerships with the private sector were leveraged to enable the continuation of education during the pandemic. Afghanistan planned to partner with TV broadcasters to improve the delivery of TV lessons.[14] In Lao P.D.R., UNICEF planned to tap into its partnership with Microsoft and Cambridge University to set up an online and offline teaching and learning platform for students, teachers and pedagogical advisers.[15]

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6 "COVID-19 and children," 2020, https://data.unicef.org/covid-19-and-children/.

7 Ministry of Education, Alternative Education Plan, Ministry of Education (2020), https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/afghanistan_final_consolidatedmoe_alternative_education_plan-english.pdf.

8 UNICEF, UNICEF Education COVID-19 Case Study: Mongolia– Safe back to school, UNICEF (2020), https://aa9276f9-f487-45a2-a3e7-8f4a61a0745d.usrfiles.com/ugd/aa9276_5416a03d55ec410d8b2c78e157bb7db2.pdf.

9 Ministry of Federal Education and Professional Training, Pakistan National Response and Resilience Plan (K-12) for Covid-19, Ministry of Federal Education and Professional Training (2020), http://mofept.gov.pk/SiteImage/Misc/files/0_%20NERRP%20COVID-19%20MoFEPT%204%20May%202020%20Ver%2001.pdf.

10 Ministry of Education and Sports, Lao PDR Education Covid-19 Response Plan, Ministry of Education and Sports (2020), https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/lao_pdr_education_covid-19_response_plan.pdf.

11 National Department of Education, COVID-19 Education Emergency Response and Recovery Plan, National Department of Education (2020), https://planipolis.iiep.unesco.org/en/2020/papua-new-guinea-covid-19-education-emergency-response-and-recovery-plan-4th-may-2020-6967.

12 National Department of Education, COVID-19 Education Emergency Response and Recovery Plan. https://planipolis.iiep.unesco.org/en/2020/papua-new-guinea-covid-19-education-emergency-response-and-recovery-plan-4th-may-2020-6967

13 UNICEF, *Lao PDR GPE COVID-19 Accelerated Funding Proposal*, UNICEF (2020), https://www.globalpartnership.org/sites/default/files/document/file/Application-and-program-document-for-covid-19-accelerated-funding-for-Lao-pdr-may-2020.pdf.

14 Ministry of Education, *Alternative Education Plan*. https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/afghanistan_final_consolidatedmoe_alternative_education_plan-english.pdf

15 UNICEF, *Lao PDR GPE COVID-19 Accelerated Funding Proposal*. https://www.globalpartnership.org/sites/default/files/document/file/Application-and-program-document-for-covid-19-accelerated-funding-for-Lao-pdr-may-2020.pdf

Despite these important efforts, children in poorer countries without access to an inclusive digital infrastructure and comprehensive digital learning practices have been greatly disadvantaged compared with children in richer countries. UNICEF reported that, by October 2020, school children in the poorest countries had already lost nearly four months of schooling since the start of the pandemic, compared to six weeks in high-income countries.[16] The disruption in learning will have a prolonged impact, and it is imperative that the digital education infrastructure and human capital are developed to ensure that such disruptions are minimized.

1.3 Giga: Connecting schools

Giga, a joint project between ITU and UNICEF, is an initiative to connect every young person in the world to the Internet, connecting them to information, opportunity and choice. Devised before the onslaught on COVID-19, the project addresses the underlying inequities in access to the Internet. It is also a platform for creating the infrastructure necessary to provide digital connectivity to all communities and all citizens in an entire country. With schools as a focal point, Giga seeks to build robust digital ecosystems, so that communities everywhere can cope with shocks such as COVID-19 and no one is left behind.

The UN is committed to ensuring connectivity for all with the UN Secretary-General's High-level Panel on Digital Cooperation's findings 1A and 1B recommending, respectively, that by "2030 every adult should have affordable access to digital networks" and "a broad, multi-stakeholder alliance, involving the UN, create a platform for sharing digital public goods"[17]. More recently the UN Secretary-General's Roadmap for Digital Cooperation highlighted the need for ambitious regional infrastructure development initiatives to achieve universal connectivity.

1.3.1 Giga's role as convenor

Giga's role in closing digital divides is as a convenor between funding opportunities and connectivity projects for schools in disconnected areas and, ultimately, their communities. As a convenor, Giga helps create greater transparency and accountability through the use of high-frequency data collection and blockchain, and provides technical advisory services to governments.

Giga has a clear value proposition involving: strategic partnerships with government and private sector actors; the ability to combine public and private funding; regulatory, network and digital infrastructure expertise; and a focus on the child (digital skills and education).

While Giga is led by ITU and UNICEF, it brings together a variety of multilateral international and regional partners in Asia and the Pacific, including UNESCO, the United Nations Capital Development Fund (UNCDF), the Asian Development Bank (ADB), and the Broadband Commission. Together, they bring a range of expertise and resources to the mission of bringing information, opportunity and choice to every young person in Asia and the Pacific.

Giga focuses on four pillars:

1. **Map:** Map schools to identify connectivity gaps;
2. **Finance:** Build affordable and sustainable finance models;

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16 UNICEF, "COVID-19 and children." https://data.unicef.org/covid-19-and-children/

17 United Nations Secretary-General's High-level Panel on Digital Cooperation https://www.un.org/en/sg-digital-cooperation-panel

3. **Connect:** Implement fit-for-purpose infrastructure to connect schools and, ultimately, every community and every citizen;
4. **Empower:** Empower schools and communities to improve learning and build digital skills by linking with other related initiatives.

1.3.2 Giga's achievements to date

Giga has made significant progress since its launch. It is already active in 17 countries in three regions. Over 900 000 schools have been mapped in more than 36 countries. School connectivity mapping in Kyrgyzstan enabled the government to save 40 per cent of its education connectivity budget. Globally, USD 22 million has been raised from partners to support Giga activities, while approximately USD 400 million has been mobilized for connecting schools. Kenya has already connected its first schools through Giga, while Kazakhstan, Kyrgyzstan, Rwanda and Sierra Leone are expected to start connectivity prototypes soon.

1.4 Giga in Asia and the Pacific

Several countries in Asia and the Pacific, including Bangladesh, Bhutan, Fiji, Indonesia, Mongolia, Pakistan, Papua New Guinea, the Philippines, Vanuatu and Viet Nam are in early-stage discussions on Giga. The school connectivity challenges in these countries are complex and varied. This study, therefore, was commissioned to examine the feasibility of these countries participating successfully in the Giga initiative and realizing its potential.

The study also elaborates on the four pillars of Giga and examines use cases from potential Giga participating countries and from other countries in the region. The explanation of the pillars and the introduction of various use cases is intended to demonstrate the feasibility of Giga in the context of Asia and the Pacific, while providing a guide for implementation.

1.4.1 Report structure

The body of this report includes five chapters covering the four pillars of bringing Internet connectivity to schools and a review of several potential Giga countries in Asia and the Pacific. The Way Forward chapter summarizes some of the key learning from the study and maps out a pathway forward for Giga in Asia and the Pacific.

The second chapter examines the Map pillar. It details how the mapping of schools helps identify the connectivity gaps, gauge the magnitude of the challenge and ensure accountability in each country. The chapter introduces top-down and bottom-up approaches to mapping school connectivity. It highlights some of the challenges of data collection and details how blending top-down and bottom-up mapping approaches can help to identify connectivity gaps and the optimum allocation of resources.

The third chapter addresses the Connect pillar and examines various regulatory, infrastructure and technology solutions that could bring affordable connectivity to unconnected schools identified by the mapping exercise. Drawing on use cases from Asia and the Pacific, the chapter demonstrates the diversity of solutions that have been deployed in the region and the capacity for them to be expanded to deliver greater school connectivity. The chapter further examines policy approaches that support greater school connectivity through particular investment and infrastructure projects.

The fourth chapter addresses the Finance pillar of school connectivity. It demonstrates how the selection of appropriate financing mechanisms depends on the magnitude and shape of the challenge. The costing analysis can only take place upon completing the mapping of connectivity gaps and identifying fit-for-purpose connectivity solutions. While government budgets or USFs could address small- to medium-sized connectivity gaps, significant challenges may require support from multilateral development banks, blended finance solutions, and the leveraging of financial instruments such as bonds.

Sustainable business models are needed to ensure the long-term financial viability of school connectivity initiatives. Hence, the fourth chapter also examines various sustainable business models and use cases from Asia and the Pacific.

The fifth chapter is concerned with the Empower pillar of school connectivity. Bringing connectivity to schools will have a limited impact if e-learning solutions are not in place and if educators do not have the digital skills to empower learners. The chapter therefore explores case studies from Asia and the Pacific to empower digital learning and show how ministries of education should integrate digital skills development into their policies.

In Giga, schools are an entry point for bringing greater connectivity to entire communities. The Empower pillar, therefore, also involves empowering entire communities in digital skills and creating platforms for accessing information and opportunities for financial inclusion, commerce, agriculture and health. The chapter illustrates a wide range of dynamic initiatives in the region that could expand with the support of the connectivity that Giga can facilitate. It also suggests that these initiatives may not reach the most vulnerable due to the connectivity gaps that Giga intends to address.

The sixth chapter recommends a way forward for Giga to bring connectivity to all schools in Asia and the Pacific. It emphasizes the importance of a comprehensive approach for mapping school connectivity that engages a wide range of stakeholders. It encourages leveraging existing government policies to deliver greater connectivity, including effectively utilizing USOs and USFs to connect schools. It acknowledges that there is much to understand and recommends the piloting of connectivity solutions and business models for long-term sustainability. Finally, it emphasizes the need to recognize that digital empowerment is not only a grass-roots mission. Ministries of education must also recognize the importance of digital skills if they are to empower schools and communities in rural and remote regions.

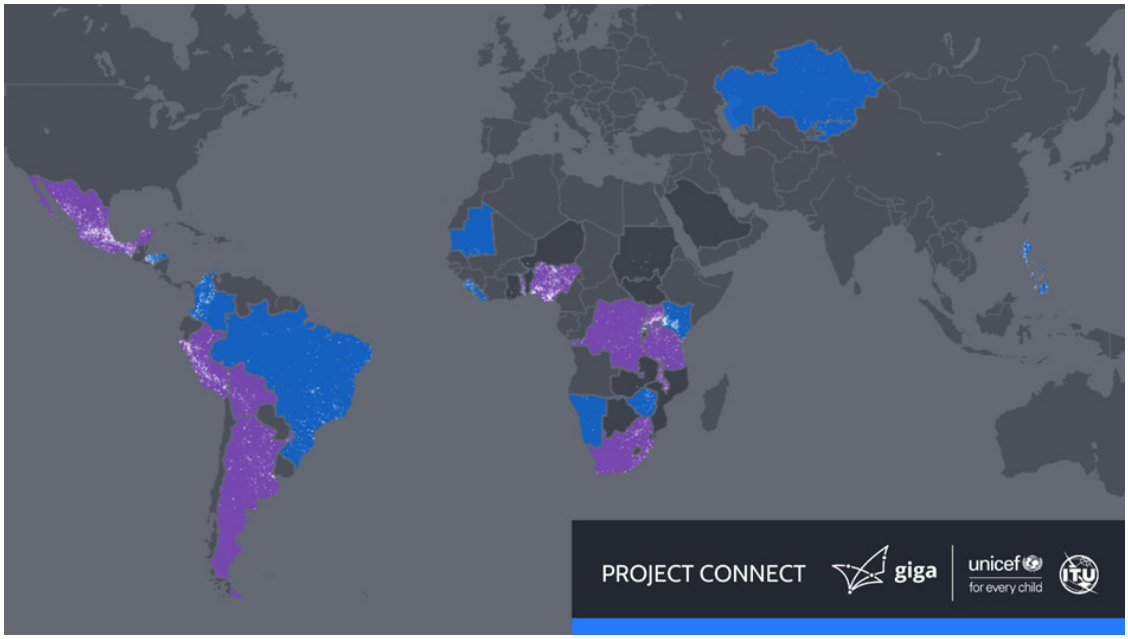
The final chapter presents an overview of several potential Giga countries by documenting their policies, regulatory environment, school connectivity initiatives and availability of connectivity data. The review of potential Giga countries and the assessment of use cases strongly indicate that there is significant promise for the expansion of Giga in the region. The countries identified have most of the foundational elements to move along the Giga implementation pathway. Furthermore, use cases are abundant in the region and should be studied and leveraged as models for executing and strengthening the pillars of Giga and establishing expanded school connectivity.

2 Map

Source: @UNICEF/UN0421882/Wilander

2.1 The purpose of school connectivity mapping

The Map pillar is foundational to Giga to close the digital divide in education. Fundamentally, school mapping involves creating a public map of school locations and their connectivity status. This information makes it possible to identify connectivity gaps and aggregate demand for connectivity to understand the magnitude and nature of the gaps so that further analysis can be undertaken to identify the right financing tools and connectivity solutions. Connectivity goes beyond availability of infrastructure and, importantly, includes access and usage. School connectivity does not just mean that a school has an Internet connection; it also concerns the quality and affordability of connectivity and whether it can meet pedagogical needs. To achieve this, Giga uses "live" updates about Internet quality of service in schools to build an efficient and transparent system to deliver connectivity to schools and their surrounding communities. In addition to mapping schools, an important part of Giga's mapping approach is the mapping of telecommunication infrastructure. Maps of network infrastructure are then overlaid with school connectivity maps to understand how far unconnected schools are from existing infrastructure. These insights help to determine the right solution for bringing Internet access to unconnected schools.



Source: UNICEF
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of ITU and of the secretariat of ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

2.2 Mapping challenges

Mapping school locations is a challenging task. In fact, often school location data do not exist. Although the government may have a comprehensive list of schools, information about their GPS coordinates is not available. Sometimes, even if the location data are available, it may not be valid and may belong to a GPS coordinate with no buildings. Furthermore, in many cases, it is not clear if the school has access to the Internet and governments do not have the systems needed to monitor their connectivity programmes at scale. Is connectivity reaching schools as expected? Are the resources invested in connectivity giving the expected results?

2.3 Mapping methods

A multifaceted approach to mapping the telecommunication infrastructure and coverage, which incorporates top-down and bottom-up methods, can help to address the challenges of connectivity mapping. A top-down approach utilizes secondary data from governments, Internet providers, etc. In contrast, a bottom-up approach focuses on local mapping. It incorporates sociodemographic data and environmental constraints of the targeted communities and may consider local demand requirements. A top-down approach has the advantage of being comprehensive, covering multiple communities and potentially numerous objectives. However, it is resource-intensive and regulatory support may be required to access data. A bottom-up approach, on the other hand, facilitates an in-depth examination of target communities. It is less resource-intensive but necessarily has a smaller scope. In practice, a mixture of both approaches can be used depending on the context.[18] An in-depth explanation of connectivity infrastructure mapping can be found in the ITU Last-mile Connectivity Guide.

[18] ITU, *The Last-mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites* (2020).

Below are some of the methods that Giga leverages to create live maps of school connectivity:

- Machine Learning: Giga uses machine learning algorithms to identify features of schools based on high-resolution satellite imagery. This allows Giga to map new schools, validate the accuracy of existing school location data, and automatically update maps when school locations change in the future.
- Partnerships: Giga is uniquely positioned to partner with both government and the private sector to develop a better map than either could create individually. Giga partners with ministries of education and ministries of information and communication technology, as well as mobile network operators, Internet service providers and other tech companies, to develop an open-source dataset for schools and telecommunication infrastructure.
- Live Internet measurement tools: To obtain periodical updates on the Internet service quality at schools and create a live connectivity map, Giga works with governments to deploy measurement tools in connected schools. Depending on the context, Giga has deployed both hardware- and software-based solutions.
- Data collection from the field: In cases when data simply do not exist, Giga works with governments and communities to develop datasets from the ground up. Our team has developed a number of tools and strategies to gather or crowdsource missing data and support governments with these assets to locate schools and evaluate connectivity status.

AI for school mapping

Innovations may help to overcome some of the complexities of school mapping. UNICEF has pioneered a bottom-up approach for school mapping using aerial satellite data and machine learning to identify unmapped schools. Between November 2018 and March 2019, UNICEF conducted a school mapping project in Colombia and the Eastern Caribbean using a combination of powerful deep learning techniques and trained human mappers.

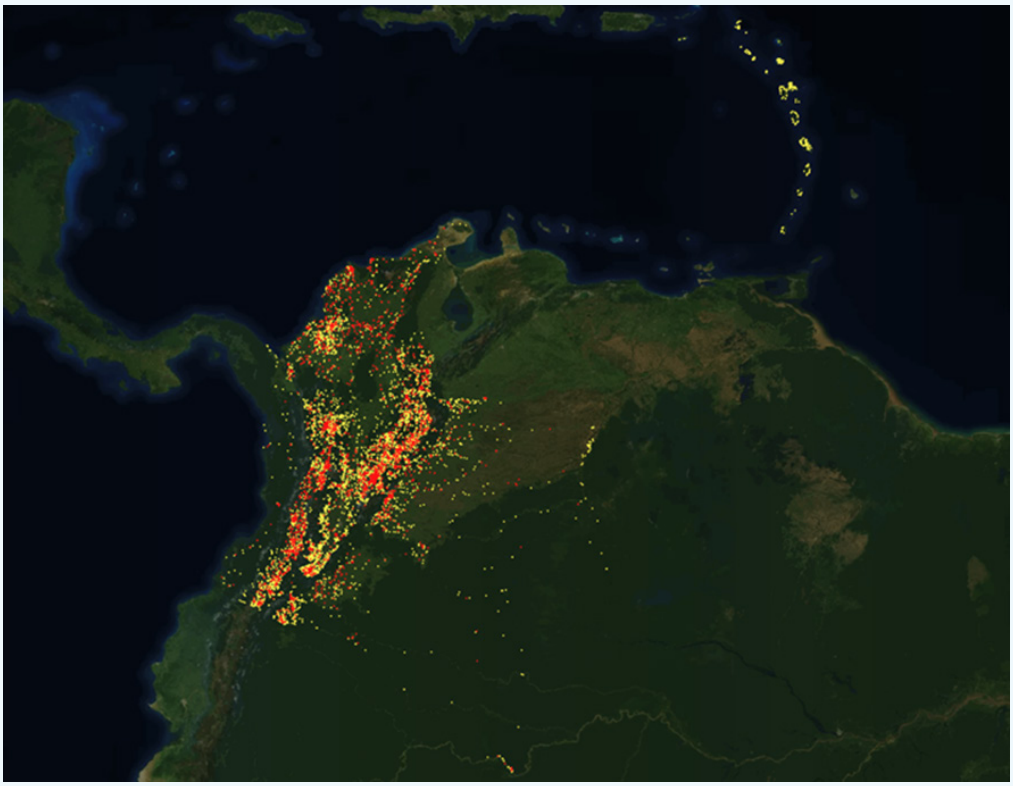
The method is based on the premise that, while school layouts may vary, they follow certain patterns that can be identified by machine learning (see picture for examples).

Figure 1: Examples of school layout patterns

The method begins by creating a high-quality map of known schools and then using the map to generate a training dataset for the AI. After iteration and tuning of the AI, the model can be run over satellite images of large areas to identify unmapped schools. In the last step, expert human mappers validate the AI predictions.

The application of this approach in Colombia led UNICEF to identify almost 7 000 previously unmapped schools over a large area (see picture). With AI assistance, this seemingly impossible task was possible for expert mappers to conduct within eight days.

Figure 2: Red: previously known school locations, Yellow: School location identified through the project. [1]



This approach has been applied successfully in a number of other countries including Niger and Sierra Leone. The effectiveness of this approach should be evaluated in the context of Asia-Pacific countries with varying terrain and schools that may physically vary in appearance depending on the jurisdiction. [2]

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1 Development Seed, *Project Connect: AI-Assisted School Mapping*. http://devseed.com/unicef-school-docs/

2 Development Seed, *Project Connect: AI-Assisted School Mapping*. http://devseed.com/unicef-school-docs/

2.3.1 Data for mapping school connectivity

Data for mapping school connectivity include data typical of connectivity mapping as well as other data specific to schools. For each school, Giga gathers the following data:

- School ID
- School name
- School location data (latitude, longitude)
- Availability of Internet connectivity (Yes/No)
- Speed of Internet connectivity (Mbit/s)
- Type of Internet connectivity (i.e. wireless, fibre, satellite)
- Real-time connectivity data (regular updates of Internet QoS – upload/download speeds, latency)
- Availability of electricity (Yes/No)
- Type of electricity (grid, solar, generator)
- Additional school indicators (i.e., number of students, number of teachers)
- Geographical information (village, region, province).

Giga also collects additional data which, when overlaid with school location data, provide key insights for Giga. These include:

- ICT infrastructure data (e.g. fibre backbones, mobile coverage, base stations and VSAT base stations)
- Electricity grid maps
- Road networks
- Population maps (age-disaggregated when available)
- Costs and pricing for different connectivity solutions (fibre, mobile, wireless, satellite)
- Other socio-economic indicators.

To complete an assessment of available data in potential Giga countries, a survey has been developed for completion by representatives in the respective countries or in collaboration with ITU and UNICEF. The purpose of the survey set out in the appendix is to ascertain the availability and accessibility of data on school locations, network coverage, electricity grids and the demography of the country.

2.3.2 School locations and ITU broadband maps

An important data point for school connectivity mapping is the geographic information system (GIS) location of schools. GIS location data can be overlaid with other datasets, such as topography, electricity or infrastructure and Internet transmission maps. ITU has developed a broadband map, which is an interactive online map of broadband transmission. It shows undersea and terrestrial backbone infrastructure and provides location intelligence through data visualization and a GIS tool for ICT development.

Currently, the map depicts data from over 480 operators, 19 775 notes, and over 3.5 million km of network infrastructure. The mapping tool also includes overlays of United Nations-recognized boundaries, natural Earth topography, and population. Combined with school location data, it is a powerful tool for identifying infrastructure gaps for school connectivity.[19]

[19] ITU, *The Last-mile Internet Connectivity Solutions Guide* (2020), https://www.itu.int/myitu/-/media/Publications/2020-Publications/Last-mile-Internet-connectivity-guide.pdf.

2.3.3 Multistakeholder engagement

A foundational part of Giga's mission is to provide a public, online map of every school in the world, including live data about the quality of each school's connectivity and its surrounding infrastructure. For this, it is necessary to involve various stakeholders that administer schools in the mapping process.

Giga works with a diverse range of stakeholders including various government entities, such as ministries of education or ICTs, international organizations, not-for-profit and technology companies as well as network providers.

2.4 School connectivity mapping study in Thailand

In the latter half of 2020, ITU, UNICEF and the United Nations Resident Coordinator commissioned a mapping study of school connectivity in Thailand. The study deployed a top-down approach and drew on a variety of data sources, including the National Statistics Office, the National Broadcasting and Telecommunications Commission, the Ministry of Education and data from an OECD survey. The study adopted multiple objectives to assess the scale of coverage, access and usage. It serves as a model for school mapping in Asia and the Pacific and offers learning for future mapping projects.

Key findings:

School connectivity:

- Approximately 255 (0.82 per cent of schools under the jurisdiction of the Office of the Basic Education Commission) are not connected to the Internet.
- Of the 255 schools that reported no connectivity, the study identified the location of 186 schools that were not connected to the Internet. Nearly two-thirds of these unconnected schools were small with fewer than one hundred students.
- The percentage of schools without Internet access was 2.6 in the North, 1.3 in the North East, 0.8 in the South and 0.3 in Central Thailand.
- Three out of ten schools in Thailand are connected via optical fibre. ADSL and VDSL connect more than 17 per cent of the schools. Nearly 6 per cent of the schools are connected using 3G and 4G cellular technology. A small percentage of schools are also connected to the Internet through the Wi-Fi of Net Pracharat – the village broadband Internet project.

Access to devices:

- On average, 17 students share one computer in a school, but there are differences between regions.
- On average, 19 students share one computer in the South, while 16 share one computer in the Central region, and 15 share one computer in the North.

As a result of these findings and the study's in-depth report on the digital divide among schools in Thailand, the Royal Thai Government will be better positioned to allocate resources to close the digital divide and reduce inequalities in the country.

Data collection challenges

Authors of the study commended the Ministry of Education in Thailand for maintaining a comprehensive list of schools with GPS coordinates. However, they noted several challenges for data collection and mapping, which serve as learning for school connectivity mapping other Giga countries:

- School GPS coordinates were not always consistent. In some cases, the coordinates were wrong, and in other cases, the number of digits in the coordinates varied.
- While the Ministry of Education keeps a record of all schools, it only records GPS coordinates and Internet connectivity for schools within the jurisdiction of the Office of the Basic Education Commission (OBEC).
- Schools under the jurisdiction of OBEC self-report the type of Internet connectivity, but it is unclear whether all school representatives have the technical knowledge to report accurately the type of connection.
- There was no common code for schools across datasets, creating data processing challenges.
- In principle, most of the required data are publicly available, but engagement with multiple contact persons in various agencies is needed to access the datasets.

Given these challenges, the report recommends that governments prioritize the establishment of a data management and sharing system that facilitates data interoperability across different jurisdictions. The report also emphasizes the need for an incremental and long-term approach to developing comprehensive maps of school connectivity that take into consideration the multiple stakeholders that must be included in the process.

2.5 Data management and sharing

Giga recognizes that digital cooperation is a key enabler of school connectivity. It is fundamental for digital cooperation that data created with public funds, such as school location data, are treated as a public good for sharing. Data governance, including guidelines, rules, principles and politics on data use, access and management, is also required. Such is the importance of public data sharing and management that it is a condition of engagement with Giga.

Governments in Asia and the Pacific should endeavour to go beyond data sharing and treat siloed datasets as an obstacle to efficiency, transparency and accountability. Ideally, common data management platforms should be established to support efficient analysis of school connectivity and, possibly, real-time monitoring on connectivity. The Philippines is an example in Asia and the Pacific of a country making strides towards open data sharing and management.

Philippines open data programme

To increase government accountability and transparency, the Philippines launched the Open Data programme. Under the programme, the government established an open data platform in 2013. The primary goal of the platform is to empower citizens to make informed decisions and to promote efficiency and transparency in government. The website is one of the more interactive public data sites, which encourages the public to request data and send in comment and suggestions.[1] To date the platform has published 310 datasets from various government sectors.[2] The country is also one of the eight founding states of the Open Government Partnership, a multilateral initiative that aims to secure tangible commitments from governments to promote transparency, empower citizens, fight corruption and harness new technologies to strengthen governance.[3]

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1 Waltraut Ritter, *Open Data in Asia An Overview of Open Data Policies and Practices in 13 Countries* (2014), https://knowledgedialogues.files.wordpress.com/2014/07/open-data-asia-09-2014.pdf.
2 "Open Data Philippines," 2020, https://www.gov.ph/data.
3 Government of the Philippines, *Open Data Philippines Action Plan 2014-2016* (2013), https://data.gov.ph/sites/default/files/Open%20Data%20Philippines%20Action%20Plan%202014-2016.pdf.

2.5.1 Child data protection

While data sharing is prioritized, it is imperative that child online protection is also prioritized. In line with the UN Principles on Personal Data Protection and Privacy, as well as UNICEF's Policy on Personal Data Protection, only school locations should be made public. Demographic data on students must be treated with sensitivity and individualized student data should be collected for a specified purpose only.

3 Connect

Source: @UNICEF/UN0367583/Raab

The Connect pillar is concerned with identifying the fit-for-purpose infrastructure and technological solution that address school connectivity gaps in an affordable, financially viable and sustainable manner. It also considers government deployment of policies for the development of affordable and sustainable infrastructure. These aspects of the Connect pillar are examined below and various use cases are presented from potential Giga countries in Asia and the Pacific.

Once mapping is conducted and gaps in school connectivity are identified and prioritized, the next step involves identifying the optimum infrastructure and technology solution based on several factors. It should be affordable, meaning that the resulting service pricing should be within affordability thresholds. It should meet usage requirements, meaning it must meet the quality of service required by the applications and programmes to be used by the target audience. The solution should be financially viable, and attention should therefore be given to efficiency and business model viability. The business model should be structured so as to be manageable within regulatory constraints. Finally, the revenue model should be sustainable and account for potential subsidies. Once the costing of the optimum solution is analysed, the appropriate financing model can be pursued, which will be discussed in the next chapter.

3.1 Last-mile connectivity solutions

Before discussing school connectivity solutions, it is helpful to understand where school connectivity challenges fit into the wider broadband infrastructure. The national network infrastructure is commonly divided into three sections that require different capacities and

different technologies. The first section is the core network, which connects the national network to the worldwide Internet. These systems and technologies require powerful servers and capacity for large amounts of data from numerous users. The second section is the middle-mile or backhaul network, which connects the core network to a central point-of-presence (POP) in the community. The technologies commonly used for the middle mile are fibre and satellite transmissions as they can provide high-bandwidth and low-loss transmission over relatively large distances. From there, the central POP connectivity is distributed to end-user devices through the last-mile or access network. The last-mile network is largely where school connectivity challenges lie, but it also presents the greatest variety of technological solutions depending on environmental limitations and user preference.

Last-mile connectivity solutions range from traditional technologies, such as fibre, copper or DSL cables, satellite transmission, Global System for Mobile Communications, e.g., 2G,3G,4G, etc., Wi-Fi, and more recent experimental technologies such as light fidelity (Li-Fi), TV White Space (TVWS), or Infrared.[20] Choosing the right technology solution for the last-mile network is vital for bringing sustainable connectivity to unconnected communities and schools; emergent and innovative technologies should be considered as last-mile technology solutions.

The following table summarizes the advantages and disadvantages of different last-mile technologies.

Mobile (GSM) networks: Advantages	**Mobile (GSM): Disadvantages**
High level of network access mobility	Broadband network access is costly
Relatively good service reliability	Cellular network access in rural areas is limited
Cost-effective to gain basic access to networks	Network speed varies with external factors such as weather and foliage
DSL/cable: Advantages	**DSL/cable: Disadvantages**
High level of network availability – especially in urban areas	Performance degradation strongly related to distance to the core network
Low infrastructure cost for access to homes and businesses	Speed limitations hinder the future-proofing of infrastructures
High service reliability and quick turnaround times for network maintenance and repairs	Copper cables prone to long-term damage and corrosion
Fibre: Advantages	**Fibre: Disadvantages**
Very high bandwidth capabilities at low latency	High cost for individual users
No susceptibility to electromagnetic interference	Glass wire cables prone to physical damage
Lightweight cables, service reliability and long lifespan	
Fixed wireless: Advantages	**Fixed wireless: Disadvantages**
Cost-effective to gain basic access to networks	Network speed varies with external factors, such as weather and foliage

[20] Wynand Lambrechts and Saurabh Sinha, "Last Mile Internet Access for Emerging Economies," Lecture Notes in Networks and Systems (Springer, 2019). https://doi.org/10.1007/978-3-030-20957-5.

(continued)

Standard protocols, such as WiMAX, already established	Network reliability and transmission speeds dependent on line-of-sight access
Potentially deliver transfer speeds of several 10's of Mbit/s	High latency typically associated with fixed wireless
Satellite: Advantages	**Satellite: Disadvantages**
Accessible from virtually anywhere in the world	Network speed varies with external factors, such as weather and foliage
High service reliability	High latency typically associated with connections
Li-Fi: Advantages	**Li-Fi: Disadvantages**
Low investment cost per household or business	Network reliability and transmission speeds dependent on line-of-sight access
Very high bandwidth transmissions	Always-on lights required for network access
Multiple users on single connection without degradation	Susceptible to environmental interference from other/ambient lights
Note. Reprinted from Last Mile Internet Access for Emerging Economies, by Lambrechts, Wynand, and Saurabh Sinha, retrieved from https://doi.org/10.1007/978-3-030-20957-5, Copyright by Springer, 2019	

3.1.1 Toolkits for last-mile connectivity

ITU has developed a toolkit of last-mile connectivity solutions as an aid for selecting and implementing interventions for connectivity. The toolkit is composed of a Last-Mile Connectivity Solutions Guide, interactive software tools, capacity-building material and guidelines for assisting implementation.[21]

ITU has also developed a Broadband Diagnostic Toolkit, which comprises a set of methodologies, software tools and parameters that allow decision-makers, network designers or infrastructure owners to support their decisions about connecting the unconnected.

3.2 Technology solutions for connecting schools

3.2.1 Public Wi-Fi to increase access in underserved areas

Public Wi-Fi can be an effective and low-cost technology with the potential to connect people who cannot afford regular Internet use. It offers low power consumption and low cost relative to cellular networks. Unlike cellular, Wi-Fi operates in an unlicensed spectrum, resulting in lower data transmission costs. Public Wi-Fi has thus become a popular option for Internet access in developing countries.[22] Below are examples of Wi-Fi being deployed to connect schools in South-East Asia.

[21] ITU, *The Last-mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites*.
[22] UNESCAP, "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific."

Net Pracharat, Thailand

The Thai Government has included the provision of Wi-Fi hotspots in its Net Pracharat project. While the project primarily aims to expand national broadband, one Wi-Fi hotspot per village was also installed at a public building, including schools and temples, providing free public Wi-Fi service to citizens at a speed of 30/10 Mbit/s.[1]

[1] UNESCAP, "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific."

Pipol Konek, the Philippines

The Government of the Philippines is following a similar approach with its Free Wi-Fi for All programme, Pipol Konek. Since 2016, the programme has aimed to establish Wi-Fi hotspots at public places such as schools, government offices and public hospitals throughout the country.[1] As of October 2018, the programme had reached approximately 2 965 290 unique devices/users at 1 904 live sites through the establishment of 18 points of presence.[2] In order to increase the roll-out of the programme, a partnership with UNDP was established in late 2018 to add another 6 000 last-mile connection sites.[3]

[1] DOST Information & Communication Technology Office, *Free Wi-Fi Internet Access in Public Places* (2015), https://dict.gov.ph/wp-content/uploads/2015/03/Free-Wi-Fi-Project-TOR.pdf.
[2] Albert C. Gabriel, *Pipol Konek: Free Wi-Fi Internet Access in Public Places Project* (2018), https://www.fma.ph/wp-content/uploads/2018/12/Free-Wifi-Internet-Access-in-Public-Places-Project-1.pdf.
[3] "Pipol Konek (Free Wi-Fi for All)," 2018, https://sustainabledevelopment.un.org/partnership/?p=33960.

3.2.2 TV white space

An alternative solution to more conventional technologies is TV white space (TVWS). It offers the opportunity to provide backhaul and access network connectivity at a lower cost.[23] TVWS utilizes TV band spectrum that is not actively used or needed and can be allocated to distribute widespread high bandwidth Internet[24] TV band spectrum in developing countries is significantly underutilized, and its radio propagation characteristics are much better than the unlicensed Wi-Fi (2.4/5GHz) band. It also has the capacity to penetrate obstructions and vegetation while having a far reach. The technology offers significant promise as means to expand connectivity at low cost in rural and remote areas, and there are several cases of deployment in Asia. However, it should also be treated with caution as the viability and sustainability still remain unclear.

[23] ITU, "Building Smart Villages: A blueprint as piloted in Niger," (2020), https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-SMART_VILLAGE.NIGER-2020-PDF-E.pdf.
[24] ITU. *The Last-Mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites.* (2020)

Integra, Indonesia

In a pilot project, the Ministry of Communication and Information Technology of Indonesia, with support from USAID, Microsoft, Hitachi and the Government of Japan, utilized TVWS to connect remote communities to the Internet. Broadband connectivity was provided to a school, a health clinic, a public Internet centre and a small agribusiness. The pilot was a success in providing financially viable connectivity and led to positive socio-economic impacts. As a result of pilot project's success, the Government of Indonesia developed a programme to connect 1 600 additional communities as a large second phase to a national roll-out of rural broadband. As of August 2016, more than 800 of those villages were connected to an affordable and reliable Internet service utilizing TVWS, among other technologies. [1]

[1] USAID, *Connecting People. Transforming Nations.*, https://www.usaid.gov/sites/default/files/documents/15396/Indonesia-Broadband-Report.pdf.

TakNet, Thailand

With support from the Office of The National Broadcasting and Telecommunications Commission, intERLab and the Department of ICT have piloted the use of TVWS as backhaul technology for TakNet, a community network that has been deployed in 17 rural communities throughout the Tak province in Thailand. After identifying unused TV band spectrum in the area, the TVWS base was set up at a local public school already connected to the fibre network. Four remote villages were connected to this gateway via TVWS, while LTE over TVWS was applied to offer last-metre access to end users inside the village. Additionally, to alleviate the problem of slow Internet associated with an increasing number of users, the project introduced a content distribution service from providers to the rural villages. [1]

[1] Lertsinsrubtavee et al., "Wireless edge network for sustainable rural community networks."

3.2.3 High-Altitude IMT Base Stations (HIBS)

High-altitude IMT (international mobile telecommunications) base stations (HIBS) are an emerging access network technology that works like a mobile network cell tower and provides mobile connectivity to end users. However, in contrast to cell towers, they are deployed in the stratosphere at an altitude of approximately 20 km and provide connectivity to a much larger area with a radius of up to 200km. They provide several benefits over satellites, including operating in currently unused airspace with relatively stable wind speed, making deployment easier, and offer lower latency and the opportunity to be used by existing devices.[25]

[25] Osamu Kamimu, *Mobile connectivity with HIBS* (2020), https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2020/RDF2020/Session%202b/ITU_Workshop_Nov_2020_8min%28final%29%20Osamu%20Kamimura.pdf.

3.2.4 Li-Fi

Li-Fi (light fidelity) is an emerging connectivity solution, which relies on LED lights that transmit data through high frequency signals. These LEDs can be installed in traditional light sources such as rooms or streetlights and are invisible to the human eye. Their easy installation, low cost and relatively high bandwidth make them an interesting alternative to traditional solutions such as Wi-Fi. However, there are also some drawbacks that might impede uptake of the technology. If installed with other light sources, connectivity is only possible when the light is on, consequently leading to higher electricity bills for users.

With the transmission of data over light, the signal is not able to travel through opaque objects, and a line of sight between transmitter and receiver is therefore required. Additionally, Li-Fi solutions require an initial investment that could be much higher than for other technologies such as Wi-Fi. Nevertheless, this technology has the potential to become key to providing connectivity in underserved areas, since it could be built into existing lighting systems such as streetlights. In addition, it does not require access to a fixed power grid, but could be powered through solar systems or other off-grid solutions. The fact that the signal can provide Internet to many users at the same time without limiting bandwidth means that it may potentially be suitable for application in the education system.[26]

3.2.5 Open RAN

As manufacturers enhanced capabilities, the industry consolidated around those with the strongest offer and often proprietary functionality. However, this is at odds with operators seeking a competitive and diverse marketplace of vendors of network architecture components, especially in the RAN. As a result, there is movement towards developing Open RAN environments in which the RAN is disaggregated into the radio unit (RU), distributed unit (DU) and the centralized unit (CU). It is expected that Open RAN could produce a more innovative ecosystem with more options for operators and potentially for expanding connectivity in rural and remote regions.[27]

Indonesia's TIP Community Lab

Open RAN is supported by the Telecom Infra Project (TIP), which is global community of companies and organizations that are driving infrastructure solutions to advance global connectivity. The Indonesian Government has lent its support to TIP and supported the new TIP Community Lab and centre of excellence at Telkom University in a multi-year collaboration between the GSM Association (GSMA), TIP, the Indonesian Government, Telkom University and mobile network operators. As the initiative moves forward, it deserves attention as its learning on Open RAN could support expanded school connectivity and be adopted in neighbouring countries.[1]

[1] "New Industry Collaboration to Improve Connectivity in Indonesia and Drive Economic Growth," 2020, https://telecominfraproject.com/new-industry-collaboration-to-improve-connectivity-in-indonesia-and-drive-economic-growth/.

[26] Lambrechts and Sinha, "Last Mile Internet Access for Emerging Economies."
[27] "Open RAN explained," 2020, https://www.nokia.com/about-us/newsroom/articles/open-ran-explained/.

3.3 Policy approaches for supporting school connectivity

Government policy plays an important role in connecting communities and schools. The regulatory environment has been identified as key in the process of ICT uptake. For instance, the development of a national broadband plan has been linked to higher fixed and mobile broadband penetration.[28] This section reviews various policy tools and approaches that can facilitate school connectivity.

3.3.1 Licence obligations

Licences for telecommunication operators have various objectives, including, but not limited to: regulating market structure, ensuring competition, protecting consumers and generating government revenue through licence auctions.[29] Licence obligations can also be structured to extend connectivity to unconnected communities and schools; governments can introduce licence obligations that tie licences to defined connectivity extension activities.

Vanuatu's UAS obligations

Vanuatu has made achieving universal access a priority of its telecommunications policy regime. The universal access policy explicitly includes educational institutions in the definition of universal access, specifying that services must be available to them. The policy adopts a "play or pay" regime to oblige network operators to contribute to universal access. Under this regime, service providers are required to contribute either actively through network deployment or passively via annual levies on revenue. Three "players" provided plans for deploying new infrastructure – TVL, Digicel Vanuatu and Telsat – while five licensees were initially identified as "payers."[1] The levies contribute to the Universal Access and Service (UAS) fund, which supports projects that encourage the development of ICT infrastructure and improve the availability of ICT services by subsidizing the costs of infrastructure, networks, facilities, services, equipment, applications, content and human resource development.[2]

1 UN-OHRLLS, *Leveraging Investments in Broadband for National Development: The Case Of Vanuatu*, UN-OHRLLS (2018), http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf.

2 "UAS Fund," UAS Secretariat, https://uas.nicta.gov.pg/index.php/about-uas/uas-fundd.

3.3.2 Infrastructure sharing

Infrastructure sharing provisions provide another policy tool to increase access to affordable connectivity. Such a policy obligates infrastructure owners to allow other operators to access their network infrastructure for service delivery under certain conditions. This not only increases competition and available choices for consumers, but also creates the opportunity for operators to build access network infrastructure without the cost of developing their own backhaul network.

28 ITU Broadband Commision for Sustainable Dvelopment, *Financing for ICT Infrastructure*, Inter-Agency Taskforce on Financing for Development (2016), https://www.un.org/esa/ffd/wp-content/uploads/2016/01/Financing-for-ICT-Infrastructure_ITU_IATF-Issue-Brief.pdf.

29 Hank Intven and McCarthy Tétrault, *Telecommunications Regulation Handbook: Licencing Telecommunications Services*, World Bank (Washington DC, 2000), https://www.itu.int/ITU-D/treg/Documentation/Infodev_handbook/2_Licensing.pdf.

Pakistan's telecommunications policy

Pakistan's telecommunications policy requires consideration of passive and active infrastructure sharing before granting a new right of way or space to build towers or other infrastructure. Furthermore, it obliges all licensees with significant market power in a relevant market to share infrastructure on fair and non-discriminatory terms where practical.[1]

[1] Ministry Of Information Technology, *Telecommunications Policy 2015* (Ministry Of Information Technology, 2015), https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf.

3.3.3 Government incentives for school connectivity

One way to encourage telecommunication operators to provide connectivity to unconnected schools and communities is to offer them fiscal or other incentives. These could take the form of either direct incentives in return for providing connectivity to target schools and communities, or general incentives for increasing connectivity.

Viettel's education networking

In 2009, Viet Nam's Ministry of Education and Training (MOET) partnered with the network operators Viettel to connect all education institutions to the Internet.[1] Viettel pledged to build the necessary infrastructure for connectivity utilizing a variety of technologies, including FTHH services, ADSL, 3G, and EDGE depending on local context[2] with an allocated total budget of approximately VND 300 billion/year (about USD 13 million/year).[3] By July 2010, Viettel had connected nearly 30 000 academic institutions to the Internet, and 72 per cent of these were to broadband (leased line, FTTH, ADSL, 3G). An estimated 25 million teachers and students in these institutions gained access to the Internet. In the second phase of the project, additional schools were connected to the Internet and 9 000 schools that had been connected via Modem Edge in the first phase of the project were upgraded to higher bandwidth connectivity.[4] By 2013, Viettel had extended connectivity to a total of 30 593 educational institutions across the nation, 81 per cent of which were connected to broadband Internet.[5]

[1] Ministry of Education and Training in Vietnam. Directive 55/2008/CT-BGDĐT. https://hethongphapluat.com/cong-van-so-9772-bgddt-cntt-ve-viec-huong-dan-thuc-hien-nhiem-vu-cong-nghe-thong-tin-nam-hoc-2008-2009-do-bo-giao-duc-va-dao-tao-ban-hanh.html

[2] "Bắc Giang: Thỏa thuận hợp tác toàn diện giữa Giáo dục và Viettel giai đoạn 2014 - 2020," 2014, http://thptlanggiangso2.edu.vn/home/news/Cuoc-song-so/Bac-Giang-Thoa-thuan-hop-tac-toan-dien-giua-Giao-duc-va-Viettel-giai-doan-2014-2020-679/.

[3] "Viettel - "Một kỷ nguyên phi thường" và trách nhiệm xã hội thời 4.0," 2020, https://laodong.vn/kinh-te/viettel-mot-ky-nguyen-phi-thuong-va-trach-nhiem-xa-hoi-thoi-40-841054.ldo.

[4] "Hoàn thành chương trình kết nối mạng giáo dục," 2010, http://www.molisa.gov.vn/Pages/tintuc/chitiet.aspx?TinTucID=11821&page=295.

[5] ""Kết nối mạng giáo dục" - Miễn phí đường truyền Internet băng rộng," 2018, https://viettelidc.com.vn/tin-tuc/ket-noi-mang-giao-duc-mien-phi-duong-truyen-Internet-bang-rong.

In addition to developing network infrastructure, Viettel also offered preferential Internet and mobile services for teachers and students, including by reducing network connection fees and equipment prices and increasing available data, thus contributing not only to increased access but also to Internet connectivity.[1]

In response to the free support and preferential pricing policy, MOET started a campaign to promote Viettel's products and services to units in the industry and instructed academic institutions to hold events promoting the Viettel brand. MOET also encouraged the internal use of Viettel's phone and Internet services. In addition, MOET provided support and expertise to Viettel in connection with human resources standardization and the recruitment of qualified human resources from universities and other academic institutions.[2]

Viettel's companies in Cambodia (Metfone)[3], Lao P.D.R. (Unitel)[4], and Myanmar (Mytel)[5] have engaged in similar plans to connect schools to the Internet. This demonstrates the company's approach in leveraging its relationship with governments to gain incentives and use school connectivity as a pillar of its market expansion strategy.

However, this specific example of government incentives likely reflects the close relationship between Viettel, as a military owned company, and the Government of Viet Nam. Thus, replicating the model could be challenging in other contexts.

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1 http://www.bentre.edu.vn/index.php?option=com_content&view=article&id=1196%3A100-trng-hc-co-iu-kin-ac-kt-ni-mng-Internet&catid=22%3Atin- t-bag & Itemid = 1

2 "Khởi công kết nối mạng giáo dục," 2008, https://nhandan.com.vn/tin-tuc-giao-duc/khoi-cong-ket-noi-mang-giao-duc-592988/.

3 "Metfone is Proud to Once Again be The Long-Term Strategic Partner of Moeys on "Ict In Education"," 2020, https://www.metfone.com.kh/en/about-us/media/press-release/metfone-is-proud-to-once-again-be-the-long-term-strategic-partner-of-moeys-on-%E2%80%9Cict-in-education%E2%80%9D.

4 "Unitel provides free Internet service to Lao schools," 2010, https://en.qdnd.vn/economy/military-businesses/unitel-provides-free-Internet-service-to-lao-schools-413994.

5 "Mytel says it will offer free Internet for schools," Myanmar Times, 2018, https://www.mmtimes.com/news/mytel-says-it-will-offer-free-Internet-schools.html.

Digital Pakistan policy

To stimulate the telecommunication sector, the Digital Pakistan policy introduces various fiscal and non-fiscal incentives, including attracting FDI, tax exemptions, easy access to loans, cash rewards and the establishment of IT parks and special economic zones.[1]

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1 Ministry of IT & Telecom, *Digital Pakistan Policy* (2018), https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf.

3.4 Whole-of-government approach

A whole-of-government approach to connectivity acknowledges the fact that connectivity initiatives need to be embedded in the wider context of target communities in order to realize the potential socio-economic benefits of Internet connectivity. This approach is a holistic and integrated method of planning, designing and delivering government services and operations. It requires the government to coordinate across and between ministries, and government organizational structures to work together on policy development, citizens' engagement and service delivery. It will allow the consideration of a comprehensive 360-degree view of citizens' needs and the provision of an integrated set of services that responds to different aspects of well-being and livelihood. The approach promises cost-efficient implementation of projects, with infrastructure or investment shared by all government departments, projects and initiatives.[30]

Indonesia Palapa Ring

The Government of Indonesia has adapted a whole-of-government approach for the planning and implementation of the Palapa Ring project, which aims to extend the fibre-optic and wireless network to every town and district in Indonesia. Practising inter-ministerial cooperation, different ministries took leadership of different aspects of the project. The Ministry of National Development Planning took the lead on strategy, setting objectives and overseeing implementation; the Ministry of Communication and Information Technology led on technical assessments and procurement; and the Ministry of Finance was responsible for carrying out financial feasibility studies. Furthermore, the project leveraged partnerships with the private sector under a public-private partnership and availability payment model (PPP AP). Under the model, private Internet providers and their investors finance, build and operate the network. In return, the government makes 'availability payments' to the infrastructure providers during the operational lifetime of the network assets. 'Availability payments' made the project commercially attractive to private infrastructure providers and investors, and tying the payments to standards of available connectivity ensures efficient use of public resources.[1]

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[1] Pathways to Prosperity Commision, *Indonesia: Fibre-Optic Cables Across an Archipelago – Palapa Ring Project* (2019), https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-11/Indonesia_Palapa_Ring_Project.pdf.

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[30] ITU, "Building Smart Villages: A blueprint as piloted in Niger." https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-SMART_VILLAGE.NIGER-2020-PDF-E.pdf

Infrastructure co-deployment in Bhutan

Bhutan's successful co-deployment of ICT and electricity infrastructure highlights the potential for cost saving through intersectoral cooperation. Increased cost efficiency through the co-deployment of ICT and electricity infrastructure has made the implementation of the National Broadband Master Plan feasible. Under this programme, fibre cables were installed connecting all 20 dzongkhags and 205 gewogs. Significant cost savings were made on the installation of fibre cables over transmission power lines since minimal civil works were required and rights of way were already granted. Furthermore, the time required to begin network operation was significantly reduced, and damage to the natural environment was minimal.[1]

Similarly, a study carried out in Mongolia found potential benefits from the co-deployment of transport and energy infrastructure with ICT infrastructure, and recommended close cooperation and alignment of policies in the different sectors.[2]

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1 Sonam Dukda, *ICT Co-Deployment with the Electricity Infrastructure: The Case of Bhutan*, UNESCAP (Bangkok, Thailand: UNESCAP, 2019), https://www.unescap.org/sites/default/files/ICT%20Co-Deployment%20with%20the%20Electricity%20Infrastructure%2C%20The%20Case%20of%20Bhutan.pdf.

2 UNESCAP, *Research Report on ICT infrastructure Co-deployment with Transport and Energy Infrastructures in Mongolia*, UNESCAP (2020), https://www.unescap.org/sites/default/files/Research%20Report%20on%20ICT%20infrastructure%20Co-deployment%20%20with%20Transport%20and%20Energy%20Infrastructures%20in%20Mongolia.pdf.

4 Finance

Source: @UNICEF/UN0466334/Wilander

4.1 Matching financing mechanisms with the challenge

School connectivity mapping determines the magnitude of the connectivity challenge, and connectivity solution analysis helps to identify the technological solution that is fit-for-purpose. These two steps lead to determining the cost of addressing connectivity gaps and the suitable financing mechanism. Small connectivity challenges could be addressed using government budgets, while other challenges may require multilateral development bank support, blended finance solutions, and possibly the issuing of bonds. Remote and rural areas with sparse populations usually require high capital expenditure (CAPEX), and are thus unattractive to private sector network operators. Public sector support is therefore needed to stimulate private sector investment. There are several possible financing mechanisms involving public capital that are discussed below; however, meeting CAPEX requirements is only part of the equation. Small island States and landlocked countries also face challenges in meeting operational expenditure (OPEX) requirements. Various sustainable business models are therefore considered in the latter part of the chapter.

4.1.1 Universal Funds

Universal service funds (USFs) are a funding mechanism for ICT infrastructure development in marginalized and remote regions. They offer significant promise in potential Giga countries in Asia and the Pacific as most of these countries have a USF in place. A report by UNICEF found that Asia and the Pacific is one of two regions with the most active USFs.[31] As a result, they should be one of the first considerations for funding Giga school connectivity initiatives.

USFs are usually financed through universal service obligations (USOs) as a levy on telecom operators' revenue or proceeds of spectrum auctions or licencing fees, etc. These funds are set up under the premise that in remote and rural areas it is not financially viable for private operators to extend network coverage. In general USFs tend to be underpinned by the three principles of availability, affordability and accessibility, and aim to connect the whole society.[32]

However, there has been much debate around the effectiveness of USFs in enhancing broadband penetration and Internet usage among target populations. While each country faces its own context- specific challenges, a few common challenges can be identified. First, delayed and low disbursement of funds: in many cases disbursement rates of USF are low, and even where specific broadband targets exist, it takes a long time for funds to be allocated to broadband projects. A related challenge is the misalignment between fund objectives and actual projects funded. Second, a lack of monitoring tools and transparency lead to operators failing to meet their obligations and leave USF-funded projects unable to meet their objectives. Third, a lack of capacity can hamper the effectiveness of USFs and USF-funded projects. Other structural challenges include a legal environment for USFs that is often uncertain and unfavourable local conditions. These common challenges need to be overcome if USFs are to deliver on their objective of extending broadband coverage. To this end, governments should work towards building capacity, increasing transparency and accountability and provide clear legal operational frameworks for USFs.[33] Additionally, USFs in Asia and the Pacific tend to favour fixed-line broadband development over wireless broadband. With the emergence of low-cost, high-bandwidth wireless technological solutions, the focus on fixed-line broadband may need to be reconsidered.[34]

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31 UNICEF, *UNIVERSAL SERVICE FUNDS: Status in South Asia* (2020).

32 GSMA, *Universal Service Fund Study* (GSMA, 2013), https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf.

33 UNESCAP, *The Impact of Universal Service Funds on Fixed-Broadband Deployment and Internet Adoption in Asia and the Pacific*, UNESCAP (Bangkok, Thailand, 2017), https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf.

34 UNICEF, *UNIVERSAL SERVICE FUNDS: Status in South Asia*.

Pakistan USF

Within the Asia-Pacific region, Pakistan's USF is noted as an exceptional example. The main sources of income for the fund are a 1.5 per cent levy on the gross operating revenues of all telecommunication operators and monies obtained from the APC (Access Promotion Charge).[1] The main funding targets are capital expenditure and operating expenditure associated with the provision of services in a contract area for a specified, limited start-up period during which the USF contractor establishes its infrastructure, grows its customer base and provides the USF Services. Funding is also used for the development and delivery of services, infrastructure or other related items, through the special projects mechanism.[2] Although the Universal Service Fund Policy 2006[3] maintains that the fund is technology neutral, the Telecommunications Policy 2015[4] mentions a preference for the use of fibre over microwave in backhaul and for fibre over copper in wireline access.

1 GSMA, *Universal Service Fund Study*. https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf
2 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf
3 IT and Telecommunication Division, *Universal Service Fund Policy*, Ministry of Information Technology (2006), https://usf.org.pk/assets/rules-pdf/usf-policy.pdf.
4 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

NetPracharat, Thailand

One example of government funding for infrastructure development is the NetPracharat project in Thailand. Villages in rural and non-marketable areas that private telecommunication operators do not service under current market conditions were targeted for the installation of high-speed fibre networks. In December 2017, the installation of the fibre-optic cable network to 24 700 target rural villages throughout the country was completed. Additionally, one Wi-Fi hotspot per village was installed at public buildings such as schools or temples. The initial CAPEX of USD 318 million for the network deployment and installation of Wi-Fi hotspots was funded through the government budget. The OPEX of the network over the period 2019–2023 will be financed though universal service obligations and the goal is for the network to become financially self-sustaining in the future.[1] However, it is not clear how village Wi-Fi services will be maintained beyond 2023 when USF funding is earmarked to end. Therefore, the long-term sustainability of the model requires consideration.

1 Boonlit Adipat et al., *Village Broadband Internet Project (Net Pracharat) of Thailand*, Asia-Pacific Telecommunity (Bangkok, Thailand: Ministry of Digital Economy and Society, 2019), https://www.netpracharat.com/Documents/20190805_APT_Netpracharat_V12_Final.pdf.

Connect the schools, Papua New Guinea

Papua New Guinea utilized its USF at a cost of around PGK 2.6 million to connect a total of eight teachers' colleges to the Internet under the "Connect the Schools Project" in 2017. The project also funded the provision of Internet service to the schools for a two-year period, after which the individual schools are expected to develop capacity to sustain the Internet service.[1] Initially, the project aimed to connect a larger number of secondary schools.[2]

1 "Connect the Schools Projct 2017," UAS Secretariat, https://uas.nicta.gov.pg/index.php/programs/community-and-institutional-broadband-networks/connect-the-schools-project.
2 National Information and Communications Technology Authority, *Report on Proposed 2017 UAS Projects*, UAS Board (2016), https://uas.nicta.gov.pg/images/Reports/Report_UAS-Board-2017-Projects.pdf.

4.1.2 Multilateral grants and loans

As the magnitude of the connectivity challenge grows in scale, it may be the case that grants or loans from multilateral development banks are more suitable. Multilateral development banks tend to make major investments in the infrastructure sector; however, they play a relatively minor role in the development of telecommunication infrastructure. According to an analysis by Xalam Analytics for the Alliance for Affordable Internet and the World Wide Web Foundation, investments in the ICT sector in low- to middle-income countries represented only 1 per cent of the total investments of multilateral development banks between 2012 and 2016.[35] This is due to a persistent view that Internet connectivity is the private sector's responsibility. However, there is evidence to the contrary in Asia and the Pacific where the Asian Development Bank (ADB) has taken a prominent role in funding digital technology projects.

Between 2000 and 2015, the ADB extended 402 digital technology-related loans, grants and technical assistance projects to the value of USD 11.9 billion to help develop and maintain digital infrastructure, digital industries, digital-enabled services, and digital policy, strategy, and capacity development.[36] Notably, the ADB has supported Kacific Satellites in bringing connectivity to small island States in the Pacific.

35 World Economic Forum, *Financing a Forward-Looking Internet for All* (2018), http://www3.weforum.org/docs/WP_Financing_Forward-Looking_Internet_for_All_report_2018.pdf.
36 "ADB's Work to Improve Access to Information and Communication," https://www.adb.org/sectors/ict/overview.

Kacific

Kacific Broadband Satellites International Limited (Kacific) launched the Kacific1 satellite to expand high-speed broadband Internet access across Asia and the Pacific. The Asian Development Bank (ADB) provided USD 50 million in financing to Kacific for the satellite to deliver Internet that will enable better education and health services, improve access to information and drive more trade and connectivity between countries.

Kacific1, launched by SpaceX's Falcon 9 rocket from Cape Canaveral, Florida, will orbit in the same location above Asia and the Pacific region during its estimated 15-year service life. The satellite will be able to deliver the most powerful signal ever achieved by a commercial satellite in the region, providing affordable broadband access to people in remote regions, many of whom have never had Internet connectivity before.

Remote and rural communities are typically beyond the reach of traditional optical fibre as terrestrial distribution and infrastructure take time to build and are expensive. Kacific1 will cover these communities in the Pacific island nations and in archipelagic countries like Indonesia and the Philippines. The satellite will also have beams over South Asia, New Zealand, and Papua New Guinea.[1]

Even prior to the launch of Kacific1, Kacific strived to bring connectivity to remote islands. An initiative launched in partnership with ITU aimed to bring together ICT for development and ICT for disaster resilience in the Pacific islands. In response to the Category 5 cyclone Harold in 2020, Kacific partnered once again with ITU to provide connectivity in affected areas. The initiative also aimed to allow for better early warning systems.[2]

1 "Kacific1 Satellite Launch to Bring Affordable Internet to Remote Parts of Asia and Pacific," 2019, https://www.adb.org/news/kacific1-satellite-launch-bring-affordable-Internet-remote-parts-asia-and-pacific.

2 "ITU and Kacific join forces to boost emergency telecoms and ICT development in Vanuatu," 2020, https://www.itu.int/en/myitu/News/2020/06/03/08/48/ITU-and-Kacific-join-forces-to-boost-emergency-telecoms-and-ICT-development-in-Vanuatu.

The World Bank and the Islamic Development Bank are also potential partners. The World Bank has recognized the importance of digital development and has developed a strategy built on five priority areas: digital infrastructure, digital financial services and digital identification, digital innovation and entrepreneurship, digital platforms, and digital literacy and skills. It has launched various initiatives to support this strategy, including the Digital Development Partnership, the Identification for Development Initiative and, in response to COVID-19, the Digital and Disruptive Technologies Secretariat.[37]

The Islamic Development Bank has adopted an ICT policy for inclusive development, which highlights the importance of including the population of its member countries in the digital revolution. To this end, it will invest and incentivize ICT investments to provide access to

37 "Digital Development: Overview," 2020, https://www.worldbank.org/en/topic/digitaldevelopment/overview#2.

infrastructure with a specific focus on capacity building of digital skills in sector knowledge activities such as e-education, e-health, e-government, e-agriculture, e-procurement, e-commerce and fintech.[38] Honouring its commitment to increasing connectivity, the Islamic Development Bank has funded projects, including in Bangladesh, where it provided USD 60 million for the deployment of submarine fibre cables. The project's completion led to a surge in Internet users in Bangladesh, including the provision of Internet access to education institutions.[39]

Multilateral development banks can provide a mix of grants and loans, and many, like the Asian Infrastructure Investment Bank (AIIB), have a Special Fund mechanism. Under this mechanism, up to USD 5 million in grant funding could be provided in advance for assessments, evaluations and studies to determine the viability of a project. If the project meets the Bank's standards, the government will then have to take a loan (at IBRD rates) with the AIIB being part of the project.

4.1.3 Bilateral funding

Bilateral official development assistance (ODA) is an important source of funding for ICT and telecommunication infrastructure in the region. Although the ODA from OECD Development Assistance Committee (DAC) members channelled into the ICT and telecommunication sectors of developing countries, including in Asia and the Pacific, declined in volume from 2010, it mostly recovered after 2016. In 2019, bilateral ODA from DAC members channelled into the ICT and telecommunication sectors in Asia and the Pacific was USD 131.69 million. While this is only a fraction (1.32 per cent) of total economic infrastructure and services by ODA volume in Asia and the Pacific, it is almost half (48.82 per cent) of global ODA flows into the ICT and telecommunication sectors.[40]

The most prominent donors in the region are Japan, the Republic of Korea and Australia. While ODA investment in ICT and telecommunication infrastructure might constitute a smaller part of overall investment, it has the potential to enable projects in the region. USAID has also launched several initiatives in the region to develop an open and safe digital economy and increase cybersecurity and digital skills, including the Digital Connectivity and Cybersecurity Partnership[41] and the Digital Asia Accelerator.[42] The TVWS pilot project in Indonesia discussed earlier in the report was also supported by USAID.

The Republic of Korea is the worldwide leader in ODA for e-government based on its own experience of increasing government accountability and transparency through e-government.[43] In this field, it has established e-government cooperation centres in several partner countries,

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38 Islamic Development Bank, *Information and Communication Technology (ICT) Sector Policy: ICT for inclusive Development* (2019), https://www.isdb.org/sites/default/files/media/documents/2020-01/Information%20and%20Communications%20Technology%20%28ICT%29%20Sector%20Policy.pdf.

39 "Digital Bangladesh: High-Speed Connectivity via Mobile Phones and the Internet," 2021, https://www.isdb.org/case-studies/digital-bangladesh-high-speed-connectivity-via-mobile-phones-and-the-Internet.

40 calculations based on data from: OECD, "Aid activities," (2014). https://www.oecd-ilibrary.org/content/data/data-00061-en.

41 USAID, *ADVANCING DIGITAL CONNECTIVITY IN THE INDO-PACIFIC REGION* (2019), https://www.usaid.gov/sites/default/files/documents/1861/USAID_DCCP_Fact_Sheet_080719f.pdf.

42 USAID, *Digital Asia Accelerator* (2019), https://www.usaid.gov/sites/default/files/documents/USAID_Digital_Asia_Accelerator_Fact_Sheet.pdf.

43 James Christopher Schopf, "Room for improvement: Why Korea's leading ICT ODA program has failed to combat corruption," *Telecommunications Policy* 43, no. 6 (2019).

including Viet Nam and Indonesia. In addition to e-government, the Republic of Korea also engages in other forms of ODA for ICT development[44]

Japan has always recognized the importance of developing ICT infrastructure in developing countries. Through consistent commitment to this priority, Japan has become the world's largest provider of aid in the telecommunications field. The regional focus of Japan's investment in ICT is Asia, particularly Thailand, the Philippines and Indonesia. Recent initiatives for the extension of ICT infrastructure in the region include the "Memorandum of Cooperation in the Field of Information and Communications Technology" with Indonesia in 2015 and the Philippines in 2017, respectively. Japan has supported the improvement of the telecommunication infrastructure in Myanmar through ODA loans (maximum JPY 10.5 billion). In Viet Nam, an MoU has been concluded to strengthen and renew cooperation on 4G and 5G infrastructure, cybersecurity and IoT.[45]

While Australia has long been a provider of funding for ICT in the region, it has been especially active in support for the COVID-19 response, particularly in the Pacific, by launching the Partnerships for Recovery framework.[46] Reflecting this, COVID-19 education response plans, and programmes in Papua New Guinea[47] and Vanuatu[48] were both supported by Australia.

4.1.4 Bonds

Bonds are an alternative way to raise capital for infrastructure projects. They can be issued by different actors, such as banks or governments. Bonds provide an interesting option for passive investment, which offers investors liquidity and diversification. Infrastructure bonds in Asia and the Pacific have generally better credit ratings and lower default rates, making them a suitable option to attract private sector investment in ICT infrastructure. Governments can increase incentives to invest by issuing tax-exempt bonds that are fully or partially exempt from taxes, or revenue bonds that are debt securities over the assets and the period of contract financed.[49]

Social bonds

Social bonds are an innovative finance mechanism pioneered by GAVI, the Vaccine Alliance.[50] Social bonds are any type of bond instrument, the proceeds of which will be used exclusively to

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44 "Joint TA on ICT with Intl Organization," 2020, https://eng.nia.or.kr/site/nia_eng/01/10102010000002016093002.jsp#active.

45 Yuji Hatakeyama, "International Cooperation ODA," in *Telecommunications Policies of Japan* (Springer, 2020).

46 Department of Foreign Affairs and Trade, *PARTNERSHIPS FOR RECOVERY: AUSTRALIA'S COVID-19 DEVELOPMENT RESPONSE* (2019), https://www.dfat.gov.au/sites/default/files/partnerships-for-recovery-australias-covid-19-development-response.pdf.

47 UNICEF, *Application to Global Partnership for Education COVID19 Accelerated Funding Window for Emergency Response in Papua New Guinea*, UNICEF (Global Partnetship for Education, 2020), https://www.globalpartnership.org/sites/default/files/document/file/2020-07-COVID-19%20AFF%20Request%20Papua%20New%20Guinea.pdf.

48 Ministry of Education and Training, *COVID-19 Accelerated Funding Program Document*, Ministry of Education and Training, (Global Partnership for Education, 2020), https://www.globalpartnership.org/sites/default/files/document/file/2020%2008%20COVID-19%20AFF%20Request%20Vanuatu%20-%20Verified.pdf.

49 UNESCAP, "Infrastructure Financing in Asian Landlocked Developing Countries: Challenges, Opportunities and Modalities," (2020), https://www.unescap.org/sites/default/d8files/knowledge-products/Infrastructure_Financing_in_Asian_%20Landlocked_%20Developing_%20Countries_ids.pdf.

50 David Gartner, "Innovative Financing and Sustainable Development: Lessons from Global Health," *Washington International Law Journal* 24, no. 3 (2015), https://digitalcommons.law.uw.edu/cgi/viewcontent.cgi?article=1696&context=wilj.

finance or re-finance, in part or in full, new and/or existing eligible social projects. Social bond programmes have four core components:

- Use of proceeds exclusively for social projects
- Process for project evaluation and selection with high levels of transparency
- Management of proceeds in a manner that ensures transparent allocation of the net proceeds to social projects
- Transparent reporting that tracks allocation of proceeds and impact of social projects.[51]

GAVI's social bond, the International Finance Facility for Immunisation (IFFIm), was launched in 2006 by six donor governments as a mechanism to front-load assistance for global health. The donors used legally-binding ODA commitments to issue bonds on international capital markets, repayable over periods of up to 20 years. Capitalizing on the good credit ratings of the donor countries, IFFIm was able to provide most of the funding to GAVI.[52] Recently, more developing countries have been developing the capacity to issue bonds as well. For instance in 2020, the Government of Bhutan, supported by UNESCAP, issued a bond to support the recovery of the economy from COVID-19. The 3-year bond series of USD 41 million at an annual coupon rate of 6.5 per cent was well received and resulted in oversubscription of 300 per cent.[53]

4.2 Blended finance for school connectivity

Blended finance includes innovative financing structures that leverage philanthropic capital to attract commercial capital for infrastructure development investments that serve public needs. These structures aim to reduce barriers for commercial capital investors, including high levels of risk, low returns relative to risk, inadequate or inefficient local markets, and lack of knowledge, experience and investment scope among private investors.[54]

The volume of blended finance commitments globally has risen consistently over the last decade, reaching USD 144 billion in aggregate financing as of 2020. The largest share of funding (33 per cent over the period 2017–2019) is directed towards sub-Saharan Africa; however, a lower average deal size results in lower aggregate funding in the region. While investment in Latin America and the Caribbean has been decreasing, Asia and the Pacific is emerging as the new gravity centre of blended finance, attracting 21 per cent of overall blended finance investments over the period 2017–2019 compared to 14 per cent in all time.[55] The most prominent sectors for blended finance investment in Asia and the Pacific are energy (28 per cent) and finance (27 per cent). Non-energy infrastructure received only 13 per cent and education only 3 per cent[56]. Globally, ICT infrastructure comprises 34 per cent of non-energy infrastructure transactions.[57]

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51 The Social Bond Principles, *Social Bond Principles - Voluntary Process Guidelines for Issuing Social Bonds* (2020), https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/June-2020/Social-Bond-PrinciplesJune-2020-090620.pdf.

52 Gartner, "Innovative Financing and Sustainable Development: Lessons from Global Health." https://digitalcommons.law.uw.edu/cgi/viewcontent.cgi?article=1696&context=wilj

53 UNESCAP, "Bhutan Issues First Sovereign Bond To Meet Increasing Fiscal Financing Needs In Fighting COVID-19," news release, 23 September 2020, 2020, https://www.unescap.org/news/bhutan-issues-first-sovereign-bond-meet-increasing-fiscal-financing-needs-fighting-covid-19#.

54 World Economic Forum, *Financing a Forward-Looking Internet for All*. http://www3.weforum.org/docs/WP_Financing_Forward-Looking_Internet_for_All_report_2018.pdf

55 Convergence, *The State of Blended Finance 2020* (2020), https://www.convergence.finance/resource/1qEM02yBQxLftPVs4bWmMX/view.

56 Convergence, *DATA BRIEF: BLENDED FINANCE IN ASIA* (2019), https://assets.ctfassets.net/4cgqlwde6qy0/5qkeWZZEopdJcTSth1oQeD/e36a284f0e86d506ecb868912611c773/Asia_Data_Brief_vFinal2.pdf.

57 Convergence, *The State of Blended Finance 2020*. https://www.convergence.finance/resource/1qEM02yBQxLftPVs4bWmMX/view

The most common types of blended finance in the region are concessional debt/equity (56 per cent) and de-risking schemes (40 per cent). Sources of investment are almost equally distributed between public and philanthropic investors on the one hand (55 per cent) and private investors on the other (45 per cent), with most private investors located in the region.[58]

Notable mentions of blended finance investors in the ICT sector in the region include the International Finance Corporation (IFC), and ADB. The IFC is the largest multilateral source of debt and equity financing for private sector digital infrastructure in emerging markets. Of its overall investment in the sector, 11.83 per cent is aimed at South Asia and 7.84 per cent at North Asia.[59] This includes a USD 50 million loan to PT Profesional Telekomunikasi Indonesia (Protelindo) for the extension of mobile network coverage[60] and, in partnership with the ADB, a USD 300 million loan to Ooredoo Myanmar for the roll-out of a mobile telecommunication network.[61]

Table 1: Top blended finance players in Asia by number of transactions

Top investors in transactions targeting Asia by number of investments	Top Asia-domiciled investors in blended finance transactions globally[62]
ADB	ADB
IFC	GCF
FMO	MUFG
USAID	JICA
OPIC	SMBC
GuarantCo	JBIC
PROPARCO	Mizuho Bank
EIB	SIBDI
DEG	ICBC
MIGA	Gov of India
CDC	

58 Convergence, *DATA BRIEF: BLENDED FINANCE IN ASIA*. https://assets.ctfassets.net/4cgqlwde6qy0/5qkeWZZEopdJcTSth1oQeD/e36a284f0e86d506ecb868912611c773/Asia_Data_Brief_vFinal2.pdf

59 International Finance Corporation, *IFC: Building the Digital Infrastructure in Emerging Markets* (2020), https://www.ifc.org/wps/wcm/connect/1267bd9f-b31a-4a62-899f-e127c2ed790d/TMT-FINAL.pdf?MOD=AJPERES&CVID=nkDNgOC.

60 "IFC Invests $50 Million in Indonesian Telecom Tower Company to Improve Mobile Coverage," 2013, https://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/11C012565727163185257BC5002799D7.

61 "ADB, IFC to Help Extend Mobile Telecom Services Across Myanmar," 2016, https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=16589.

62 Convergence, *DATA BRIEF: BLENDED FINANCE IN ASIA*. https://assets.ctfassets.net/4cgqlwde6qy0/5qkeWZZEopdJcTSth1oQeD/e36a284f0e86d506ecb868912611c773/Asia_Data_Brief_vFinal2.pdf

Indonesia

These tools can significantly increase private investment into development that meets social needs, particularly if there are supportive government policies in place. The Indonesian Government is looking to demonstrate that blended finance can play a critical role in achieving development and environmental targets, while attracting greater volumes of private capital for development projects. Over the last five years, the Indonesian Government has implemented three noteworthy blended finance initiatives: the Tri Hita Karana (THK) roadmap for blended finance, which is an international unifying framework for mobilizing additional commercial capital towards the SDGs; SDG Indonesia One, the first-of-its-kind integrated funding platform with the objective of combining funds from public and private sources and channelling them into infrastructure projects related to the achievement of the SDGs; and the PT Penjaminan Infrastruktur Fund, which provides government guarantees for infrastructure projects. Thanks to the government's initiative and private sector interest in blended finance, the majority of blended finance transactions in South-East Asia take place in Indonesia, accounting for approximately 40 per cent of the region's transactions by volume and approximately 59 per cent by value.[1]

[1] "Indonesia – A hub for blended finance in the Asia-Pacific," 2020, https://www.convergence.finance/news-and-events/news/2JxHe7gu4yCImhQa4RFcRy/view.

4.2.1 Advanced Market Commitments

Advanced Market Commitments (AMC) are one of the earlier innovative financing tools, and were pioneered by GAVI with the aim of increasing access to vaccinations in developing countries. Simply put, an AMC is a long-term contract between donors and, in this case, vaccine producers, in which donors promise to spend a specified amount on a product that is not yet developed or produced to de-risk entry into underserved markets that are otherwise financially unviable.[63] A report by the Digital Impact Alliance found substantial similarities between the vaccine market before GAVI and the markets for digital goods in developing countries. The report therefore sees great opportunities for the adoption of market-shaping tools similar to those adopted by GAVI, which, in addition to financing tools, include improved pooled procurement processes and the establishment of standards to ensure higher quality products.[64]

4.2.2 Impact bonds

Impact bonds are a blended finance tool that emerged as a new form of impact investing out of the broader tradition of payment by results. The payment by results tradition includes various mechanisms, depending on who takes the financial risk, i.e., the government or service providers. In an impact bond, the financial risk is taken by an investor, who provides upfront capital to a service provider to deliver an intervention. If outcomes are achieved, the investor will be repaid, plus a return, by the government through a social impact bond or by a third party through a development impact bond. Impact bonds are therefore not really a bond, rather a

[63] Gartner, "Innovative Financing and Sustainable Development: Lessons from Global Health." https://digitalcommons.law.uw.edu/cgi/viewcontent.cgi?article=1696&context=wilj

form of results-based funding that moves the risk of achieving results to a private sector player. Impact bonds offer opportunities for innovative programming without assuming any monetary risk or making significant shifts to current service provision structures. Because investment is tied to outcomes, rather than activities, service providers gain greater flexibility to innovate and improve their programmes, and the risks of programme performance are transferred from the government and taxpayers to the private sector.[65]

Educate Girls Development Impact Bond (DIB)

The Educate Girls DIB was launched in the Indian province of Rajasthan in 2015, and closed after three years in 2018. The service provider, Educate Girls, targeted out-of-school girls encouraging enrolment, and delivering improved curricula three times a week. The investor, UBS Optimus Foundation, provided upfront capital of approximately USD 270 000, and received a 15 per cent internal rate of return from the outcome funder, the Children's Investment Fund Foundation. Following the success of the project, a new bond was launched in 2018 on a larger scale, potentially improving learning outcomes for over 300 000 children in India. The Michael and Susan Dell Foundation, together with consortium of other funders, act as outcome funders, and several service providers are responsible for different interventions. As was the case for the Educate Girls DIB, the UBS Optimus Foundation will provide upfront capital for the service providers – with a risk investment of USD 3 million.[1]

[1] Ravi et al., *The Promise of Impact Investing in India*. https://www.brookings.edu/wp-content/uploads/2019/07/The-promise-of-impact-investing-in-India.pdf

4.2.3 Social success notes

Social success notes (SSN) are a relatively new blended finance tool similar to social impact bonds, developed by Yunus Social Business in partnership with the Rockefeller Foundation.[66] Under an SSN scheme, a commercial capital investor grants a loan on favourable conditions to a small or medium-sized social enterprise with a proven impact model and the philanthropic outcome payer offers the investor an additional incentive if the specified social outcome is reached. In contrast to social impact bonds, the service provider is responsible for repayment of the loan; only the incentive payment is conditional on outcomes, reducing risk for the capital investor. The SSN model aligns incentives across all stakeholders, aids timely access to low-cost debt capital, offers verifiable and relevant performance metrics, mobilizes additional return-seeking funding for social impact, and pays for performance. [67]

[65] Shamika Ravi et al., *The Promise of Impact Investing in India*, Brookings Institution India (New Delhi, India, 2019), https://www.brookings.edu/wp-content/uploads/2019/07/The-promise-of-impact-investing-in-India.pdf.

[66] "Introducing the Social Success Note," Yunus Social Business, 2015, https://www.yunussb.com/blog/social-success-note.

[67] ANDE India SGB Finance Learning Lab, *Social Success Note Playbook: A Blended Finance Tool For Social Impact* (2020), https://cdn.ymaws.com/ande.site-ym.com/resource/resmgr/publications/final_ssn_playbook11.9.2020.pdf.

Impact Water

Yunus Social Business, in partnership with the Rockefeller Foundation and the UBS Optimus Foundation, first piloted this financing model in 2018 in a project addressing limited access to clean drinking water in Uganda. The UBS Optimus Foundation provided the social enterprise Impact Water with a working capital loan of USD 500 000 at an annual interest rate of 5 per cent. The loan ensured that Impact Water continued to operate and provide affordable water purification systems to schools in Uganda. The Rockefeller Foundation offered a maximum outcome payment of USD 200 000, to be divided between the upfront funder (UBS Optimus Foundation) and the social enterprise (Impact Water), if the predetermined targets were achieved.[1]

[1] ANDE India SGB Finance Learning Lab, *Social Success Note Playbook: A Blended Finance Tool For Social Impact*. https://cdn.ymaws.com/ande.site-ym.com/resource/resmgr/publications/final_ssn_playbook11.9.2020.pdf

4.2.4 Challenges to blended finance

As promising as these innovative financing tools are, they are not without challenges. A report by the Overseas Development Institute highlights the following challenges for blended finance instruments:

- Little private finance is mobilized for low-income countries (LICs).
- The potential of blended finance in LICs is hindered by factors such as poor investment climate, lack of investable opportunities and risk averse decision-making by investors.
- The big push for blended finance risks diverting ODA from its core agenda of helping eradicate poverty in the poorest countries.
- Effective policy-making has been thwarted by the lack of a common official blended finance framework and poor data availability, hindering transparency and accountability, and undermining public trust in this approach.[68]

4.3 Financial sustainability

4.3.1 Business models for sustainable Internet service provision

Developing network infrastructure is not enough to ensure the continued provision of Internet services to unconnected communities and schools. Challenges related to high OPEX and potentially low spending capacities of target populations make the sustainable provision of Internet services hard for traditional telecom operators. In addition, network infrastructure needs to be updated regularly, which requires additional investment from network operators. The business models discussed in this section offer opportunities for the sustainable deployment and operation of network infrastructure and Internet services.

[68] Samantha Attridge and Lars Engen, *Blended finance in the poorest countries: The need for a better approach*, Overseas Development Institute (ODI) (London, 2019), http://hdl.handle.net/10419/206745.

4.3.2 Revenue sharing models

To increase the financial viability of network infrastructure projects in remote and rural areas, some business models move beyond a single network operator. In these models, different parties form a partnership with separate responsibilities to provide access to underserved areas. This partnership can take several forms, either splitting responsibility between infrastructure deployment and operation or between different levels of the network, i.e., access and backhaul. The two parties then agree on one of various revenue-sharing models.[69]

Open access network model

Generally, fibre networks consist of passive equipment, i.e., the fibre network and active equipment needed for the actual delivery of connectivity, i.e., transponders and routers, etc. The former is usually characterized by high CAPEX and the latter by high OPEX. In areas where the CAPEX for the passive infrastructure is not viable for local telecom operators, a third party (government or large corporation) can fund the deployment of the network and then allow local Internet service providers equal access to the network, thus expanding connectivity to areas that otherwise would be left unconnected.[70]

Facebook's open transport networks

Through its Facebook Connectivity initiative, Facebook invests in network infrastructure at all levels of the value chain. One part of this initiative is the open transport networks project through which Facebook co-funds the development of backhaul fibre networks in partnership with local operators that deploy and operate the network. The network infrastructure deployed under this initiative is subject to an open access network policy. In late 2019, Facebook entered into partnership with an Indonesian operator for the deployment of fibre infrastructure to support 4G coverage extension across selected cities throughout the country. In the first phase of the project, 3000km of fibre will be built across 20 cities in East Java, West Kalimantan, North Sulawesi and Bali, facilitating high-speed Internet to approximately 10-15 million people.[1]

[1] David Abecassis et al., *The Impact of Facebook's Connectivity Initiatives in The Asean Region*, Analysys Mason (2020), https://www.analysysmason.com/contentassets/f8a396952f9c4481982c674724d85356/the-impact-of-facebooks-connectivity-initiatives-in-the-asean-region---28-june-2020.pdf.

Wholesale model

Another way this can be operationalized is through a wholesale Internet service provider. This provider sells backhaul and core Internet services to local telecommunication operators that then sell access services to the local population. In contrast to the open access network approach, in this model both operators own and operate their respective infrastructure.

[69] GSMA, "Closing the Coverage Gap: How Innovation Can Drive Rural Connectivity," (2019), https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-Closing-The-Coverage-Gap-How-Innovation-Can-Drive-Rural-Connectivity-Report-2019.pdf.

[70] Marco Forzati, Claus Larsen, and Crister Mattsson, *Open access networks, the Swedish experience* (2010). https://www.researchgate.net/publication/224167522_Open_access_networks_the_Swedish_experience.

Kacific wholesale model

Kacific, a company registered in Singapore, developed and launched Kacific1, a high-throughput ka-band satellite that allows for higher bandwidth, with a loan from the ADB.[1] Kacific aims to sell wholesale broadband services to telecommunication operators, Internet service providers (ISPs) and governments across Asia and the Pacific at a much lower cost than currently available in the market. Kacific takes care of the infrastructure upstream of the satellite, connecting the satellite to the Internet backbone through existing fibre networks, while local telecommunication operators will provide last-mile access to the local population.[2]

1 "Kacific1 Broadband Services Commence Across Asia Pacific," 2020, https://kacific.com/news/kacific1-broadband-services-commence-across-asia-pacific/.

2 Asian Development Bank, *Proposed Loan and Administration of Loan Kacific-1 Limited and Kacific Broadband Satellites International Limited Asia-Pacific Remote Broadband Internet Satellite Project (Regional)* (2019), https://www.adb.org/sites/default/files/project-documents/53115/53115-001-rrp-en.pdf.

Franchise model

Like the wholesale model, in the franchise model, there is a split between the operator for backhaul and access networks. However in this case, the provision of Internet access services is managed by a local entrepreneur as a franchisee of the access network infrastructure developer. This model often relies on simple and low-cost technology. To expand school connectivity, schools could take the role of the local entrepreneur providing Internet to the local community.

Facebook Express Wi-Fi

Facebook developed Express Wi-Fi, which combines low-cost Wi-Fi equipment with custom software and analytical capabilities to enable Internet connectivity at a much lower cost than traditional mobile cells. This allows network operators to expand coverage to remote and rural areas where it would otherwise not be financially viable. The sale of data packs to end users in communities is done via local entrepreneurs who have Express Wi-Fi hotspots installed in their shops. In partnership with Facebook, Indonesian ISP D-Net has successfully deployed Express Wi-Fi in remote areas managed by local entrepreneurs, significantly increasing access to connectivity for local populations.[1]

1 Abecassis et al., *The Impact of Facebook's Connectivity Initiatives in The Asean Region*. https://www.analysysmason.com/contentassets/f8a396952f9c4481982c674724d85356/the-impact-of-facebooks-connectivity-initiatives-in-the-asean-region---28-june-2020.pdf

Bluetown, India

In India, Bluetown is operating as a managed hotspot service provider for rural areas in partnership with BSNL as a local backhaul network operator. Bluetown is providing Wi-Fi hotspots in over 782 remote locations in rural areas. A village-level entrepreneur working as franchisee of Bluetown acts as single point of contact in the community for all broadband-related products and services.

4.3.3 Community networks

Community networks offer a bottom-up approach to extending connectivity. In this case, the community itself installs and operates the access network infrastructure, often supported financially and technically by initiatives of civil society organizations or, in some cases, government. The local community access network is then connected to the backhaul network. The access network infrastructure in these cases is often small, and uses technology that is inexpensive and easy to operate.[71] To increase connectivity in local communities, schools initially connected to the backhaul network could play a leadership role in expanding community networks, thus increasing return on investment in the initial infrastructure deployment. Expanding on the concept of community networks, the smart villages and smart islands framework offers a holistic perspective on expanding connectivity and empowering communities.

TakNet, Thailand

TakNet utilizes community wireless mesh network technology, where different nodes within the community are connected with each other and then to one backhaul access point. TakNet has been deployed in 17 rural communities throughout the Tak province, with approximately 2 000 residents using the network on a daily basis.[1] Furthermore, the project has pioneered the use of TV white space, a technology that utilizes unused TV band spectrums, for backhaul connectivity in order to circumvent barriers to extending connectivity in remote areas.[2]

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1 Lertsinsrubtavee, "TakNet – A community white space wireless network." https://blog.apnic.net/2019/07/01/taknet-a-community-white-space-wireless-network/#:~:text=This%20year%20is%20the%20sixth,Internet%20access%20to%20rural%20areas.&text=One%20solution%20is%20to%20use,TV%20White%20Space%20(TVWS).

2 Lertsinsrubtavee et al., "Wireless edge network for sustainable rural community networks."

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71 GSMA, "Closing the Coverage Gap: How Innovation Can Drive Rural Connectivity." https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-Closing-The-Coverage-Gap-How-Innovation-Can-Drive-Rural-Connectivity-Report-2019.pdf

Internet Society community networks

The Internet Society is promoting community networks as a bottom-up approach to connect rural areas. It has supported the development of community networks in India,[1] the Republic of Nepal[2] and Pakistan,[3] providing connectivity to unconnected communities while at the same time empowering local residents. Community networks in the Republic of Nepal have been financially supported by Nepal's USF, and 12 previously unconnected schools have been connected to the Internet.[4] The Internet Society recently signed an MoU with Papua New Guinea to support the establishment of a community network in a coastal community. The activities outlined in the MoU include the development of the network, training workshops for community residents to successfully use online services and the development of a case study on network deployment.[5]

1 Digital Empowerment Foundation, *Wireless for Communities: A Case Book* (2013), https://wforc.in/wp-content/uploads/2019/10/W4C-Caselet.pdf.
2 Internet Society, *Wireless for Communities Nepal Status Report* (2016), https://www.Internetsociety.org/wp-content/uploads/2017/10/W4C-NepalReport-201605.pdf.
3 Internet Society, *A Pilot Community Network in Pakistan: Online Supplementary Education and its Impact* (2018), https://www.Internetsociety.org/wp-content/uploads/2018/09/Pakistan-SupplementaryEducation_short-report.pdf.
4 UNICEF, *UNIVERSAL SERVICE FUNDS: Status in South Asia*.
5 "2019 Impact Report: Community Networks," 2020, https://www.Internetsociety.org/impact-report/2019/community-networks/.

4.3.4 In-kind support

Another way in which Giga collaborates with private sector actors is through in-kind support. Provision of in-kind support could range from software or hardware to pro-bono advice and expertise. For instance, Softbank Investment Advisers has partnered with Giga to offer pro-bono expertise in structured financing and use its ecosystem to map, finance and implement connectivity solutions.[72] Softbank will help in developing a reliable, evidence-based model on the return on investment in connectivity, and in providing advisory services to governments to build country-specific finance and delivery approaches.[73] The telecommunications giant Ericsson has also pledged to commit resources for data engineering and data science capacity to accelerate school connectivity mapping. Specifically, Ericsson will assist with the collection, validation, analysis, monitoring and visual representation of real-time school connectivity data.[74] Giga also aims to develop partnerships with foundations and other organizations in the education sector.

72 "Partnering with Unicef to Help Wire the World's Classrooms," 2020, https://www.linkedin.com/pulse/partnering-unicef-help-wire-worlds-classrooms-catherine-lenson/.
73 "Giga: Connecting Every School to the Internet," 2020, https://www.unicef.org/innovation/giga.
74 "Ericsson and UNICEF Launch Global Partnership to Map School Internet Connectivity," 2020, https://www.generationunlimited.org/news-and-stories/Ericsson-UNICEF-launch-global-partnership.

5 Empower

Source: @UNICEF/UN0403528/Raab

5.1 Amplifying the impact of connectivity

The impact of school connectivity hinges on having a comprehensive approach that addresses demand-driven factors, such as a lack of digital skills and literacy barriers; open, relevant and localized educational content; accessible learning platforms; trained and supported teachers; and awareness of the importance of connectivity. There is also a need to address a fear of adoption and sociocultural norms that exclude minorities and girls. This means that solutions for learning are needed and crucial to achieving the desired impact of school connectivity.

For Giga, schools are an entry point for bringing greater connectivity to entire communities. Therefore, empowerment also involves entire communities in developing digital skills and creating platforms for accessing information and opportunities for financial inclusion, commerce, and health. Fortunately, there are abundant initiatives in Asia and the Pacific that strive to empower learners, teachers, and communities with the tools, skills and platforms to enrich their lives with information, choices and opportunities. In the following chapter, various case studies from Asia and the Pacific are introduced. The impact of connectivity infrastructure can be amplified through the expansion of these initiatives.

However, although promising, many initiatives will struggle unless ICTs and digital skills are integrated into the education structure. Therefore, the chapter emphasizes the importance of integrating ICTs into education policies and beginning the empowerment process with ministries of education. Policy-makers and administrators in ministries of education must be equipped with the digital skills to realize the power of connectivity. Digital skills should become

engrained in their work to ensure that they can effectively engage with grass-roots stakeholders and execute digital empowerment policies. ITU's Digital Skills Toolkit should be the starting point for ministries of education. It provides policy-makers and other stakeholders with practical information, examples and step-by-step guidance to develop a national digital skills strategy.

Giga strives to collaborate with and connect governments with other initiatives such as UNICEF's Reimagine Education, Generation Unlimited, ITU's Generation Connect, the Digital Public Goods Alliance and others to ensure that the appropriate programmes are deployed to amplify the impact of connectivity.

5.2 Empowering learners

5.2.1 E-learning platforms and content

To empower learners, the creation of appropriate e-learning platforms and local language content are crucial, and several UNICEF initiatives seek to achieve this goal.

UNICEF initiatives

Learning Passport, Timor Leste

When schools closed in Timor Leste at the end of March 2020, affecting 408 633 learners, the Ministry of Education, Youth and Sports quickly seized on the Learning Passport online learning platform developed through a partnership between UNICEF and Microsoft as a way to deliver its "Eskola ba Uma" (School at Home) distance learning programme. Although this was the country's first foray into digital learning, nearly 1 000 users signed up within 48 hours of its launch. This marked the beginning of a series of transformative changes in the Timorese education system. COVID-19 acted as a catalyst for change, and the Learning Passport is a critical tool in the country's response to the COVID-19 pandemic. During the school closures from 23 March to 23 June, it was a way to keep children learning from home. During the reopening, it was used successfully to prepare teachers, reaching 95 percent of the workforce – more than 15 000 teachers – through online training.

Digital learning toolkit

In order to create meaningful investment in EdTech, UNICEF, in collaboration with the Aga Khan Foundation and Innovation Unit, has created a human-centered digital learning toolkit. The toolkit contains two volumes, one for schools and education providers and one for national and subnational governments. It consists of four steps. Step 1: understand the challenges and opportunities; step 2: assess context leading to a scorecard; step 3: develop and test approaches; and step 4: make a proposal for action. The toolkit contains eight tools that assist the design of impactful ICT for learning and EdTech solutions. [1]

Reimagine Education

Reimagine Education is an initiative by UNICEF, which aims to connect every child and young person to world-class digital solutions that offer personalized learning to leapfrog to a brighter future. The initiative builds on partnerships across the public and private sectors, and not the least with young people themselves. Reimagine Education will drive change in five key areas: world-class digital learning solutions; connectivity; devices; affordable content and data; young people's engagement. It will unlock opportunities, choice and learning for every child and young person.

1 "Digital Learning Toolkit," 2020, https://www.unicef.org/esa/digital-learning-toolkit.

The Digital Public Goods Alliance has been developed to contribute to the identification, support and scaling-up of digital public goods, and related software, data, content and algorithms in order to advance humanity. The Alliance is incubated by Norway and UNICEF and seeks to accelerate the attainment of the SDGs in low- and middle-income countries by facilitating the discovery, development and use of digital public goods and investment in them.[75]

There are multiple initiatives in Asia and the Pacific that could benefit from the Alliance, the digital learning pillar under Reimagine Education or stand-alone initiatives that support the empowerment of children reached by school connectivity initiatives.

75 "Who we are," 2020, https://digitalpublicgoods.net/who-we-are/.

Viettel - Online learning networks

ViettelStudy is an online learning social network where teachers can organize online classes by livestreaming lectures, uploading lessons, exams (in the form of videos, documents, review questions, etc.) and see the results of their students' homework. Students can join online classes, review lessons, view test results, see gaps in knowledge and discuss with teachers and friends immediately after doing a test. Viettel has also developed an educational website "Connecting Schools". The system supports the organization and management of professional activities in the field of education and training through the online information network. The website allows registered students to engage in online lessons and learning activities managed by teachers. The website includes features for group learning and sharing, evaluation and feedback from teachers.

Huawei's digital education project in Peng'an, China

Huawei helped the Peng'an County Education, Science and Sports Bureau build all-optical campus networks (Huawei Campus OptiX network), providing high-speed connections to more than 80 rural schools, with each classroom enjoying 100 Mbit/s speeds. Huawei also developed a resource-sharing platform that works via a video app so that teachers in both urban and rural areas can enhance their skills with online class modules such as skills transfer and top teachers. During the pandemic, the subject resources and teaching Q&A resources helped teachers prepare classes at home. Although classrooms were shut, students and teachers could continue learning and teaching. It has also developed the educational admin module that includes systems such as automated office and digital library. Headmasters and teachers from 80 schools in Peng'an can coordinate their work, read documents and deploy resources on this platform, breaking the physical boundaries between schools. The wide coverage of fibre-optic networks has enabled more than 70 000 teachers and students in Peng'an to gain equal access to high-quality education resources in both rural and urban settings.[1]

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1 "Technology opens up new horizons for children in Peng'an, Sichuan," https://www.huawei.com/minisite/tech4all/en/pengan.html.

5.2.2 Providing devices

A lack of ICT devices such as computers, printers and tablets in schools severely limits the benefits of connectivity in schools and in communities. For example, in Thailand, on average, seventeen students shared one computer in their school, and this was identified as a major issue hindering the empowerment of students through connectivity.

Aide et Action, Lao P.D.R.

The Aide et Action project provides equipment in the form of tablets, projectors, screens, speakers, and electrical cables to schools in Lao P.D.R. However, as many students and teachers do not have the skills necessary to utilize these tools, the project also includes capacity- building activities for teachers.[1]

1 "Aide et Action Brings Mobile Libraries and e-learning to Rural Children in Cambodia, Laos & Vietnam," 2017, https://headfoundation.org/2017/07/27/aide-et-action-bringing-mobile-libraries-and-e-learning-platforms-to-villages/.

Huawei bridging education gap in Bangladesh

To address the education gap in Bangladesh in the COVID-19 pandemic, Huawei has provided tablets to students and teachers at a local high school. The project also provided educational content as the tablets were preloaded with educational applications. With animated graphics, the apps are designed to be fun and keep students interested and engaged. The programme was launched in close partnership with UNESCO in July 2020 at the T&T Boys High School in Dhaka and is planned to be extended to reach another 2 000 students.[1]

Libraries for all

The Child Fund established eight digital libraries with books and educational resources for children in Lao P.D.R. It also distributed tablets to schools so that children can access the digital library. It further carried out capacity-building activities for teachers to assist children using the tablets and accessing the libraries.[2]

1 "Bridging the Education Gap in Bangladesh," 2020, https://www.huawei.com/minisite/tech4all/en/education-digischool-bangladesh.html.
2 Child Fund, *Annual Report 2019 – 2020* (2020), https://www.childfund.org.au/wp-content/uploads/2020/12/FINAL-Laos-Annual-Report-2019-20.pdf.

5.2.3 Capacity building for teachers

With the emergence of new ICT tools to promote quality education, it is vital to focus on capacity building for teachers in integrating ICT in education. This is because teachers require a different set of skills to manage the classroom, enhance the learning environment, and support and assess student learning when integrating ICTs with pedagogy. Teachers need to develop the capacity to teach using blended teaching approaches and navigate digital content. Thus, both their digital and pedagogical skills need to be improved.

Alternative learning system (ALS) blended teacher training programme

Highlighting the importance of the learning experience design, this initiative is building the capacity of those implementing the on effective strategies in delivering ALS training and learning sessions through multimodal approaches (combination of synchronous and asynchronous, digital and print) while addressing restrictions during the pandemic. Training topics include ALS implementation for team teaching, assessment, action research, self-directed learning, flipped learning, relevant ICT/ social media tools and digital citizenship.[1]

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1 Department of Education, *Development of a Blended Teacher Learning Program for the ALS* (2020), %20Development%20of%20A%20Blended%20Teacher%20Training%20Program%20for%20the%20ALS.pdf.

Teacher ICT capacity-building project in Mongolia

Since 2004, the Yamaguchi-Takada Laboratory has been involved in educational development in Mongolia in close collaboration with central and local government, educational experts and school teachers.[1] The five-year project on sustainable use of ICT for improving the quality of primary education in rural Mongolia included the development of teacher training material, teacher training and training materials for pilot schools. The project targeted approximately 700 primary schools across all provinces of Mongolia. A project impact survey concluded that it was successful in increasing: the length of use of computers for educational purposes, the use of ICT in lessons, communication between teachers about ICT use in school, teacher competency in using ICT, awareness of the potential benefits of ICT for students among teachers and school principals, and awareness of the importance of professional development training for teachers.[2]

A study carried out by the Yamaguchi-Takada Laboratory highlights the importance of capacity building for teachers on ICT uptake in the classroom. The study found that professional competency and benefits from use of ICT are affecting both teachers' perception of the use of ICT tools and digital content promoting student-centred education. It further identified teacher cooperation as another factor affecting teachers' perception of the use of digital content for student-centred education.[3] These findings are supported by another study on factors that affect teacher self-efficacy regarding the use of ICT in the classroom. The study found that school-based training contributes to higher self-efficacy of teachers. It also found that a positive institutional attitude towards ICT-integrated education is important for higher self-efficacy of teachers.[4] Overall, this case study shows that capacity building for teachers is vital to ensure increased connectivity and the actual use of ICT infrastructure and is therefore of benefit to both students and teachers.

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1 "Mongolian Projects," http://www.yamaguchi.gsic.titech.ac.jp/?page_id=7335.

2 Japan International Cooperation Agency and Tokyo Institute of Technology, *Report of the Impact Survey of "Quality Improvement of Primary Education Teachers through Development of Training Materials Using Ict" Project* (2017), https://drive.google.com/file/d/1d2dl3Fz9PqKcrHCn0fF5CsVjeIZL7ZaR/view.

3 Shengru Li, Shinobu Yamaguchi, and Jun-ichi Takada, "Understanding factors affecting primary school teachers' use of ICT for student-centered education in Mongolia," *International Journal of Education and Development using Information and Communication Technology (IJEDICT)* 14, no. 1 (2018), http://ijedict.dec.uwi.edu/viewarticle.php?id=2381.

4 Yukiko Yamamoto and Shinobu Yamaguchi, "A study on teacher's self-efficacy for promoting ICT integrated education in primary schools in Mongolia," *Journal of International Cooperation in Education* 18, no. 2 (2016), https://drive.google.com/file/d/1IAZ4IonUL5XGPuWxHDE_seF4tPY9oZR1/view.

5.2.4 Integrating ICT into education policy

The integration of ICT into education policies is essential to enable the effective and efficient uptake of ICT in educational institutions and streamline activities in the areas discussed above. Integrated policies provide a strategic rationale guiding the use of technology in education, without which ICT policy will remain operational only. National ICT policies will have the greatest impact if they are aligned with other strategic and operational policies. The integration of ICT into education policies can potentially support economic growth and promote social development. Furthermore, the integration of ICT into education policy can potentially play a particularly important role in supporting further education reform and transformation in other areas.[76]

Bhutan education ICT master plan iSherig 2

Bhutan has developed comprehensive education ICT master plans, iSherig and iSherig2. iSherig2 builds on the three thrust areas: iAble – enhance ICT competency of educators, learners and support staff; iBuild – enhance the use of ICT-integrated teaching and learning resources by learners, teachers, non-formal education (NFE) instructors and community learning centre (CLC) managers; and iConnect: – strengthen ICT infrastructure and connectivity for better learning and educational services. Each thrust area includes specific programmes and projects to be implemented by the relevant agency, indicators and targets, and allocated budget. The integration of ICT into the national education policy ensures the streamlined development of different objectives that complement each other (i.e. iBuild, iAble, iConnect). Furthermore, the plan also established an interministerial steering committee to ensure that the different ministries and departments cooperate effectively and efficiently in implementing the objectives.[1]

[1] Ministry of Education, *iSherig-2 Education ICT Masterplan 2019-2023*, Ministry of Education (Thimpu, Bhutan, 2019), https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/bhutan_isherig-2-education-ict-mnasterplan-2019-2023.pdf.

Pakistan's education policy

Pakistan's national education policy aims to leverage the integration of ICT into the education policy for an overall education reform that brings about a shift in teaching from traditional forms to a more modern approach. The National Education Policy 2017–2025 notes the objective to "make integration of ICT in school education an integral part along with a shift from the memorization paradigm of school education to a modern method of learning by exploring, experimenting and innovation."[1]

[1] Ministry of Federal Education and Professional Training, *Pakistan National Education Policy 2017-2025*, Ministry of Federal Education and Professional Training (Islamabad, Pakistan, 2017), http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf.

[76] Robert B. Kozma, "Comparative Analysis of Policies for ICT in Education," in *International Handbook of Information Technology in Primary and Secondary Education* (Springer, 2008).

5.2.5 Child protection

Although younger generations are often perceived to be more tech-savvy, this does not necessarily mean that they are equipped to identify and deal with cyberthreats. With the increasing importance of online tools, it is vital to ensure that children can use these tools safely. This can be achieved by designing services to be safer for children, engaging educators and parents and informing them about online child protection, introducing a streamlined government policy for online child protection, and embedding the issue into digital skills training programmes for children and adults.[77] In 2020, ITU published updated guidelines on child online protection to reflect the new technological landscape in which children find themselves. They should be considered as an initial step in engaging all stakeholders, including educators and parents, industry, policy-makers, and children, for whom they are available in simplified language. The guidelines are designed to serve as a blueprint that can be adapted to different national contexts.[78]

5.3 Community empowerment

Taking a holistic perspective, Giga aims to leverage schools as an entry point to expand connectivity and empower local communities. Connectivity promises positive impacts for communities in a variety of sectors including agriculture, finance, health and government.

Connecting a school to the Internet in a certain area has the potential to increase Internet access beyond the school campus. The connected school can act as point-of-presence for further access network infrastructure that connects the wider community. One example of a school playing this role is the TakNet community network in northern Thailand where a TVWS base station was set up at a local school providing Internet access to a wider community network.[79] Of the innovative business models discussed earlier in the report and in addition to the community network model, the franchise model suits this approach for extending Internet access to the community. In addition, several government projects in the region have leveraged school connectivity for the establishment of public Wi-Fi hotspots such as PipolKonek[80] in the Philippines and the Net Pracharat project in Thailand[81].

Furthermore, schools could potentially serve as a local ICT service centre, similar to community centre initiatives in Bhutan. The project on empowering communities: reaching the unreached in Bhutan aimed to establish community centres with Internet access in each gewong in order to facilitate access to e-government services and ICT education and empower local businesses through the provision of online services. While the project faced challenges related to the lack of skilled staff and cautious uptake by local citizens, the overall experience of the project shows

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77 Broadband Commission, "The Digital Transformation of Education: Connecting Schools, Empowering Learners," (2020), https://www.broadbandcommission.org/Documents/working-groups/SchoolConnectivity_report.pdf.

78 "Guidelines on Child Online Protection: keeping children safe online," 2020, https://www.itu-cop-guidelines.com/.

79 Lertsinsrubtavee et al., "Wireless edge network for sustainable rural community networks."

80 Gabriel, *Pipol Konek: Free Wi-Fi Internet Access in Public Places Project*. https://www.fma.ph/wp-content/uploads/2018/12/Free-Wifi-Internet-Access-in-Public-Places-Project-1.pdf

81 Adipat et al., *Village Broadband Internet Project (Net Pracharat) of Thailand*. https://www.netpracharat.com/Documents/20190805_APT_Netpracharat_V12_Final.pdf

that the establishment of one point of access to the Internet combined with additional service provisions has the potential to enhance community well-being.[82]

5.3.1 Community digital skills

With the increasing significance of digital technologies and services, digital skills are essential for individuals to participate in today's society. They are important not only to gain and keep employment, but are also vital to bridge the digital divide. Research shows that providing access to connectivity is not enough, but that individuals need to learn the skills necessary to use digital services and applications in order to benefit from them.[83] There are many initiatives aiming to improve digital skills in the region; the following initiatives are in no way exhaustive and serve only an illustrative purpose.

Viet Nam national digital literacy framework

UNICEF Viet Nam is supporting the Ministry of Education and Training in the development of a national digital literacy framework. In addition, UNICEF Viet Nam is supporting digital literacy and transferable skills development for in-school and out-of-school adolescents:

For in-school adolescents: To develop an integrated approach to enhancing digital literacy and transferable skills through in-school and extracurricular activities for 10 000 students, to enable them to reach their full potential and support future employability in the new digital economy. Once at scale, this curriculum will benefit 7.5 million secondary school students.

For out-of-school adolescents: To co-create a foundational and advanced digital skills curriculum and support transferable skills development opportunities. This will increase the employability of 1 000 learners in technical and vocational education and training (TVET) institutions that cater for adolescents who are out of school or at risk of dropping out, with a special focus on girls and adolescents from an ethnic minority or with a disability. If results are demonstrated, the Government of Viet Nam has expressed interest in rapidly scaling up the initiative to all TVET institutions, reaching approximately 2 million adolescents who are out of school or at risk of dropping out.

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82 Sonam Tobgye, "DIGITAL TRANSFORMATION IN BHUTAN: CULTURE, WORKFORCE AND TRAINING" (PhD Queensland University of Technology, 2017), https://eprints.qut.edu.au/115459/1/115459_8792526_tobgye_sonam_thesis.pdf.

83 International Telecommunication Union, *Digital Skills Insights 2020*, International Telecommunication Union (Geneva, Switzerland, 2020), https://academy.itu.int/sites/default/files/media2/file/Digital%20Skills%20Insights%202020.pdf.

Digital Training Bus project in Bangladesh

In 2017, Huawei, the Government of Bangladesh (ICT Division), and Robi Axiata jointly launched the Digital Training Bus project. Six buses, equipped with 23 workstations, were built to bring digital skills training courses to women in rural Bangladesh. The buses and equipment are powered by a standby generator, meaning that the lack of easily obtainable power supply frequently seen in rural areas presents no barrier. As well as their mobility, the buses are much more cost-effective than setting up and running fixed-location training centres in remote locations. The project aims to transform the lives of 240 000 women from 64 districts, help Bangladesh in its drive towards gender equality and support long-term economic growth.[1]

[1] "Digital Training Bus: Empowering Women in Rural Bangladesh," https://www.huawei.com/minisite/tech4all/en/bangladesh_training_bus.html.

5.3.2 Finance

Financial technology (fintech) is playing a growing role in improving financial inclusion around the world. The cost savings and economies of scale arising from fintech have made financial services commercially viable for some previously excluded groups. Financial inclusion does matter for economic growth and is associated with a reduction in poverty and inequality. Empirical results point to potentially significant growth benefits from financial inclusion, with the largest gains for low-income and developing countries. Although some fintech applications can be utilized without access to broadband connectivity, broadband has been linked to an increasing uptake of fintech solutions.[84]

M-PAiSA, Fiji

Vodafone, with support from UNCDF, started M-PAiSA in 2010 as a basic mobile money service enabling people to send and receive money using a simple feature phone app. People can immediately send and receive small quantities of money and hold certain funds in a sort of mobile wallet that they can use to transact with. The service brought a significant change in access, convenience and safety. The digital solution can overcome a lot of issues, such as distances in remote areas and difficult-to-reach locations. It also improves gender equality as women are better able to control resources through the mobile wallets. Now M-PAiSA also offers remittance services allowing people to send remittances from Australia or New Zealand to their relatives in Fiji.[1]

[1] "From Financially Excluded To Entrepreneur with Vodafone Fiji's M-PAiSA," 2020, https://www.uncdf.org/article/6021/from-financially-excluded-to-entrepreneur-with-vodafone-fijis-m-paisa.

[84] Elena Loukoianova et al., *Financial Inclusion in Asia-Pacific* (2018). https://www.imf.org/~/media/Files/Publications/DP/2018/46115-dp1817-financial-inclusion-in-asia-pacific.ashx.

ZigWay, Myanmar

Founded in 2016, ZigWay is a fintech social enterprise based in Yangon that provides flexible and affordable loans as well as subscriptions for everyday goods and services via a mobile app. The social enterprise has won various start-up prizes and received support from UNCDF. It offers low-income families the ability to buy household items on monthly subscriptions, thus offering volume discounts leading to savings of up to 20 per cent. It also offers "nano loans" in partnership with local banks. Its app utilizes integrated machine learning models to assess credit worthiness by tracking traditional factors such as family size, household expenses as well as other aspects such as personality factors and attitudes towards saving. Individuals who do not have access to the mobile phone app can apply for loans with so called "super-users" or a smartphone-savvy member of the ZigWay community. The company is also specifically targeting women in order to close the gender gap in financial inclusion.[1]

[1] Sasakawa Peace Foundation, *The Role of Entrepreneurship in Closing Gender Gaps in Myanmar* (2020), https://www.spf.org/en/global-data/user50/SPF-EME_Full.pdf.

UNCTAD TrainForTrade programme

The UNCTAD TrainForTrade programme is based on a pedagogical methodology, including the training of trainers, coaching and blended learning in the areas of e-commerce, trade statistics, and port management. It provides countries with a public–private partnership model, sustainable training, capacity building, a talent management scheme and a systematic methodology combining blended learning and digital technology. Between 2014 and 2018 the programme held 150 courses with more than 5 000 participants from 116 countries. The programme specifically focuses on South-South cooperation with over 500 trainers promoting South-South knowledge sharing.[1]

[1] UNCTAD, *Trainfortrade: Strengthening Knowledge and Skills for Sustainable Economic Development*, https://unctad.org/system/files/official-document/tc2015d1rev2_S04_P03.pdf.

eTrade for all by UNCTAD

The e-Trade for all project was initiated by UNCTAD under its e-commerce and the digital economy programme. The platform was launched in July 2016, during the fourteenth session of the United Nations Conference on Trade and Development. It is a collaborative effort of 30 partners to help developing countries engage in and benefit from e-commerce. The platform is a knowledge-sharing and information hub that facilitates access to a wide range of information and resources on e-commerce and the digital economy. Beneficiaries can connect with potential partners, learn about trends, best practices, up-to-date e-commerce indicators and upcoming events, all in one place.[1]

1 "About Us," https://etradeforall.org/about/.

5.3.3 Agriculture

Broadband connectivity makes possible the application of emerging technologies, such as artificial intelligence, robotics, big data, the Internet of Things, gene editing and drones, to address challenges associated with food production. Smart technologies may increase yield and reduce inputs, while also reducing labour requirements in many cases. Furthermore, they may improve environmental health by enabling the production of more food on existing land, thus sparing further land conversion and increasing eco-efficiency. The application of these technologies also promises potential positive social impacts, although some scholars warn that if the social side is not considered from the outset, these technologies might also have negative impacts on communities.[85]

85 David Christian Rose et al., "Agriculture 4.0: Making it work for people, production, and the planet," *Land Use Policy* 100 (2021/01/01/ 2021), http://www.sciencedirect.com/science/article/pii/S0264837719319489.

8villages, Indonesia

8villages is one of the first agritech start-ups in Indonesia, which provides a complete system using different services to empower small-scale farmers. The first service developed was LISA, an information platform (mobile application) for farmers, to send important alerts and farming tips to subscribers. As the company grew and attracted investment, the product evolved into PETANI, a social media-like network that enabled interaction and knowledge exchange between farmers. 8villages further offers DataHub.id, a field data collection platform (web and mobile application) used by several government institutions to map farmers effectively and assist farmers in gathering and processing field data to create user-friendly data. Lastly, RegoPantes is a shopping application that allows customers to purchase products directly from rural communities without intermediaries, increasing farmers' income and making available consistent and quality products for customers. With their services, 8villages aims to accelerate modernization in a rural area and minimize the gap between urban and rural communities by allowing farmers to directly interact with entrepreneurs, companies and urban consumers without needing to experience fraud caused by intermediaries. The start-up claims it significantly contributes to rural advancement both in terms of mindset and economic growth.[1]

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1 ""Every spoonful is a result of someone else's hard work": Interview with 8villages's CEO Sanny Gaddafi," 2020, https://www.compasslist.com/insights/every-spoonful-is-a-result-of-someone-elses-hard-work-interview-with-8villagess-ceo-sanny-gaddafi.

iFarmer

iFarmer is a technology company in Bangladesh that enables small-scale farmers and agribusinesses to maximize their profit with the declared goal of democratizing agriculture, financing and the supply chain. The start-up is engaged in partnerships with UNCDF, UNESCAP, Prime Bank, Care, Green Delta Insurance, Youth COLAB, Startup Bangladesh, Toru, Accelerating Asia, Hello Tractor, Provati Insurance Co. Ltd. IIX, and Impact Collective, and has received funding support from the Government of Canada and UNESCAP.[1]

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1 "About Us," https://ifarmer.asia/about_us.

5.3.4 Health

Telemedicine involves medical activities such as diagnosis and clinical management, treatment and education for both health-care workers and patients over distance utilizing the Internet. It is a crucial and innovative means for delivering quality health-care services in rural settings by tapping into medical expertise from specialized and urban centres. It is considered clinically useful, feasible, sustainable and replicable in rural areas and underserved communities. However, for telemedicine initiatives to be effective they require stable access to broadband connectivity.[86]

Rural telemedicine programme, Republic of Nepal

The Government of the Republic of Nepal has started a rural telemedicine programme in 30 remote district hospitals with the aim of providing access to specialized health-care services. Use is made of e-mails for supplies, and videoconferencing or telephone for medical consultations in the Republic of Nepal. Despite constraints and challenges, the rural telemedicine programme has supported health workers in the rural district hospitals and rural patients by providing specialist health-care services from their local health facilities and ultimately helped them to save their time and money.[1]

[1] Bhatta and Ellingsen, "Opportunities and Challenges of a Rural-telemedicine Program in Nepal." https://www.researchgate.net/publication/311117864_Opportunities_and_Challenges_of_a_Rural-telemedicine_Program_in_Nepal

RUMAH SELA mHealth, Indonesia

RUMAH SELA is a peer-customized mobile app that aims to increase knowledge about HIV transmission, create awareness about safe sex and HIV prevention, facilitate behavioural change, and foster the uptake of HIV testing for improving access to health services among key populations in Indonesia. The android-based app is based on the principle of self-learning and provides information on HIV prevention and the possibility to connect to local health workers and doctors. The app shows potential promise for enhancing the spectrum of HIV knowledge, reducing risky sexual behaviours, increasing uptake of services, and improving self-esteem among vulnerable and underserved groups as a cost-efficient self-administered intervention.[1]

[1] Priyanka Rani Garg et al., "Mobile Health App for Self-Learning on HIV Prevention Knowledge and Services Among a Young Indonesian Key Population: Cohort Study," *JMIR Mhealth Uhealth* 8, no. 9 (2020/9/8 2020), https://doi.org/10.2196/17646, https://mhealth.jmir.org/2020/9/e17646, https://doi.org/10.2196/17646, http://www.ncbi.nlm.nih.gov/pubmed/32896831.

[86] Ramesh Bhatta and Gunnar Ellingsen, "Opportunities and Challenges of a Rural-telemedicine Program in Nepal," *Journal of Nepal Health Research Council* 13 (05/30 2015), https://www.researchgate.net/publication/311117864_Opportunities_and_Challenges_of_a_Rural-telemedicine_Program_in_Nepal.

5.3.5 E-government

The introduction of e-government services does not simply mean that information is made available online and that government officials have access to computers and other technology. It also calls for rethinking the ways in which government functions are being carried out to improve processes and integration by streamlining service delivery. E-government applications provide many potential benefits for citizens, businesses and government entities, including round-the-clock availability of services, reduced costs of service operation, increased effectiveness and efficiency, increased transparency and reduced transactional costs.[87]

E-government in Bhutan

The Government of Bhutan started an initial pilot in 2010 to try and radically transform all public services into e-services with a centralized "government to citizen" (G2C) initiative. The project was expanded and coordinated into a network of 200 community centres to support the rural population in using the new online services. However, the programme was a mix of successes and failures. Most notably, the services were not implemented through a holistic model that addressed barriers to citizens' access to services, such as difficulties with the payment system, the need to physically sign and scan documents and siloed services for different agencies. To address these issues, the government initiated the Digital Drukyul flagship project that aims to overcome these issues by taking a whole-of-government approach incorporating all areas into the project.[1]

[1] Jigme Tenzing, "Digital Drukyul – an ICT Masterplan for Bhutan," *The Druk Journal* (2020), http://drukjournal.bt/digital-drukyul-an-ict-masterplan-for-bhutan/.

5.3.6 Smart villages

The concept of Smart villages provides a holistic model for connectivity initiatives that empower communities by integrating their needs. Under this model, capacity-building and service delivery activities need to be incorporated into connectivity initiatives aimed at meeting community needs in the areas discussed above. The model further applies an intersectoral perspective through a whole-of-government approach while moving beyond government as an actor incorporating local communities, civil society and private sector actors into the planning and implementation of connectivity initiatives. However, the concept stresses the importance of government leading the charge by adopting an integrated, cross-ministerial, and cross-sectoral approach to planning and implementation.[88]

[87] Mohammed Alshehri and Steve Drew, "Implementation of e-government: advantages and challenges" (paper presented at the International Association for Scientific Knowledge (IASK), 2010).https://core.ac.uk/download/pdf/143886366.pdf.

[88] ITU, "Building Smart Villages: A blueprint as piloted in Niger." https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-SMART_VILLAGE.NIGER-2020-PDF-E.pdf

Example: Smart villages project, Niger

ITU spearheaded the development of the smart villages concept for implementation in the context of Niger's 2.0 strategic plan. ITU and the National Agency for the Information Society (ANSI) conducted a smart villages integration lab in July 2019 in collaboration with several ministries and organizations, including the ministries of health, agriculture, education and ICT, telecom regulators, UN agencies such as WHO, FAO, UNESCO, and local Nigerien telecommunication companies and start-ups. This created a model for smart villages in which each organization has its own unique role but all work together when required. In addition, ITU and the Digital Impact Alliance have developed a methodology for Niger's smart villages platform to guide a common cross-sectoral digital infrastructure. The Government of Niger is applying the model in its smart villages project aiming to connect all of Niger's 15 000 administrative villages to one another while providing additional digital services.[1] [2]

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1 "Smart Villages: Empowering rural communities in 'Niger 2.0'," 2019, https://news.itu.int/smart-villages-empowering-rural-communities-in-niger-2-0/.

2 "Leaving no one behind: Niger's Smart Villages Project," 2019, https://news.itu.int/leaving-no-one-behind-nigers-smart-villages-project/.

6 The way forward

Source: @UNICEF/UN0403580/Raab

This report identified essential components, good initiatives and available tools to connect the unconnected schools in Asia and the Pacific. It also points to future directions for countries and organizations contemplating a school connectivity initiative. This section summarizes suggestions and recommendations based on the findings of the preceding sections of this report.

What is important at the initial planning stage is to confirm a common understanding among various sectors, including the ICT, education and financial sectors based on current status as well as challenges and opportunities surrounding school connectivity. Often, various sectors develop their own development plans that include school connectivity, but these may not necessarily be aligned with each other. ITU promotes a whole-of-government approach to address such challenges and identify opportunities for synergies and efficiency gains.

In addition, it is imperative that awareness of the value of school connectivity mapping be generated among stakeholders in the potential Giga countries. This process should involve government officials from the ministries of education and ICT, UN country offices and private sector actors, particularly telecommunications companies, in the respective countries. Notably, the engagement process should include a series of workshops at the regional and country levels on the value of school connectivity mapping.

The awareness-raising process should stress:

- The value of open data and school connectivity mapping for identifying connectivity gaps in the education sector;
- How connectivity costs can be reduced based on comprehensive mapping;
- The value of high frequency data on connectivity status (live updates) to ensure transparency and accountability and improve quality of service;
- The importance of a multistakeholder approach to mapping to address local realities of data-sharing;
- The challenge of school connectivity data being maintained by multiple school jurisdictions –the absence of data from one or more jurisdictions can lead to significant holes in the mapping and schools being overlooked by connectivity initiatives;
- The importance of maintaining standard nationwide and transparent datasets that support efficient and up-to-date mapping; and
- The multidimensional aspects of connectivity.

This process should be followed by a data availability assessment, which should be conducted on the ground through engagement with respective stakeholders since desk research does not reveal the full extent of data availability and quality. The data availability survey in the appendix could be used as a guide, and a Giga expert should support or lead the process.

After the available data are assessed, mapping school connectivity can progress. If the analysis identifies holes in data availability or issues with the quality of the data, workshops—and potentially training – should be conducted with stakeholders to improve the collection and maintenance of school connectivity data.

Connectivity mapping should be treated as the foundation for understanding the magnitude of the challenge in potential Giga countries. Based on the mapping, connectivity solutions can be assessed, and a cost analysis performed, which should inform financing solutions.

The way forward in the Connect pillar considers that there are a multitude of technological solutions already being deployed in the region. They should be closely evaluated and the results showcased so that stakeholders in Giga countries can learn from them.

Workshops on the policies that facilitated the introduction of cost-effective and sustainable connectivity solutions should be conducted for policy-makers in the region. For instance, opening the use of TV spectrum for Internet connectivity and policies incentivizing investment in telecommunication innovation hold significant promise.

Mapping and connectivity analysis form the basis for selecting the appropriate financing mechanism. The magnitude of the challenge and costing of the solution will determine the best financing pathway. Stakeholders from the public and private sectors should be brought together to examine available mechanisms in each country and how they match different connectivity challenges.

There are various new innovative financing mechanisms available, but their applicability in Asia and the Pacific will depend on local political realities. Emphasis should be placed on ready resources that tend to be underused, such as Universal Service Funds. Overcoming political and administrative hurdles could see significant financial resources freed to connect schools. It is equally important to establish partnerships among key stakeholders, including the local private sector, for the initiative to be sustainable.

Addressing CAPEX challenges is the first part of the equation. It is also necessary to develop school connectivity projects and ensure their sustainable operation. A variety of models are already in place in Asia and the Pacific, such as community networks. It is important to understand how they can be improved and expanded.

Finally, the report demonstrates an abundance of initiatives to empower children and communities digitally, and Giga's school connectivity initiatives will amplify their impact. However, the report stresses the importance of beginning empowerment with ministries of education to develop and execute policies effectively.

It is also critical to integrate cybersecurity and environmental considerations from the beginning. As an increasing number of school children will join cyberspace for the first time through school connectivity initiatives, such as Giga, online child protection and digital literacy programmes should be integrated into the programme. Furthermore, school connectivity initiatives are expected to increase the number of electronic devices in a country, and this will require a well-planned strategy for their disposal and recycling in an environmentally sustainable manner.

7 Overview of potential Giga countries

Source: @UNICEF/UN0409816/Bea

7.1 Bhutan

Key statistics

- Population using the Internet (2017): 48.11 per cent
- Fixed telephone subscriptions per 100 inhabitants (2018): 2.92
- Mobile-cellular subscriptions per 100 inhabitants (2018): 93.26
- Households with computer (2017): 23.58 per cent
- Households with Internet (2017): 44.34 per cent
- Fixed-broadband subscriptions per 100 inhabitants (2018): 2.27[89]

[89] "ICTeye," https://www.itu.int/net4/ITU-D/icteye/#/economie.

Telecommunications market

Internet Service Providers[90]		
Sl #	Name of the ISPs	Coverage
1.	Bhutan Telecom Limited*	Nationwide
2.	Tashi InfoComm Limited*	Nationwide
3.	DrukComm Pvt. Ltd	Thimphu & Phuentsholing
4.	Supernet InfoComm	Phuentsholing
5.	BitCom Systems	Thimphu
6.	Datanet Wi-Fi	Phuentsholing
7.	Nano	Nationwide

*** mobile operators**

- As of 2020, Bhutan Telecom Ltd has the largest market share for mobile subscriptions with 61per cent followed by Tashi InfoComm Ltd with 39 per cent.
- Bhutan Telecom Ltd also dominates the market for fixed-line subscriptions with a market share of over 90 per cent. This is also true for leased fixed-lines where it still has a market share of over 50 per cent followed by Tashi InfoComm Ltd with just over 36 per cent.[91]

National policies

iSherig 2 education ICT master plan (2019–2023)

The master plan was developed building on a review process of the initial iSherig 1 plan and covers the period from 2019–2023, coinciding with the 12th five-year plan. The plan builds on the three thrust areas: iAble – enhance ICT competency of educators, learners and support staff", iBuild – enhance the use of ICT-integrated teaching and learning resources by learners, teachers, non-formal education instructors and community learning centre managers; and iConnect – strengthen ICT infrastructure and connectivity for better learning and educational services. Each thrust area includes specific programmes and projects to be implemented by the relevant agency, indicators and targets and allocated budget. The majority of the budget of BTN 1.686 billion is provided under the 12th five-year plan, while the remaining BTN 0.034 billion still needs to be raised through different sources. Regarding school connectivity, the iSherig 2 plan aims to connect all schools to the Internet by 2023.[92] To complement the iSherig 2 plan, Bhutan has started to implement the education flagship programme, which adds a focus on skills development, specifically on coding education. The programme includes: the introduction of ICT education as a compulsory subject in schools; the establishment of computer labs in all

90 "ICT Services," Bhutan Infocomm and Media Authority, 2020, https://www.bicma.gov.bt/bicmanew/?page_id=503.

91 Bhutan Infocomm and Media Authority, *Annual Report 2019-20*, Bhutan Infocomm and Media Authority (2020), http://www.bicma.gov.bt/bicmanew/data/reports/annual-reports/Annual_Report_2019_2020.pdf.

92 Ministry of Education, *iSherig-2 Education ICT Masterplan 2019-2023*, Ministry of Education (Thimpu, Bhutan, 2019), https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/bhutan_isherig-2-education-ict-mnasterplan-2019-2023.pdf.

primary schools and the revamping of local networks in existing computer labs in secondary schools, as recommended in iSherig 2; and the enhancement of STEM education.[93]

Bhutan Telecommunications and Broadband Policy

This is the main ICT policy document from the Ministry of Information and Communications regarding the development of ICT in Bhutan, published in 2014. It follows the four key principles: market-driven development, universal access, affordability, leadership (by the private sector and the government).[94] Under this policy the government has implemented the National Broadband Master Plan project to roll out fibre to all twenty dzongkhags and 205 gewogs. This is based on the premise that construction of the fibre network is not commercially viable for the private sector. In carrying out the National Broadband Master Plan Project, co-deployment with the electricity infrastructure has successfully increased efficiency and cost-saving.[95]

The government has made additional ICT master plans in the e-government, e-education, e-health and tourism sectors.

The ICT Roadmap 2015 specifically mentions aiming for alternative funding methods such as public-private partnership (PPP) or subscription-based models.[96] In response to the COVID-19 pandemic, the Government of Bhutan issued its first sovereign bond in a bid to diversify government financial sources. The three-year bond series of BTN 3 000 million (or USD 41 million) was well received and resulted in an oversubscription of 300 per cent.[97]

Financing

Bhutan has set up an USF in order to establish universal service throughout the country. The main sources of income for the fund are from service provider fees and a percentage of the annual gross revenues of service providers. In allocating subsidies, the fund adopted a minimum subsidy competitive bidding process. The fund has contributed to a number of rural communication programmes as well as to projects connecting schools and health centres.[98] Bhutan's USF has an overall fund utilization of around 47 per cent to date.[99]

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93 Yeshey Lhendup, "ICT in Bhutanese Education," *The Druk Journal* (2020), http://drukjournal.bt/ict-in-bhutanese-education/.

94 Ministry of Information & Communications, *Bhutan Telecommunications and Broadband Policy*, Ministry of Information & Communications (2014), https://www.moic.gov.bt/wp-content/uploads/2016/05/bhutan_telecommunications_and_broadband_policy_pdf_16764.pdf.

95 Sonam Dukda, *ICT Co-Deployment with the Electricity Infrastructure: The Case of Bhutan*, UNESCAP (Bangkok, Thailand: UNESCAP, 2019), https://www.unescap.org/sites/default/files/ICT%20Co-Deployment%20with%20the%20Electricity%20Infrastructure%2C%20The%20Case%20of%20Bhutan.pdf.

96 Ministry of Information and Communications, *Revised Bhutan ICT Roadmap* (2015), https://www.dit.gov.bt/sites/default/files/bhutan_ict_roadmap_2015_pdf_85407.pdf.

97 UNESCAP, "Bhutan Issues First Sovereign Bond To Meet Increasing Fiscal Financing Needs In Fighting COVID-19," news release, 23 September 2020, 2020, https://www.unescap.org/news/bhutan-issues-first-sovereign-bond-meet-increasing-fiscal-financing-needs-fighting-covid-19#.

98 Lakshunam Chhetri, "New Innovative Universal Service Fund Projects in Bhutan" (ITU-USF (Pakistan) Workshop on Internet Access and Adoption, 2018).

99 UNICEF, *UNIVERSAL SERVICE FUNDS: Status in South Asia*.

Available data

The annual education statistics report details the proportion of schools that are connected to the Internet by school level. As of 2019, 38 per cent of public and 5.3 per cent of private schools did not have Internet access.[100]

The annual report of the Department of Information Technology and Telecom details the number of mobile/fixed-line subscriptions by provider and maps of fibre networks.[101]

The Bhutan InfoComm and Media Authority releases annual records detailing number of mobile and fixed-line subscriptions by operator and market share. The 2019–20 report also includes a list of villages verified physically under the rural communications project, including network type and households not covered.[102] It also released QoS-monitoring reports, including a drive test to measure mobile coverage quality in 2020.[103]

According to ITU's ICT regulatory tracker, in 2019 Bhutan scored 15 out of 20 in the regulatory authority cluster; 20 out of 22 in the regulatory mandate cluster; 16 out of 30 in the regulatory regime cluster; and 18.3 out of 28 in competition framework cluster.[104]

Notable projects:

- School connectivity programmes under the USF.[105]
- Establishment of GovNET and DrukREN – two government high-speed networks aiming to create more efficient service delivery. DrukREN connects higher education facilities throughout the country.[106]
- Regarding infrastructure, the National Broadband Master Plan project was a major project expanding broadband coverage throughout the country.[107]
- Establishment of community connectivity centres as a focal point for expanding connectivity in rural and remote locations. These centres also offer digital skills courses and services, such as printing and scanning.[108]
- The newest government flagship project, Digital Drukyul, aims to deliver a holistic approach, learning from challenges and building on earlier projects.[109] The programme, which has an already approved budget of BTN 1.17 billion for the fiscal year 2020–21 making for 51.3per cent of financial progress,[110] builds on the seven core areas of:
- Integrated citizen services
- E-patient information system (up to basic health unit (BHU) II level implementation)
- Digital school (EMIS 3.0 and digital courses)

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100 Policy and Planning Division, *Annual Education Statistics 2019*, Ministry of Education (2019), http://www.education.gov.bt/wp-content/downloads/publications/aes/Annual-Education-Statistics-2019.pdf.
101 Department of Information Technology and Telecom, *DIIT Annual Report 2018-2019*, Department of Information Technology and Telecom, Ministry of Information and Communications (2019), https://www.dit.gov.bt/sites/default/files/DITT%20Annual%20Report%202011-19.pdf.
102 Bhutan Infocomm and Media Authority, *Annual Report 2019-20*.
103 "Other Reports," Bhutan Infocomm and Media Authority 2020, https://www.bicma.gov.bt/bicmanew/?page_id=168.
104 "Country Card: Bhutan," ICT Regulatory Tracker, 2020, https://www.itu.int/net4/itu-d/irt/#/country-card/BTN.
105 "Projects," Department of Information Technology and Telecom,, 2020, https://www.dit.gov.bt/projects.
106 Department of Information Technology and Telecom, "Projects."
107 Department of Information Technology and Telecom, "Projects."
108 Department of Information Technology and Telecom, "Projects."
109 Jigme Tenzing, "Digital Drukyul – an ICT Masterplan for Bhutan," *The Druk Journal* (2020), http://drukjournal.bt/digital-drukyul-an-ict-masterplan-for-bhutan/.
110 "Nu 1.17bn Approved For Digital Drukyul In FY 2020-21," business bhutan, 2020, https://www.businessbhutan.bt/2020/08/05/nu-1-17bn-approved-for-digital-drukyul-in-fy-2020-21/.

- E-business (integrated business licensing and single customs-trade system)
- One digital identity (Digital identity, biometrics and digital signature)
- Government-initiated network (1000 government offices, schools and hospitals and 5 rings in backbone network to be connected)
- ICT capacity and capability (ICT professionals' certification and digital literacy for non-ICT).[111]

7.2 Mongolia

Key statistics

- Population using the Internet (2017): 23.71 per cent
- Fixed telephone subscriptions per 100 inhabitants (2018): 11.67
- Mobile-cellular subscriptions per 100 inhabitants (2018): 133.18
- Households with computer (2018): 36.45 per cent
- Households with Internet (2017): 22.99 per cent
- Fixed-broadband subscriptions per 100 inhabitants (2018): 9.66[112]

Telecommunications market

- The telecommunications market in Mongolia has experienced rapid growth.
- There has been a gradual implementation of policies on privatization, market liberalization and competition.
- The government's State-owned Information Communications Network Company LLC (or Netcom) accounts for around half of the country's total fibre-optic deployment.
- Only four very small aperture terminal (VSAT) operators are authorized to work in rural areas.[113]

National ICT policies

Most policies are not available in English. However, research suggests that the main ICT development policy documents are:

- The Mongolian Sustainable Development Vision up to 2030
- The State policy on the development of ICT up to 2025
- The action plan of the Government of Mongolia 2016–2020
- The Mongolia–China–Russia economic corridor programme, agreed in 2012
- The national satellite programme, approved by the government in 2012
- The development road national programme, approved by the government in 2017.[114]

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111 "Digital Drukyul Flagship Program," GNHC, 2020, http://flagship.gnhc.gov.bt/digital-drukyul/

112 ITU, "ICTeye." https://www.itu.int/net4/ITU-D/icteye/#/economie

113 UNESCAP, *Research Report on ICT infrastructure Co-deployment with Transport and Energy Infrastructures in Mongolia*. https://www.unescap.org/sites/default/files/Research%20Report%20on%20ICT%20infrastructure%20Co-deployment%20%20with%20Transport%20and%20Energy%20Infrastructures%20in%20Mongolia.pdf

114 UNESCAP, *Research Report on ICT infrastructure Co-deployment with Transport and Energy Infrastructures in Mongolia*. https://www.unescap.org/sites/default/files/Research%20Report%20on%20ICT%20infrastructure%20Co-deployment%20%20with%20Transport%20and%20Energy%20Infrastructures%20in%20Mongolia.pdf

National education policies

The Mongolian education system faces unique challenges such as the large land area which is sparsely populated and the nomadic habits of some of its population. Thus, since the change to a decentralized education system, education has been an important field for ICT integration. However, many of the ICT in education policies and programmes are aimed at teacher capacity building:[115] [116]

- The education master plan 2006 and ICT Vision 2021;
    - education emphasized the use of ICT for teacher development;
    - also includes infrastructure plans (including for schools).[117]
- The education sector (2012– 2016) aims to improve the continuous professional development of teachers through a national teacher training platform.
- The education policy action plan (2012–2016) formed a plan to renew teacher training programmes in accordance with the latest ICT development, as well as new education standards and curricula.
- In 2015, the Ministry of Education, Culture, Science and Sports of Mongolia established a web portal for promoting the utilization of electronic and interactive learning content.[118]
- The report "Towards Mongolia's Long-Term Development Policy Vision 2050: Advancing education equity, efficiency and outcomes" mentions ICT in only two of its objectives, both relating to teacher capacity building.[119]

ICT financing

Mongolia has established a Universal Service Obligation Fund (USOF), which aims to:

- introduce fixed and mobile communication services to remote locations;
- build infrastructure to improve quality coverage;
- reduce Internet prices;
- introduce Internet services to the public;
- provide information and communication education to rural people and herders;
- increase consumption.[120]

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115 Shengru Li, Shinobu Yamaguchi, and Jun-ichi Takada, "The influence of interactive learning materials on self-regulated learning and learning satisfaction of primary school teachers in Mongolia," *Sustainability* 10, no. 4 (2018), https://www.readcube.com/articles/10.3390%2Fsu10041093.

116 Sambuu Uyanga, "Baseline Analysis on ICT in General Education of Mongolia," *Informatics in Education* 13, no. 1 (2014), https://files.eric.ed.gov/fulltext/EJ1064372.pdf.

117 Uyanga, "Baseline Analysis on ICT in General Education of Mongolia." https://files.eric.ed.gov/fulltext/EJ1064372.pdf

118 Li, Yamaguchi, and Takada, "The influence of interactive learning materials on self-regulated learning and learning satisfaction of primary school teachers in Mongolia." https://www.readcube.com/articles/10.3390%2Fsu10041093

119 Ministry of Education Culture Science and Sports, *Towards Mongolia's Long-Term Development Policy Vision 2050: Advancing education equity, efficiency and outcomes*, Ministry of Education, Culture, Science and Sports (2020), http://documents1.worldbank.org/curated/en/801531597033753381/pdf/Towards-Mongolia-s-Long-Term-Development-Policy-Vision-2050-Advancing-Education-Equity-Efficiency-and-Outcomes.pdf.

120 "Projects and Programs," 2020, https://www.usof.gov.mn/?page_id=12.

The fund's capital comes from a 2 per cent levy on the income of telecommunication service companies. The USOF has been involved in over 100 projects and programmes between 2007 and 2018.[121]

Available data

There is very little data publicly available in English. However, other research suggests that some statistics on ICT infrastructure in schools are available (e.g., number of computers, access to the Internet).[122]

7.3 Pakistan

Key statistics

- Population using the Internet (2017): 15.51 per cent
- Fixed telephone subscriptions per 100 inhabitants (2018): 1.32
- Mobile-cellular subscriptions per 100 inhabitants (2018): 72.56
- Households with computer (2017): 16.15 per cent
- Households with Internet (2017): 22.14 per cent
- Fixed-broadband subscriptions per 100 inhabitants (2018): 0.85[123]

Telecommunications market

Cellular market profile[124]

Cellular service provider	Market share
Pakistan Mobile Communications Ltd (Jazz)	36.7 per cent
Telenor	27.34 per cent
CMPAK (Zong)	21.93 per cent
Pakistan Telecom Mobile Ltd (Ufone)	13.13 per cent

Additionally, the Pakistan Telecommunication Authority provides extensive lists of operators for all types of licences, including fixed and mobile lines, and infrastructure.[125]

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121 UNESCAP, *Research Report on ICT infrastructure Co-deployment with Transport and Energy Infrastructures in Mongolia*. https://www.unescap.org/sites/default/files/Research%20Report%20on%20ICT%20infrastructure%20Co-deployment%20%20with%20Transport%20and%20Energy%20Infrastructures%20in%20Mongolia.pdf

122 Uyanga, "Baseline Analysis on ICT in General Education of Mongolia." https://files.eric.ed.gov/fulltext/EJ1064372.pdf

123 ITU, "ICTeye." https://www.itu.int/net4/ITU-D/icteye/#/economie

124 "Telecom Indicators," Pakistan Telecommunications Authority, 2020, https://www.pta.gov.pk//en/telecom-indicators.

125 "List of Operators," Pakistan Telecommunications Authority, 2020, https://www.pta.gov.pk/en/industry-support/home/list-of-operators.

National policies

Education policies

The main relevant education policy documents are the National Education Policy 2017–2025[126] and the National Education Policy Framework 2018[127]. The National Education Policy Framework 2018 outlines key challenges and priorities for the development of the education sector. The key challenges identified include the large number of out-of-school children, a fragmented school system, overall low quality of education and a weak higher education system. To address these challenges, the document details priority areas for action, which include the innovative use of technology to build the capacity of teachers through training and the use of ICT to enhance access to education in remote areas.[128]

The National Education Policy 2017–2025 is more detailed plan setting out how to enact this agenda. It discusses various aspects in detail and has a whole chapter dedicated to ICT in education. The chapter identifies integration of ICT into education as a key pathway for catching up given lost time and the increasing number of ill-educated and illiterate youth. Learning from international IT corporations and in order to circumvent the time-consuming process of developing new curricula in the face of a fast-changing technological landscape, the policy aims for a "professional certification" approach. The policy seeks to re-establish connections with IT giants, including, but not limited to, Microsoft, Intel, Open Sources and Linux, with a view to utilizing the curricula of their worldwide recognized educational programmes and thus empowering high school children in Pakistan with employable certification of IT skills and knowledge. In this context, the Ministry of Federal Education and Professional Training has already signed a MoU with Intel.[129] Against this background, the main objectives of the policy are to focus on equipping students with relevant ICT skills for the labour market, increase access to ICT in education and build teachers' capacity to utilize ICT in the classroom for student-centred education.[130]

In line with other policies, the Pakistan National Response and Resilience Plan for COVID-19 explicitly mentions the possible long-term benefits of the introduction of ICT for distance learning to increase access to education beyond the COVID-19 pandemic.[131]

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126 Ministry of Federal Education and Professional Training, *Pakistan National Education Policy 2017-2025*. http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf

127 Ministry of Federal Education and Professional Training, *National Education Policy Framework 2018*, Ministry of Federal Education and Professional Training (Islamabad, Pakistan, 2018), http://www.mofept.gov.pk/SiteImage/Policy/National%20Eductaion%20Policy%20Framework%202018%20Final.pdf.

128 Ministry of Federal Education and Professional Training, *National Education Policy Framework 2018*. http://www.mofept.gov.pk/SiteImage/Policy/National%20Eductaion%20Policy%20Framework%202018%20Final.pdf

129 Ministry of Federal Education and Professional Training, *Pakistan National Education Policy 2017-2025*. http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf

130 Ministry of Federal Education and Professional Training, *Pakistan National Education Policy 2017-2025*. http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf

131 Ministry of Federal Education and Professional Training, *Pakistan National Response and Resilience Plan (K-12) for Covid-19*. http://mofept.gov.pk/SiteImage/Misc/files/0_%20NERRP%20COVID-19%20MoFEPT%204%20May%202020%20Ver%2001.pdf

Telecommunications policies

The main relevant ICT policies are the Telecommunications Policy[132] enacted in 2000 and amended in 2015 and the Digital Pakistan Policy 2018[133]. The Telecommunications Policy 2015 sets out detailed provisions for all areas of ICT development, including regulations and guidelines regarding markets, broadband, infrastructure, spectrum and universal service. The policies establish the following expectations:

- universally available, affordable and quality telecommunication services;
- open, competitive, and well-managed markets;
- ubiquitous adoption for a substantial increase in the penetration of universally available and affordable telecommunication services;
- consequently, high penetration of telecommunication services and their resultant use will lead to increased growth in GDP;
- market-driven infrastructure provision and service delivery.
- appropriate regulation for the development of efficient telecommunication markets;
- accelerated digitization;
- universal access;
- government in a leadership position.[134]

The Digital Pakistan Policy 2018 expands on the Telecommunications Policy 2015 and promotes a holistic policy approach that encompasses all sectors of society. As part of this holistic approach, it details guidelines for the digitalization of the sectors: e-agriculture, e-health, e-energy, e-commerce, e-justice, IoT, fintech, artificial intelligence and robotics, cloud computing and big data, and ICT education. With regard to the ICT education sector, the policy objectives aim to: ensure inclusive, equitable and quality ICT education and lifelong learning process for all; ensure the relevance of ICT education to industry needs; increase students' critical thinking skills through computing and analytical curricula and ICT tool adoption programmes; increase network accessibility at educational institutes across Pakistan; integrate computing courses into the curriculum at all levels of education; update the curricula of IT higher educational degree programmes in line with international guidelines; and develop e-portals for the provision of academic, research and other supplementary materials for educational institutions.[135]

Financing

Pakistan established a USF in order to extend coverage to remote and underserved areas in 2006[136]. The main sources of income for the fund are a 1.5 per cent levy on the gross operating revenues of all telecommunication operators and monies obtained from the APC (access promotion charge)[137]. The main funding targets are capital expenditure and operating

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132 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

133 Ministry of IT & Telecom, *Digital Pakistan Policy*. https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf

134 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

135 Ministry of IT & Telecom, *Digital Pakistan Policy*. https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf

136 IT and Telecommunication Division, *Universal Service Fund Policy*. https://usf.org.pk/assets/rules-pdf/usf-policy.pdf

137 GSMA, *Universal Service Fund Study*. https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf

expenditure associated with the provision of services that facilitate universal service.[138] Although the Universal Service Fund Policy 2006[139] maintains that the fund is technology neutral, the Telecommunications Policy 2015[140] mentions a preference for the use of fibre over microwave in backhaul and for fibre over copper in wireline access. Pakistan's USF has been mentioned as a best-practice example in various reports,[141][142] although some research suggests it is less efficient in distributing funds than often claimed.[143]

In addition to the USF, Pakistan also established the National ICT R&D Fund funded by a levy of 0.5 per cent on licensee's gross revenue. This supports the development of applications and content, demand and output-driven research, ICT start-ups, incubation and acceleration centres, as well as ICT events and conferences.[144]

In order to stimulate the telecommunication sector, the Digital Pakistan policy introduces various fiscal and non-fiscal incentives. These include incentives to attract FDI, tax exemptions, easy access to loans, cash rewards and establishment of IT parks and special economic zones.[145]

Notable projects

- Participation in the Partners in Learning programme launched by Microsoft in 2004 with the objective of preparing children for the digital world, developing employable IT skills and increasing IT resources in schools and teacher training institutes.[146]
- Projects under the USF:
    - basic rural telecom programme, which targeted 10 000 underserved villages subsidizing 4000 km of fibre-optic cables;
    - optical fibre for all, with the aim of installing 9 000 km of cable;
    - establishment of telecentres in villages as part of the broadband extension of a subsidy winning company.[147]
- Responses to the COVID-19 pandemic that introduced distance-learning technologies including over TV and the Internet.[148]

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138 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

139 IT and Telecommunication Division, *Universal Service Fund Policy*. https://usf.org.pk/assets/rules-pdf/usf-policy.pdf

140 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

141 GSMA, *Universal Service Fund Study*. https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf

142 UNESCAP, *The Impact of Universal Service Funds on Fixed-Broadband Deployment and Internet Adoption in Asia and the Pacific*. https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf

143 Rohan Samarajiva and Gayani Hurulle, "Measuring disbursement efficacy of Universal Service Funds: Case studies from India, Malaysia, Pakistan & Sri Lanka," *SSRN* (2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3044254.

144 Ministry Of Information Technology, *Telecommunications Policy 2015*. https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

145 Ministry of IT & Telecom, *Digital Pakistan Policy*. https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf

146 Ministry of Federal Education and Professional Training, *Pakistan National Education Policy 2017-2025*. http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf

147 GSMA, *Universal Service Fund Study*. https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf

148 Ministry of Federal Education and Professional Training, *Pakistan National Response and Resilience Plan (K-12) for Covid-19*. http://mofept.gov.pk/SiteImage/Misc/files/0_%20NERRP%20COVID-19%20MoFEPT%204%20May%202020%20Ver%2001.pdf

- The Global Partnership for Education has supported the governments of Balochistan and Sindh provinces in utilizing technology to increase access to information:
    - utilization of geospatial data to identify abandoned buildings for transformation into schools and locations for school construction;
    - establishment of real-time information systems utilizing mobile phone technology.[149]

Available data

The Pakistan social and living standards measurement survey includes general statistics on education, such as enrolment rates, literacy rates and expenditure on schools. Since 2016, it has also included statistics on ICT access and used data disaggregated by province and rural and urban areas including on:

- household access to computers, Internet and smart phones
- household usage of computers, Internet and smart phones
- types of ICT skills
- overall population with use of the Internet.[150]

The annual reports from the Pakistan Telecommunication Authority (PTA) include the following data:

- total telecommunication revenue
- telecommunication investments
- FDI
- telecommunication contribution to the exchequer
- cellular-mobile subscribers
- NGMS subscribers
- broadband subscribers by technology
- fixed local loop subscribers.[151]

The same data are available on the PTAs website disaggregated monthly.[152]

According to ITU's ICT regulatory tracker, in 2019 Pakistan scored 19 out of 20 in the regulatory authority cluster; 16 out of 22 in the regulatory mandate cluster; 24 out of 30 in the regulatory regime cluster; and 27 out of 28 in the competition framework cluster.[153]

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149 "Pakistan: Technology Boosts Education Reform in Remote Areas," 2019, https://www.globalpartnership.org/results/stories-of-change/pakistan-technology-boosts-education-reform-remote-areas.

150 Pakistan Bureau of Statistics, *Pakistan Social & Living Standards Measurement Survey (PSLM) 2018-19 National /Provincial (Social Report)* (2020), http://www.pbs.gov.pk/sites/default/files//pslm/publications/pslm2018-19/pslm_report_2018-19_national_provincial.pdf.

151 Pakistan Telecommunications Authority, *Pakistan Telecommunications Authority Annual Report 2019* (2019), https://www.pta.gov.pk/assets/media/pta_ann_rep_2019_27032020.pdf.

152 Pakistan Telecommunications Authority, "Telecom Indicators." https://www.pta.gov.pk//en/telecom-indicators

153 "Country Card: Pakistan," ICT Regulatory Tracker, 2020, https://www.itu.int/net4/itu-d/irt/#/country-card/PAK.

7.4 Papua New Guinea

Key statistics

- Population using the Internet (2017): 11.21 per cent
- Fixed telephone subscriptions per 100 inhabitants (2017): 1.87
- Mobile-cellular subscriptions per 100 inhabitants (2017): 47.62
- Households with computer (2017): 4.74 per cent
- Households with Internet (2017): 11.02 per cent
- Fixed-broadband subscriptions per 100 inhabitants (2017): 0.21[154]

Telecommunications market

- The National Information and Communications Technology Authority is the sole regulating authority for the telecommunications market.
- Although the regulation framework follows international best practices, its performance is weak and prices are high.
- The State-owned former monopoly, Telikom, dominates the fixed-line market.
- Digicel dominates the mobile market with a 95 per cent market share. The other notable company is B-Mobile, a subsidiary of Telikom.[155]

National policies

National Information and Communication Technology (ICT) Policy (2008)

The policy has the following main objectives:

- creating competition in the market
- securing the social and economic benefits of an efficient ICT sector
- securing substantial investment to refurbish the existing network and extend its availability across the country
- substantially increasing access to basic and affordable telecommunication services across Papua New Guinea
- transforming Telikom PNG for competition and more efficiency
- improving international capacity and connectivity.[156]

The policy notes that there are many ways in which ICT can enhance education, specifically regarding distance learning which is helpful in the context of Papua New Guinea (rugged geography). In order to increase the use of ICT in education, the policy outlines the following strategies:

1. encourage online learning in the educational institutions and universities of Papua New Guinea;
2. promote centres of excellence that are held up as beacons of online learning for other institutions to emulate;

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154 ITU, "ICTeye." https://www.itu.int/net4/ITU-D/icteye/#/economie

155 Bronwyn E. Howell, Petrus H. Potgieter, and Ronald Sofe, "Regulating for telecommunications competition in developing countries: Papua New Guinea," *Asian-Pacific Economic Literature* 33, no. 1 (2019), https://doi.org/https://doi.org/10.1111/apel.12248, https://onlinelibrary.wiley.com/doi/abs/10.1111/apel.12248.

156 Department of Communication & Information, *National Information & Communication Technology (ICT) Policy* (Department of Communication & Information, 2008), https://www.nicta.gov.pg/legislative/policies-all/.

3. create awareness of the educational possibilities of ICT enabled learning;
4. facilitate the sharing of e-learning knowledge and resources between educational institutions;
5. encourage vocational training and awareness of vocational training through the use of employer incentives for staff undertaking such training;
6. investigate the provision of computing devices, with pre-loaded literacy and numeracy software, to children and students inside Papua New Guinea under the One Laptop Per Child programme;
7. provide incentives to the private sector to donate equipment and sponsor community-based privately-owned Internet kiosks; and
8. create a set of applications that are focused on particular areas of society and make them accessible via low-cost privately-owned kiosks.[157]

Additionally, the policy sets out various strategies to: 1) encourage programmes to educate the population on the effective use of the Internet as a business and life tool; and 2) encourage Papua New Guinea's citizens to engage in education programmes available through the Internet. These include the development of a national education plan and establishment of ICT colleges.[158]

National Broadband Policy (2013)

This policy was drafted to provide an overarching framework aligned with long- and mid-term development goals to utilize ICT for good governance and economic growth, extend network infrastructure, increase private sector development and employment, and increase capacity building and human resources development. Overall, the policy follows the principles of market-driven community involvement and ownership, universal access, affordability, leadership and government intervention. Regarding education, it highlights the need to: 1) deliver broadband-enhanced education in all schools, including the development of relevant ICT skills at all educational levels to bring about curriculum extension, choice and improved quality of education; and 2) increase ICT understanding and skills among the entire population, particularly to ensure that skills are developed to match future economic needs. To achieve these objectives, the following goals have been set: increase teacher training, update curricula, and ensure availability of richer syllabus choices.[159]

National Education Plan 2015–2019

Includes the following objectives to integrate ICT into education:

- implement e-learning suitable for Papua New Guinea
    - includes curriculum development, teacher capacity building, and advice on school infrastructure
- use ICT to enhance teaching and learning.[160]

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157 Department of Communication & Information, *National Information & Communication Technology (ICT) Policy*. https://www.nicta.gov.pg/legislative/policies-all/

158 Department of Communication & Information, *National Information & Communication Technology (ICT) Policy*. https://www.nicta.gov.pg/legislative/policies-all/

159 NICTA, *National Broadband Policy Draft* (NICTA, 2013), https://www.nicta.gov.pg/legislative/policies-all/.

160 Department of Education, *National Education Plan 2015-2019*, Department of Education, (2016), https://www.education.gov.pg/documents/NEP_2015-2019_DoE.pdf.

Financing

Papua New Guinea established a universal access and service (UAS) fund and the National ICT Act 2009 to promote the long-term economic and social development of Papua New Guinea. The fund supports approved projects that encourage the development of ICT infrastructure and improve the availability of ICT services within Papua New Guinea, including in rural communities. The fund is financed mainly by levies paid by operator licensees and direct government funding.[161] Notable projects under the UAS scheme include:

- The rural communications project:
    - to provide 3G broadband Internet services by upgrading existing 2G or installing new cell towers in selected areas throughout the country that do not have access to the Internet.
- Mobile broadband network upgrade and expansion:
    - to extend the coverage of advanced broadband wireless mobile communication services (at least 3G/HSPA+, 4G/LTE, or other advanced systems).
- Community and institutional broadband networks:
    - to help deliver high-speed, full-service fixed broadband Internet connections to selected communities, with services and capacity widely available to public institutions (including schools) as well as local businesses and households.
- ICT platform for future growth:
    - focuses on the demand side of ICT development objectives to ensure that citizens and communities are able to gain the most benefits from the installation and availability of advanced broadband ICT networks and services.
- Expansion of broadcasting network coverage:
    - supports the extension of radio and television broadcasting to all citizens and communities in Papua New Guinea.[162]
- Connect the schools (under the community and institutional broadband network programme):
    - planned to provide Internet connectivity and broadband services to all primary, secondary and tertiary institutions in the country.[163]
    - However, the programme ended up connecting a total of eight teacher's colleges.[164]

[161] UAS Secretariat, "UAS Fund." https://uas.nicta.gov.pg/index.php/about-uas/uas-fundd
[162] "UAS Programs," UAS Secretariat, https://uas.nicta.gov.pg/index.php/programs.
[163] National Information and Communications Technology Authority, *Report on Proposed 2017 UAS Projects*. https://uas.nicta.gov.pg/images/Reports/Report_UAS-Board-2017-Projects.pdf
[164] UAS Secretariat, "Connect the Schools Projct 2017." https://uas.nicta.gov.pg/index.php/programs/community-and-institutional-broadband-networks/connect-the-schools-project

Available data

There is little publicly accessible data available. The UAS secretariat releases regular reports on the progress of UAS projects.[165]

The National Education Plan 2015–2019 gives a snapshot of general education data.[166]

7.5 Vanuatu

Key statistics

- Population using the Internet (2017): 25.72 per cent
- Fixed telephone subscriptions per 100 inhabitants (2017): 1.58
- Mobile-cellular subscriptions per 100 inhabitants (2018): 79.86
- Households with computer (2017): 22.42 per cent
- Households with Internet (2017): 29.45 per cent
- Fixed-broadband subscriptions per 100 inhabitants (2017): 1.59[167]

Telecommunications market

With the aim of ending the existing monopoly and creating competition in the telecommunication sector, the 2007 Telecommunications Policy Statement established four guiding principles:

- open and competitive markets
- modern, independent and proportionate regulation
- non-discrimination and technology neutrality
- optimal use of scarce resources.[168]

List of Telecommunication companies[169]

Telecom Vanuatu	2008	mobile and fixed voice, Internet	ATH of Fiji
Digicel	2008	mobile and fixed voice, Internet	Digicel Group Ltd
Telsat Broadband	2009	Internet	Local privately owned
Wantok Network	2009	Internet	Terralight Holdings Limited of Canada
Interchange	2009	Internet	Government & private inves-tors

165 National Information and Communications Technology Authority, *2020 UAS Projects Report*, National Information and Communications Technology Authority, (2019), https://uas.nicta.gov.pg/images/Reports/Report_UAS-Board-2020-Projects.pdf.

166 Department of Education, *National Education Plan 2015-2019*. https://www.education.gov.pg/documents/NEP_2015-2019_DoE.pdf

167 ITU, "ICTeye." https://www.itu.int/net4/ITU-D/icteye/#/economie

168 UN-OHRLLS, *Leveraging Investments in Broadband for National Development: The Case Of Vanuatu*. http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf

169 UN-OHRLLS, *Leveraging Investments in Broadband for National Development: The Case Of Vanuatu*. http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf

List of Telecommunication companies (continued)

Incite	2010	Internet	Affiliate of overseas company
Spim	2011	Internet	Local privately owned
Global Telecom Pacific	2015	Internet	Local privately owned

National policies

National Information and Communication Technology Policy

The policy includes the following eight priority areas:

- access to ICTs in education
- access to ICT infrastructure and devices
- e-government
- integration of ICTs into sectoral policies
- building trust and mitigating risks and threats in ICT development
- locally relevant content
- capacity building
- developing a platform for multistakeholder and multisectoral coordination and collaboration[170] [171]

Universal Access Policy (UAP)

- Has the goal of ensuring access by 98 per cent of the population to voice and narrowband data services and broadband Internet services by 1 January 2018.
- Stipulates that services must be available at educational institutions, health facilities and public offices.
- Geographically uniform pricing is expected at levels consistent with those of an effectively competitive market, although discounted prices may be made available to educational and health facilities.
- Includes three projects for extending ICT access to schools and communities with funding from the Australian Governance for Growth programme.
- As of June 2017, the regulator expected that the UAP target of access to broadband data services by 98 per cent of the population would be achieved by the target date of 1 January 2018.[172] [173]

The Interim Vanuatu Education and Training Sector Strategy 2017–2018 only mentions the increased use of ICT in monitoring and managing.[174]

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[170] UN-OHRLLS, *Leveraging Investments in Broadband for National Development: The Case Of Vanuatu*. http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf

[171] Government of the Republic of Vanuatu, *National Information and Communication Technology Policy*, Government of the Republic of Vanuatu (2013), https://ogcio.gov.vu/images/Vanuatu-National-ICT-Policy-EN.pdf.

[172] UN-OHRLLS, *Leveraging Investments in Broadband for National Development: The Case Of Vanuatu*. http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf

[173] Council of Ministers, *Universal Access Policy* (2013), https://ogcio.gov.vu/images/Universal-Access-Policy-EN-FR-BI.pdf.

[174] Ministry of Education and Training, *Interim Vanuatu Education And Training Sector Strategy 2017-2018*, Ministry of Education and Training (2017), https://moet.gov.vu/docs/policies/Interim%20Vanuatu%20Education%20Sector%20Strategy%20French%20and%20English_2017-2018.pdf.

Financing

Vanuatu established a Universal Access Policy Fund. Service providers were offered the option of contributing actively through network deployment, or passively through annual levies on revenue.

Available data

In 2012, the Ministry of Education carried out a school mapping exercise throughout the country.[175]

The mini-census of 2016 includes household data on use of and access to telecommunications, including phones, Internet, TV and radio.[176]

The first survey of ICT usage in Vanuatu schools carried out in 2013 details schools' access to ICT facilities, ICT skills, usage of ICT in education, and priority given to ICT. The study found that very low priority was given to ICT in education, reflected in low ICT access, usage and skills.[177]

The Ministry of Education releases annual reports on education statistics that include data on enrolment rates, number of schools, sanitation infrastructure, and the number and qualifications of teachers, etc. [178]

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175 Department of Education, *Vanuatu School Mapping Report - 2012*, Department of Education (2012), https://moet.gov.vu/docs/mapping/School%20Mapping%20Report_2013.pdf.

176 Vanuatu National Statistics Office, *Mini – Census Report*, Ministry of Finance and Economic Management (2016), https://sdd.spc.int/digital_library/vanuatu-2016-post-pam-mini-census-report-volume-1.

177 Prime Minister's Office et al., *The First Survey of ICT Usage in the Vanuatu Schools* (2013), http://www.themosttraveled.com/Vanuatu/First%20Survey%20of%20ICT%20Usage%20in%20Schools%20Final%20Final.pdf.

178 Ministry Of Education And Training, *Education Statistics: Basic Tables Of 2019*, Ministry Of Education And Training (2019), https://moet.gov.vu/docs/statistics/2019%20MoET%20Education%20Statistics%20Report_2020.pdf.

8 Appendix

Data availability survey

Respondent Name:_____

Organization: _____

Position: _____

School data

Is there a comprehensive list of school names? Yes No Don't know

If yes, which department, ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Is there geolocation data of each school (latitude, longitude)? Yes No Don't know

If yes, which department, ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Are data available on Internet connectivity for each school? Yes No Don't know

If yes, which department, ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Are data on the speed of Internet connectivity (Mbit/s) for each school?

Yes No Don't know

If yes, which department or ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Are data available on electricity for each school? Yes No Don't know

If yes, which department, ministry, or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Are there data on the type of Internet connectivity (i.e., wireless, fibre, satellite) each school has?

Yes No Don't know

If yes, which department, ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Do you have real-time connectivity data: Periodical updates of the QoS of Internet connectivity (upload/download speed, latency)? Yes No Don't know

If yes, which department, ministry or agency keeps the data? _____

If the data are publicly available, what is the source? _____

Do you have any of the following additional school indicators:

Number of students at each school? Yes No Don't know

If yes, who is the data owner? _____Public data source if any:_____

Number of teachers at each school? Yes No Don't Know

If yes, who is the data owner? _____Public data source if any:_____

Enrolment rates? Yes No Don't know

If yes, who is the data owner? _____Public data source if any:_____

Dropout rates? Yes No

If yes, who is the data owner? _____Public data source if any:_____

Do you have any of the following geographic indicators per school?

Village: Yes No Don't know

If yes, who is the data owner? _____Public data source if any:_____

Region: Yes No Don't know

If yes, who is the data owner? _____Public data source if any:_____

Province/state: Yes No Don't know

If yes, who is the data owner? _____Public data source if any:_____

Network data

Are there comprehensive maps of the fibre networks in the country? Yes No Don't know

If yes, who keeps the maps?_____Public data source if any:_____

Are there mobile coverage maps? Yes No Don't know

If yes, who keeps the maps? _____Public data source if any:_____

Are there lists of cell tower geolocations? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

Are there satellite coverage maps? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

Is there a list of spectrum allocation and assignment? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

Is there data on costs and pricing for different connectivity solutions (fibre, mobile, wireless, satellite)? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

If yes, which department, ministry or agency keeps this data? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

Additional data

Are there comprehensive electric grid maps that cover the country? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

Are there population maps? Yes No Don't know

If yes, who keeps the data?_____Public data source if any:_____

If yes, are the population maps disaggregated by age? Yes No Don't know

At what level is the following socio-economic data disaggregated?

Per capita income: household subdistrict district provincial national

mobile phone ownership: household subdistrict district provincial national

economic activity: household subdistrict district provincial national

List of references

Abecassis, David, Elena Korsukova, Michael Kende, Richard Morgan, and Lim Jia Yee. *The Impact of Facebook's Connectivity Initiatives in the Asean Region*. Analysys Mason (2020). https://www.analysysmason.com/contentassets/f8a396952f9c4481982c674724d85356/the-impact-of-facebooks-connectivity-initiatives-in-the-asean-region---28-june-2020.pdf

Adipat, Boonlit, Natthaphong Phongwitthayanukit, Buddhachart Siributr, Warisara Phetnil, and Piyada Sudkangwan. *Village Broadband Internet Project (Net Pracharat) of Thailand*. Asia-Pacific Telecommunity (Bangkok, Thailand: Ministry of Digital Economy and Society, 2019). https://www.netpracharat.com/Documents/20190805_APT_Netpracharat_V12_Final.pdf

Alshehri, Mohammed, and Steve Drew. "Implementation of E-Government: Advantages and Challenges." Paper presented at the International Association for Scientific Knowledge (IASK), 2010.https://core.ac.uk/download/pdf/143886366.pdf

ANDE India SGB Finance Learning Lab. *Social Success Note Playbook: A Blended Finance Tool for Social Impact*. (2020). https://cdn.ymaws.com/ande.site-ym.com/resource/resmgr/publications/final_ssn_playbook11.9.2020.pdf

"Adb's Work to Improve Access to Information and Communication." https://www.adb.org/sectors/ict/overview.

"Kacific1 Satellite Launch to Bring Affordable Internet to Remote Parts of Asia and Pacific." 2019, https://www.adb.org/news/kacific1-satellite-launch-bring-affordable-Internet-remote-parts-asia-and-pacific.

Asian Development Bank. *Proposed Loan and Administration of Loan Kacific-1 Limited and Kacific Broadband Satellites International Limited Asia–Pacific Remote Broadband Internet Satellite Project (Regional)*. (2019). https://www.adb.org/sites/default/files/project-documents/53115/53115-001-rrp-en.pdf

Attridge, Samantha, and Lars Engen. *Blended Finance in the Poorest Countries: The Need for a Better Approach*. Overseas Development Institute (ODI) (London: 2019). http://hdl.handle.net/10419/206745

Bhatta, Ramesh, and Gunnar Ellingsen. "Opportunities and Challenges of a Rural-Telemedicine Program in Nepal." *Journal of Nepal Health Research Council* 13 (05/30 2015): 149-53. https://www.researchgate.net/publication/311117864_Opportunities_and_Challenges_of_a_Rural-telemedicine_Program_in_Nepal.

Child Fund. *Annual Report 2019 – 2020*. (2020). https://www.childfund.org.au/wp-content/uploads/2020/12/FINAL-Laos-Annual-Report-2019-20.pdf

Commission, Broadband. "The Digital Transformation of Education: Connecting Schools, Empowering Learners." (2020). https://www.broadbandcommission.org/Documents/working-groups/SchoolConnectivity_report.pdf.

Convergence. *Data Brief: Blended Finance in Asia*. (2019). https://assets.ctfassets.net/4cgqlwde6qy0/5qkeWZZEopdJcTSth1oQeD/e36a284f0e86d506ecb868912611c773/Asia_Data_Brief_vFinal2.pdf

———. *The State of Blended Finance 2020*. (2020). https://www.convergence.finance/resource/1qEM02yBQxLftPVs4bWmMX/view

Council of Ministers. *Universal Access Policy*. (2013). https://ogcio.gov.vu/images/Universal-Access-Policy-EN-FR-BI.pdf

"Open Data Philippines." 2020, https://www.gov.ph/data.

Department of Communication & Information. *National Information & Communication Technology (Ict) Policy*. (Department of Communication & Information, 2008). https://www.nicta.gov.pg/legislative/policies-all/

Department of Education. *Development of a Blended Teacher Learning Program for the Als*. (2020). http://119.93.157.237/cdo/phocadownloadpap/2020%20Issuances/Division%20General%20Memo%20(Memo)/Memo69s2020-%20Development%20of%20A%20Blended%20Teacher%20Training%20Program%20for%20the%20ALS.pdf

———. *National Education Plan 2015-2019*. Department of Education, (2016). https://www.education.gov.pg/documents/NEP_2015-2019_DoE.pdf

———. *Vanuatu School Mapping Report - 2012*. Department of Education (2012). https://moet.gov.vu/docs/mapping/School%20Mapping%20Report_2013.pdf

Department of Foreign Affairs and Trade. *Partnerships for Recovery: Australia's Covid-19 Development Response*. (2019). https://www.dfat.gov.au/sites/default/files/partnerships-for-recovery-australias-covid-19-development-response.pdf

Development Seed. *Project Connect: Ai-Assisted School Mapping*. (2019). http://devseed.com/unicef-school-docs/

Digital Empowerment Foundation. *Wireless for Communities: A Case Book*. (2013). https://wforc.in/wp-content/uploads/2019/10/W4C-Caselet.pdf

Digital Impact Alliance. *Financing Digital Markets: What Vaccines Can Tell Us About Scaling Digital Technologies in Low- and Middle-Income Countries*. (2018). https://digitalimpactalliance.org/wp-content/uploads/2018/12/DIAL_Financing_Digital_Markets_final.pdf

"Who We Are." 2020, https://digitalpublicgoods.net/who-we-are/.

Dukda, Sonam. *Ict Co-Deployment with the Electricity Infrastructure: The Case of Bhutan*. UNESCAP (Bangkok, Thailand: UNESCAP, 2019). https://www.unescap.org/sites/default/files/ICT%20Co-Deployment%20with%20the%20Electricity%20Infrastructure%2C%20The%20Case%20of%20Bhutan.pdf

"Leaving No One Behind: Niger's Smart Villages Project." 2019, https://news.itu.int/leaving-no-one-behind-nigers-smart-villages-project/.

"About Us." https://etradeforall.org/about/.

"Finally! Accurate Mobile Network Coverage Maps Show Connectivity Reality." 2019, https://www.ictworks.org/mobile-network-coverage-maps-show-connectivity/#.X98yedgzbIV.

Forzati, Marco, Claus Larsen, and Crister Mattsson. *Open Access Networks, the Swedish Experience*. 2010. doi:10.1109/ICTON.2010.5549139. https://www.researchgate.net/publication/224167522_Open_access_networks_the_Swedish_experience.

Gabriel, Albert C. *Pipol Konek: Free Wi-Fi Internet Access in Public Places Project*. (2018). https://www.fma.ph/wp-content/uploads/2018/12/Free-Wifi-Internet-Access-in-Public-Places-Project-1.pdf

Garg, Priyanka Rani, Leena Uppal, Sunil Mehra, and Devika Mehra. "Mobile Health App for Self-Learning on Hiv Prevention Knowledge and Services among a Young Indonesian Key Population: Cohort Study." *JMIR Mhealth Uhealth* 8, no. 9 (2020/9/8 2020): e17646. https://doi.org/10.2196/17646. https://mhealth.jmir.org/2020/9/e17646

https://doi.org/10.2196/17646

http://www.ncbi.nlm.nih.gov/pubmed/32896831.

Gartner, David. "Innovative Financing and Sustainable Development: Lessons from Global Health." *Washington International Law Journal* 24, no. 3 (2015): 495-515. https://digitalcommons.law.uw.edu/cgi/viewcontent.cgi?article=1696&context=wilj.

"Ericsson and Unicef Launch Global Partnership to Map School Internet Connectivity." 2020, https://www.generationunlimited.org/news-and-stories/Ericsson-UNICEF-launch-global-partnership.

"Pakistan: Technology Boosts Education Reform in Remote Areas." 2019, https://www.globalpartnership.org/results/stories-of-change/pakistan-technology-boosts-education-reform-remote-areas.

Government of the Philippines. *Open Data Philippines Action Plan 2014-2016*. (2013). https://data.gov.ph/sites/default/files/Open%20Data%20Philippines%20Action%20Plan%202014-2016.pdf

Government of the Republic of Vanuatu. *National Information and Communication Technology Policy*. Government of the Republic of Vanuatu (2013). https://ogcio.gov.vu/images/Vanuatu-National-ICT-Policy-EN.pdf

GSMA. "Closing the Coverage Gap: How Innovation Can Drive Rural Connectivity." (2019). https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-Closing-The-Coverage-Gap-How-Innovation-Can-Drive-Rural-Connectivity-Report-2019.pdf.

———. *Universal Service Fund Study*. (GSMA, 2013). https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2013_Report_SurveyOfUniversalServiceFunds.pdf

Hatakeyama, Yuji. "International Cooperation Oda." In *Telecommunications Policies of Japan*, 267-86: Springer, 2020.

"Aide Et Action Brings Mobile Libraries and E-Learning to Rural Children in Cambodia, Laos & Vietnam." 2017, https://headfoundation.org/2017/07/27/aide-et-action-bringing-mobile-libraries-and-e-learning-platforms-to-villages/.

Howell, Bronwyn E., Petrus H. Potgieter, and Ronald Sofe. "Regulating for Telecommunications Competition in Developing Countries: Papua New Guinea." *Asian-Pacific Economic Literature* 33, no. 1 (2019): 98-112. https://doi.org/https://doi.org/10.1111/apel.12248. https://onlinelibrary.wiley.com/doi/abs/10.1111/apel.12248.

"Bridging the Education Gap in Bangladesh." 2020, https://www.huawei.com/minisite/tech4all/en/education-digischool-bangladesh.html.

"Digital Training Bus: Empowering Women in Rural Bangladesh." https://www.huawei.com/minisite/tech4all/en/bangladesh_training_bus.html.

"Technology Opens up New Horizons for Children in Peng'an, Sichuan." https://www.huawei.com/minisite/tech4all/en/pengan.html.

"About Us." https://ifarmer.asia/about_us.

"Adb, Ifc to Help Extend Mobile Telecom Services across Myanmar." 2016, https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=16589.

"Ifc Invests $50 Million in Indonesian Telecom Tower Company to Improve Mobile Coverage." 2013, https://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/11C012565727163185257BC5002799D7.

International Finance Corporation. *Ifc: Building the Digital Infrastructure in Emerging Markets*. (2020). https://www.ifc.org/wps/wcm/connect/1267bd9f-b31a-4a62-899f-e127c2ed790d/TMT-FINAL.pdf?MOD=AJPERES&CVID=nkDNgOC

International Telecommunication Union. *Digital Skills Insights 2020*. International Telecommunication Union (Geneva, Switzerland: 2020). https://academy.itu.int/sites/default/files/media2/file/Digital%20Skills%20Insights%202020.pdf

International Telecommunications Union. *Last-Mile Internet Connectivity Toolkit: Solutions to Connect the Unconnected in Developing Countries*. International Telecommunications Union (2020). https://www.itu.int/en/ITU-D/Technology/Documents/RuralCommunications/20200120%20-%20ITU%20Last-Mile%20Internet%20Connectivity%20Toolkit%20-%20DraftContent.pdf

"2019 Impact Report: Community Networks." 2020, https://www.Internetsociety.org/impact-report/2019/community-networks/.

Internet Society. *A Pilot Community Network in Pakistan: Online Supplementary Education and Its Impact*. (2018). https://www.Internetsociety.org/wp-content/uploads/2018/09/Pakistan-SupplementaryEducation_short-report.pdf

———. *Wireless for Communities Nepal Status Report*. (2016). https://www.Internetsociety.org/wp-content/uploads/2017/10/W4C-NepalReport-201605.pdf

Intven, Hank, and McCarthy Tétrault. *Telecommunications Regulation Handbook: Licencing Telecommunications Services*. World Bank (Washington DC: 2000). https://www.itu.int/ITU-D/treg/Documentation/Infodev_handbook/2_Licensing.pdf

"Digital Bangladesh: High-Speed Connectivity Via Mobile Phones and the Internet." 2021, https://www.isdb.org/case-studies/digital-bangladesh-high-speed-connectivity-via-mobile-phones-and-the-Internet.

Islamic Development Bank. *Information and Communication Technology (Ict) Sector Policy: Ict for Inclusive Development*. (2019). https://www.isdb.org/sites/default/files/media/documents/2020-01/Information%20and%20Communications%20Technology%20%28ICT%29%20Sector%20Policy.pdf

IT and Telecommunication Division. *Universal Service Fund Policy*. Ministry of Information Technology (2006). https://usf.org.pk/assets/rules-pdf/usf-policy.pdf

ITU. *The Affordability of Ict Services 2020*. (2020). https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2020/ITU_A4AI_Price_Briefing_2020.pdf

———. "Building Smart Villages: A Blueprint as Piloted in Niger." (2020). https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-SMART_VILLAGE.NIGER-2020-PDF-E.pdf.

"Country Card: Pakistan." ICT Regulatory Tracker, 2020, https://www.itu.int/net4/itu-d/irt/#/country-card/PAK.

ITU. *Digital Trends in Asia and the Pacific 2021*. (2021). https://www.itu.int/en/myitu/Publications/2021/03/08/09/13/Digital-Trends-in-Asia-Pacific-2021

———. *Economic Impact of Broadband in Ldcs, Lldcs, and Sids: An Empirical Study*. (2019). https://www.itu.int/dms_pub/itu-d/opb/ldc/D-LDC-BROAD_IMP.01-2019-PDF-E.pdf

"Guidelines on Child Online Protection: Keeping Children Safe Online." 2020, https://www.itu-cop-guidelines.com/.

"Icteye." https://www.itu.int/net4/ITU-D/icteye/#/economie.

ITU. *The Last-Mile Internet Connectivity Solutions Guide*. (2020). https://www.itu.int/myitu/-/media/Publications/2020-Publications/Last-mile-Internet-connectivity-guide.pdf

———. The Last-Mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites. (2020)

"Smart Villages: Empowering Rural Communities in 'Niger 2.0'." 2019, https://news.itu.int/smart-villages-empowering-rural-communities-in-niger-2-0/.

ITU Broadband Commision for Sustainable Dvelopment. *Financing for Ict Infrastructure*. Inter-Agency Taskforce on Financing for Development (2016). https://www.un.org/esa/ffd/wp-content/uploads/2016/01/Financing-for-ICT-Infrastructure_ITU_IATF-Issue-Brief.pdf

"Itu and Kacific Join Forces to Boost Emergency Telecoms and Ict Development in Vanuatu." 2020, https://www.itu.int/en/myitu/News/2020/06/03/08/48/ITU-and-Kacific-join-forces-to-boost-emergency-telecoms-and-ICT-development-in-Vanuatu.

Japan International Cooperation Agency, and Tokyo Institute of Technology. Report of the Impact *Survey of "Quality Improvement of Primary Education Teachers through Development of Training Materials Using Ict" Project*. (2017). https://drive.google.com/file/d/1d2dl3Fz9PqKcrHCn0fF5CsVjeIZL7ZaR/view

"Kacific1 Broadband Services Commence across Asia Pacific." 2020, https://kacific.com/news/kacific1-broadband-services-commence-across-asia-pacific/.

Kamimu, Osamu. *Mobile Connectivity with Hibs*. (2020). https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2020/RDF2020/Session%202b/ITU_Workshop_Nov_2020_8min%28final%29%20Osamu%20Kamimura.pdf

Kozma, Robert B. "Comparative Analysis of Policies for Ict in Education." In *International Handbook of Information Technology in Primary and Secondary Education*: Springer, 2008. http://www.ictliteracy.info/rf.pdf/kozma_comparative_ict_policies_chapter.pdf

Lambrechts, Wynand, and Saurabh Sinha. "Last Mile Internet Access for Emerging Economies," In "Lecture Notes in Networks and Systems," 77, (2019). https://doi.org/https://doi.org/10.1007/978-3-030-20957-5.

"Viettel - "Một Kỷ Nguyên Phi Thường" Và Trách Nhiệm Xã Hội Thời 4.0." 2020, https://laodong.vn/kinh-te/viettel-mot-ky-nguyen-phi-thuong-va-trach-nhiem-xa-hoi-thoi-40-841054.ldo.

"Partnering with Unicef to Help Wire the World's Classrooms." 2020, https://www.linkedin.com/pulse/partnering-unicef-help-wire-worlds-classrooms-catherine-lenson/.

"Taknet – a Community White Space Wireless Network." 2019, https://blog.apnic.net/2019/07/01/taknet-a-community-white-space-wireless-network/#:~:text=This%20year%20is%20the%20sixth,Internet%20access%20to%20rural%20areas.&text=One%20solution%20is%20to%20use,TV%20White%20Space%20(TVWS).

Lertsinsrubtavee, Adisorn, Nunthaphat Weshsuwannarugs, Nisarat Tansakul, Attaphongse Taparugssanagorn, and Kanchana Kanchanasut. "Wireless Edge Network for Sustainable Rural Community Networks." Paper presented at the Proceedings of the Applied Networking Research Workshop, 2018.https://www.thnic.or.th/wp-content/uploads/2017/01/2018WirelessEdgeNetworkforSustainableRuralCommunityNetworks.pdf

Li, Shengru, Shinobu Yamaguchi, Javzan Sukhbaatar, and Jun-ichi Takada. "The Influence of Teachers' Professional Development Activities on the Factors Promoting Ict Integration in Primary Schools in Mongolia." *Education Sciences* 9, no. 2 (2019): 78. https://www.mdpi.com/2227-7102/9/2/78#cite.

Li, Shengru, Shinobu Yamaguchi, and Jun-ichi Takada. "The Influence of Interactive Learning Materials on Self-Regulated Learning and Learning Satisfaction of Primary School Teachers in Mongolia." *Sustainability* 10, no. 4 (2018): 1093. https://www.readcube.com/articles/10.3390%2Fsu10041093.

———. "Understanding Factors Affecting Primary School Teachers' Use of Ict for Student-Centered Education in Mongolia." *International Journal of Education and Development using Information and Communication Technology (IJEDICT)* 14, no. 1 (2018): 103-17. http://ijedict.dec.uwi.edu/viewarticle.php?id=2381.

Loukoianova, Elena, Yongzheng Yang, Jayendu De, Si Guo, Leni Hunter, Sarwat Jahan, Piyaporn Sodsriwiboon, *et al. Financial Inclusion in Asia-Pacific*. 2018. https://www.imf.org/~/media/Files/Publications/DP/2018/46115-dp1817-financial-inclusion-in-asia-pacific.ashx.

"Indonesia – a Hub for Blended Finance in the Asia-Pacific." 2020, https://www.convergence.finance/news-and-events/news/2JxHe7gu4yClmhQa4RFcRy/view.

"Metfone Is Proud to Once Again Be the Long-Term Strategic Partner of Moeys on "Ict in Education"." 2020, https://www.metfone.com.kh/en/about-us/media/press-release/metfone-is-proud-to-once-again-be-the-long-term-strategic-partner-of-moeys-on-%E2%80%9Cict-in-education%E2%80%9D.

Ministry of Education. *Alternative Education Plan*. Ministry of Education (2020). https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/afghanistan_final_consolidatedmoe_alternative_education_plan-english.pdf

———. *Isherig-2 Education Ict Masterplan 2019-2023*. Ministry of Education (Thimpu, Bhutan: 2019). https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/bhutan_isherig-2-education-ict-mnasterplan-2019-2023.pdf

Ministry of Education and Sports. *Lao Pdr Education Covid-19 Response Plan*. Ministry of Education and Sports (2020). https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/lao_pdr_education_covid-19_response_plan.pdf

Ministry of Education and Training. *Covid-19 Accelerated Funding Program Document*. Ministry of Education and Training, (Global Partnership for Education, 2020). https://www.globalpartnership.org/sites/default/files/document/file/2020%2008%20COVID-19%20AFF%20Request%20Vanuatu%20-%20Verified.pdf

———. *Education Statistics: Basic Tables of 2019*. Ministry Of Education And Training (2019). https://moet.gov.vu/docs/statistics/2019%20MoET%20Education%20Statistics%20Report_2020.pdf

———. *Interim Vanuatu Education and Training Sector Strategy 2017-2018*. Ministry of Education and Training (2017). https://moet.gov.vu/docs/policies/Interim%20Vanuatu%20Education%20Sector%20Strategy%20French%20and%20English_2017-2018.pdf

Ministry of Education Culture Science and Sports. *Towards Mongolia's Long-Term Development Policy Vision 2050: Advancing Education Equity, Efficiency and Outcomes*. Ministry of Education, Culture, Science and Sports (2020). http://documents1.worldbank.org/curated/en/801531597033753381/pdf/Towards-Mongolia-s-Long-Term-Development-Policy-Vision-2050-Advancing-Education-Equity-Efficiency-and-Outcomes.pdf

Ministry of Federal Education and Professional Training. *National Education Policy Framework 2018*. Ministry of Federal Education and Professional Training (Islamabad, Pakistan: 2018). http://www.mofept.gov.pk/SiteImage/Policy/National%20Eductaion%20Policy%20Framework%202018%20Final.pdf

———. *Pakistan National Education Policy 2017-2025*. Ministry of Federal Education and Professional Training (Islamabad, Pakistan: 2017). http://www.mofept.gov.pk/SiteImage/Policy/Draft%20National%20Educaiton%20Policy%202017.pdf

———. *Pakistan National Response and Resilience Plan (K-12) for Covid-19*. Ministry of Federal Education and Professional Training (2020). http://mofept.gov.pk/SiteImage/Misc/files/0_%20NERRP%20COVID-19%20MoFEPT%204%20May%202020%20Ver%2001.pdf

Ministry Of Information Technology. *Telecommunications Policy 2015*. (Ministry Of Information Technology, 2015). https://moitt.gov.pk/SiteImage/Misc/files/Telecommunications%20Policy%20-2015%20APPROVED.pdf

Ministry of IT & Telecom. *Digital Pakistan Policy*. (2018). https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf

"Hoàn Thành Chương Trình Kết Nối Mạng Giáo Dục." 2010, http://www.molisa.gov.vn/Pages/tintuc/chitiet.aspx?TinTucID=11821&page=295.

National Department of Education. *Covid-19 Education Emergency Response and Recovery Plan*. National Department of Education (2020). https://planipolis.iiep.unesco.org/en/

2020/papua-new-guinea-covid-19-education-emergency-response-and-recovery-plan-4th-may-2020-6967

National Information and Communications Technology Authority. *2020 Uas Projects Report*. National Information and Communications Technology Authority, (2019). https://uas.nicta.gov.pg/images/Reports/Report_UAS-Board-2020-Projects.pdf

———. *Report on Proposed 2017 Uas Projects*. UAS Board (2016). https://uas.nicta.gov.pg/images/Reports/Report_UAS-Board-2017-Projects.pdf

"Joint Ta on Ict with Intl Organization." 2020, https://eng.nia.or.kr/site/nia_eng/01/10102010000002016093002.jsp#active.

"Bắc Giang: Thỏa Thuận Hợp Tác Toàn Diện Giữa Giáo Dục Và Viettel Giai Đoạn 2014 - 2020." 2014, http://thptlanggiangso2.edu.vn/home/news/Cuoc-song-so/Bac-Giang-Thoa-thuan-hop-tac-toan-dien-giua-Giao-duc-va-Viettel-giai-doan-2014-2020-679/.

NICTA. *National Broadband Policy Draft*. (NICTA, 2013). https://www.nicta.gov.pg/legislative/policies-all/

"Open Ran Explained." 2020, https://www.nokia.com/about-us/newsroom/articles/open-ran-explained/.

"Mytel Says It Will Offer Free Internet for Schools." Myanmar Times, 2018, https://www.mmtimes.com/news/mytel-says-it-will-offer-free-Internet-schools.html.

OECD. "Aid Activities." 2014. https://www.oecd-ilibrary.org/content/data/data-00061-en.

Office, DOST Information & Communication Technology. *Free Wi-Fi Internet Access in Public Places*. (2015). https://dict.gov.ph/wp-content/uploads/2015/03/Free-Wi-Fi-Project-TOR.pdf

Pakistan Bureau of Statistics. *Pakistan Social & Living Standards Measurement Survey (Pslm) 2018-19 National /Provincial (Social Report)*. (2020). http://www.pbs.gov.pk/sites/default/files//pslm/publications/pslm2018-19/pslm_report_2018-19_national_provincial.pdf

"List of Operators." Pakistan Telecommunications Authority, 2020, https://www.pta.gov.pk/en/industry-support/home/list-of-operators.

Pakistan Telecommunications Authority. *Pakistan Telecommunications Authority Annual Report 2019*. (2019). https://www.pta.gov.pk/assets/media/pta_ann_rep_2019_27032020.pdf

"Telecom Indicators." Pakistan Telecommunications Authority, 2020, https://www.pta.gov.pk//en/telecom-indicators.

Pathways to Prosperity Commision. *Indonesia: Fibre-Optic Cables across an Archipelago – Palapa Ring Project*. (2019). https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-11/Indonesia_Palapa_Ring_Project.pdf

"Unitel Provides Free Internet Service to Lao Schools." 2010, https://en.qdnd.vn/economy/military-businesses/unitel-provides-free-Internet-service-to-lao-schools-413994.

"Pipol Konek (Free Wi-Fi for All)." 2018, https://sustainabledevelopment.un.org/partnership/?p=33960.

Prime Minister's Office, Office of the Government Chief Information Officer, Ministry of Education, and Telecommunications and Radiocommunications Regulator. *The First Survey of Ict Usage in the Vanuatu Schools.* (2013). http://www.themosttraveled.com/Vanuatu/First%20Survey%20of%20ICT%20Usage%20in%20Schools%20Final%20Final.pdf

""Every Spoonful Is a Result of Someone Else's Hard Work": Interview with 8villages's Ceo Sanny Gaddafi." 2020, https://www.compasslist.com/insights/every-spoonful-is-a-result-of-someone-elses-hard-work-interview-with-8villagess-ceo-sanny-gaddafi.

Ravi, Shamika, Emily Gustafsson-Wright, Prerna Sharma, and Izzy Boggild-Jones. *The Promise of Impact Investing in India.* Brookings Institution India (New Delhi, India: 2019). https://www.brookings.edu/wp-content/uploads/2019/07/The-promise-of-impact-investing-in-India.pdf

Ritter, Waltraut. *Open Data in Asia an Overview of Open Data Policies and Practices in 13 Countries.* (2014). https://knowledgedialogues.files.wordpress.com/2014/07/open-data-asia-09-2014.pdf

Rose, David Christian, Rebecca Wheeler, Michael Winter, Matt Lobley, and Charlotte-Anne Chivers. "Agriculture 4.0: Making It Work for People, Production, and the Planet." *Land Use Policy* 100 (2021/01/01/ 2021): 104933. http://www.sciencedirect.com/science/article/pii/S0264837719319489.

Samarajiva, Rohan, and Gayani Hurulle. "Measuring Disbursement Efficacy of Universal Service Funds: Case Studies from India, Malaysia, Pakistan & Sri Lanka." *SSRN* (2017). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3044254.

Sasakawa Peace Foundation. *The Role of Entrepreneurship in Closing Gender Gaps in Myanmar.* (2020). https://www.spf.org/en/global-data/user50/SPF-EME_Full.pdf

Schopf, James Christopher. "Room for Improvement: Why Korea's Leading Ict Oda Program Has Failed to Combat Corruption." *Telecommunications Policy* 43, no. 6 (2019): 501-19.

Tenzing, Jigme. "Digital Drukyul – an Ict Masterplan for Bhutan." *The Druk Journal* (2020). http://drukjournal.bt/digital-drukyul-an-ict-masterplan-for-bhutan/.

The Social Bond Principles. *Social Bond Principles - Voluntary Process Guidelines for Issuing Social Bonds.* (2020). https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/June-2020/Social-Bond-PrinciplesJune-2020-090620.pdf

"New Industry Collaboration to Improve Connectivity in Indonesia and Drive Economic Growth." 2020, https://telecominfraproject.com/new-industry-collaboration-to-improve-connectivity-in-indonesia-and-drive-economic-growth/.

Tobgye, Sonam. "Digital Transformation in Bhutan: Culture, Workforce and Training." PhD, Queensland University of Technology, 2017. https://eprints.qut.edu.au/115459/1/115459_8792526_tobgye_sonam_thesis.pdf.

"Khởi Công Kết Nối Mạng Giáo Dục." 2008, https://nhandan.com.vn/tin-tuc-giao-duc/khoi-cong-ket-noi-mang-giao-duc-592988/.

"Connect the Schools Projct 2017." UAS Secretariat, https://uas.nicta.gov.pg/index.php/programs/community-and-institutional-broadband-networks/connect-the-schools-project.

"Uas Fund." UAS Secretariat, https://uas.nicta.gov.pg/index.php/about-uas/uas-fundd.

"Uas Programs." UAS Secretariat, https://uas.nicta.gov.pg/index.php/programs.

UN-OHRLLS. *Leveraging Investments in Broadband for National Development: The Case of Vanuatu*. UN-OHRLLS (2018). http://unohrlls.org/custom-content/uploads/2019/02/Vanuatu-LDC-Broadband-Study-2018.pdf

"From Financially Excluded to Entrepreneur with Vodafone Fiji's M-Paisa." 2020, https://www.uncdf.org/article/6021/from-financially-excluded-to-entrepreneur-with-vodafone-fijis-m-paisa.

UNCTAD. *Trainfortrade: Strengthening Knowledge and Skills for Sustainable Economic Development*. https://unctad.org/system/files/official-document/tc2015d1rev2_S04_P03.pdf

UNESCAP. "Bhutan Issues First Sovereign Bond to Meet Increasing Fiscal Financing Needs in Fighting Covid-19." news release, 23 September 2020, 2020, https://www.unescap.org/news/bhutan-issues-first-sovereign-bond-meet-increasing-fiscal-financing-needs-fighting-covid-19#.

———. "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific," In "Asia-Pacific Information Superhighway (AP-IS) Working Paper Series,"(2020).

"Digital Resilience against Covid-19." 2020, https://www.unescap.org/blog/digital-resilience-against-covid-19.

UNESCAP. *The Impact of Universal Service Funds on Fixed-Broadband Deployment and Internet Adoption in Asia and the Pacific*. UNESCAP (Bangkok, Thailand: 2017). https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf

———. "Infrastructure Financing in Asian Landlocked Developing Countries: Challenges, Opportunities and Modalities." (2020). https://www.unescap.org/sites/default/d8files/knowledge-products/Infrastructure_Financing_in_Asian_%20Landlocked_%20Developing_%20Countries_ids.pdf.

———. *Research Report on Ict Infrastructure Co-Deployment with Transport and Energy Infrastructures in Mongolia*. UNESCAP (2020). https://www.unescap.org/sites/default/files/Research%20Report%20on%20ICT%20infrastructure%20Co-deployment%20%20with%20Transport%20and%20Energy%20Infrastructures%20in%20Mongolia.pdf

UNICEF. *Application to Global Partnership for Education Covid19 Accelerated Funding Window for Emergency Response in Papua New Guinea*. UNICEF (Global Partnetship for Education, 2020). https://www.globalpartnership.org/sites/default/files/document/file/2020-07-COVID-19%20AFF%20Request%20Papua%20New%20Guinea.pdf

"Covid-19 and Children." 2020, https://data.unicef.org/covid-19-and-children/.

"Digital Learning Toolkit." 2020, https://www.unicef.org/esa/digital-learning-toolkit.

"Giga: Connecting Every School to the Internet." 2020, https://www.unicef.org/innovation/giga.

UNICEF. *Lao Pdr Gpe Covid-19 Accelerated Funding Proposal*. UNICEF (2020). https://www.globalpartnership.org/sites/default/files/document/file/Application-and-program-document-for-covid-19-accelerated-funding-for-Lao-pdr-may-2020.pdf

———. *Unicef Education Covid-19 Case Study: Mongolia– Safe Back to School*. UNICEF (2020). https://aa9276f9-f487-45a2-a3e7-8f4a61a0745d.usrfiles.com/ugd/aa9276_5416a03d55ec410d8b2c78e157bb7db2.pdf

———. *Universal Service Funds: Status in South Asia*. (2020)

USAID. *Advancing Digital Connectivity in the Indo-Pacific Region*. (2019). https://www.usaid.gov/sites/default/files/documents/1861/USAID_DCCP_Fact_Sheet_080719f.pdf

———. *Connecting People. Transforming Nations*. https://www.usaid.gov/sites/default/files/documents/15396/Indonesia-Broadband-Report.pdf

———. *Digital Asia Accelerator*. (2019). https://www.usaid.gov/sites/default/files/documents/USAID_Digital_Asia_Accelerator_Fact_Sheet.pdf

———. *Indonesia Rural Connectivity Pilot Final Report*. (2015). https://www.integrallc.com/wp-content/uploads/2020/07/Indonesia-Rural-Connectivity-Pilot-Final-Report.pdf

"Projects and Programs." 2020, https://www.usof.gov.mn/?page_id=12.

Uyanga, Sambuu. "Baseline Analysis on Ict in General Education of Mongolia." *Informatics in Education* 13, no. 1 (2014): 121-40. https://files.eric.ed.gov/fulltext/EJ1064372.pdf.

Vanuatu National Statistics Office. *Mini – Census Report*. Ministry of Finance and Economic Management (2016). https://sdd.spc.int/digital_library/vanuatu-2016-post-pam-mini-census-report-volume-1

"“Kết Nối Mạng Giáo Dục” - Miễn Phí Đường Truyền Internet Băng Rộng." 2018, https://viettelidc.com.vn/tin-tuc/ket-noi-mang-giao-duc-mien-phi-duong-truyen-Internet-bang-rong.

"Digital Development: Overview." 2020, https://www.worldbank.org/en/topic/digitaldevelopment/overview#2.

World Economic Forum. *Financing a Forward-Looking Internet for All*. (2018). http://www3.weforum.org/docs/WP_Financing_Forward-Looking_Internet_for_All_report_2018.pdf

"Mongolian Projects." http://www.yamaguchi.gsic.titech.ac.jp/?page_id=7335.

Yamamoto, Yukiko, and Shinobu Yamaguchi. "A Study on Teacher's Self-Efficacy for Promoting Ict Integrated Education in Primary Schools in Mongolia." *Journal of International Cooperation in Education* 18, no. 2 (2016): 1-15. https://drive.google.com/file/d/1IAZ4IonUL5XGPuWxHDE_seF4tPY9oZR1/view.

"Introducing the Social Success Note." Yunus Social Business, 2015, https://www.yunussb.com/blog/social-success-note.

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