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International Telecommunication Union
Development Sector

Connecting every school in Indonesia to the Internet: Policy landscape assessment

Connecting every school in Indonesia to the Internet: Policy landscape assessment

In Partnership with:

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The report was prepared by the ITU Regional Office for Asia and the Pacific and was written by Dr Arif Wismadi, Director of Universitas Islam Indonesia's Growth Hub, in his capacity as an ITU expert.

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Please consider the environment before printing this report.

Foreword

I am delighted to present this policy landscape assessment report on connecting every school in Indonesia to the Internet.

Since 1989, the International Telecommunication Union (ITU) has been working, through the Telecommunication Development Bureau (BDT), to strengthen technical assistance to lower- and middle-income countries to close the digital divide and drive digital transformation.

Despite the increasing importance of technology in our daily lives, there are still 2.7 billion people offline. Those left unconnected are disproportionally located in least developed countries, in rural or remote areas, or belonging to marginalized groups of society. The power of information and communication technologies, particularly in relation to the opportunities that can be opened up through digital learning, can drive economic prosperity, generate jobs, and advance national digital skills as well as promoting gender equality and encouraging diversity.

With our partners, we are trying to understand how universal connectivity can be achieved, in particular school connectivity, and how we can improve digital skills in low- and middle-income countries to close the digital divide and drive digital transformation. We are focusing on regulatory analysis, capacity development, tools and frameworks to explore innovative sustainable financing and technology development models.

As part of this work, this report considers the high-level policies relating to school connectivity initiatives in Indonesia. The assessment explores the gaps in ICT sector supply and education sector demand, it examines approaches to consolidate funding opportunities to secure Internet access in schools in areas overlooked by current policies and it recommends policy interventions to address these gaps.

Universal broadband connectivity will ultimately enhance the quality of the education our children receive. It will open the door to an almost unlimited store of online learning content and educational resources, regardless of a child's location and it can significantly contribute to developing that child's full potential.

I recommend this report to national regulators and decision-makers as they work to implement the policies, regulations, technologies, and financing required to ensure that school broadband connectivity is truly universal, safe, sustainable, and equitable to all.

Dr. Cosmas Luckyson Zavazava
Director, Telecommunication Development Bureau (BDT)
International Telecommunication union (ITU)

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Abbreviations

BAKTI	Indonesia Telecommunication and Information Accessibility Agency
BRTI	Indonesian Telecommunication Regulatory Authority
GNI	Gross national income
ICT	Information and communication technology
OTT	Over-the-top
NGO	Non-governmental organization
PISA	Programme for International Student Assessment
USO	Universal service obligation
WOAN	Wireless open access network

Executive summary

The digital divide and school connectivity gaps remain issues in developing countries, including Indonesia. To recommend the policy measures needed to resolve those issues, this assessment measured and explored the gaps in terms of both supply (ICT sector) and demand (education sector).

The assessment of supply-side gaps addresses policy and regulatory progress necessary for industry efficiency and implementation of the universal service obligation (USO) programme.

The assessment of demand-side gaps focuses on affordability and utilization in the education sector. It shows that, in Indonesia, 42 159 schools (19 per cent) have no Internet connection (Chabibie, 2020). The fact that 70 per cent of those schools are covered by the 4G network (Chabibie, 2020) is indicative of the size of the gap that needs resolving. During the COVID-19 pandemic, the education sector provided Internet subsidies for all students and teachers. This programme revealed an even greater penetration gap, as it reached only 60 per cent of its target beneficiaries (Makarim, 2021), leaving the remaining 40 per cent without access to networks and devices.

On the supply side, interventions currently rely on the USO programme, which extends only to the "3T" areas (frontier, outermost and underdeveloped regions), yet some unserved and underserved schools are located outside this area. The resulting policy gaps leave thousands of schools in financially unviable locations unconnected.

The option to expand the USO programme beyond the 3T areas faces budgetary issues. The funding available from the USO Fund and spectrum fees is sufficient to cover only the programme for 3T areas. Addressing the nationwide school connectivity gaps would require revisiting the multi-sector national policy so as to consolidate the fiscal capacity in terms of both supply and demand that is dedicated to accessibility, affordability and penetration. Should this consolidated national capacity be insufficient, another strategy will be needed to combine national funding and external resources for school connectivity programmes.

Summary of findings

The COVID-19 pandemic reveals the actual demand for connectivity and affordability

Despite Indonesia having reached the target price for entry-level mobile Internet service of 0.85 per cent of monthly GNI per capita (Broadband Commission for Sustainable Development, 2021), the requirement for studying and teaching from home has impacted the actual demand and affordability level for use in education. The new way of using the Internet that emerged during the pandemic – for longer periods and with greater demand for data – frequently places access beyond the means of teachers and students.

Demand-side subsidies: still not enough and too costly

In 2020, the Ministry of Education, Culture, Research and Technology provided subsidies totalling IDR 7 200 billion to 60 per cent (or 35 725 387) of students and teachers in Indonesia (Makarim, 2021). In the end, that amount covered only 60 per cent of the target beneficiaries, leaving the rest unconnected throughout the pandemic. The subsidies are equal to 7 per cent

of the Ministry's national education budget and subsidized the data quota for students and teachers who had access and devices. If all 59.5 million target beneficiaries had been able to connect to the Internet, the Ministry would have been required to spend 11.6 per cent of its budget, completely depleting it in the process.

Spectrum fees to increase accessibility

On the supply side, in order to enhance accessibility, the Government increased the budget allocation for rural connectivity programmes using the spectrum fees it collected, in effect increasing BAKTI's programme budget tenfold. Despite that increase, the region designated by BAKTI for USO disbursement remains limited to the 3T areas as determined by the President's Regulations,[1] thus excluding unconnected schools outside those areas. At the same time, the Ministry of Education, Culture, Research and Technology, which has access to 20 per cent of the national budget, is not responsible for intervening on the supply side (infrastructure).

The shrinking USO-designated areas create supply-side gaps

The 3T regulations and decrees encourage various sectors to focus on, and therefore eventually dramatically to reduce, the 3T areas. As BAKTI's terms of reference extend only to disbursement in the 3T areas, there is a risk that an area's immature market will exclude schools from access to the supply-side subsidy.

Overcrowded urban markets and the disrupted digital industry are widening the gaps

In areas outside the USO designation, infrastructure companies and network operators are hesitant to provide service where gaps exist, mainly because the USO policy has changed their responsibility from "play" in rural areas to "paying" via USO contributions. The current urban market is also very competitive, preventing them from investing in more remote and less viable areas. Meanwhile, the disruptions caused by global OTT services that absorb revenues, creates more disincentives for private industry to fill the gaps. Given those limitations, the digital sector has consolidated two significant funding sources on the supply side: the USO Fund and spectrum fees. However, the school connectivity gaps persist, owing to BAKTI's obligation to deliver the USO projects. Moreover, the consolidated budget has a restrictive policy enabling it to allocate programme funding only in 3T areas.

Recommendations

In view of the above findings, this assessment offers two approaches to consolidating funding opportunities for securing Internet access in schools in areas overlooked by current policies.

Transfer national fiscal capacity on the demand side to the supply side

- The education sector, which has far-reaching mandate and a large budget, but which suffers from lack of Internet access, should consider transferring part of its budget to support supply-side action, so as to increase capacity for expanding the infrastructure network and thereby lower the service cost for users.

[1] Specifically, Regulations Nos 131 2015 and 63 2020.

Mandate BAKTI to fill the gaps outside 3T areas

- The Ministry of Communication and Information Technology should consider extending the BAKTI mandate so that it can also use the funds to address access issues inside and outside 3T areas with consolidated planning and network architecture. Within the 3T areas, BAKTI would draw exclusively on the USO Fund; outside those areas, it could source financing from the transferred funds from spectrum fees.

Besides making those two general recommendations, the assessment describes the root cause of the identified problems and recommends that the national authorities and international agencies cooperate to address connectivity gaps. It provides a list of recommendations for BAKTI, as the leader in management of the school connectivity programmes in the 3T areas. It outlines possibilities for action at the strategic, tactical and operational levels. It also provides a set of guidelines for using USO funding to support the school connectivity pilot, its replication and scaling up in various areas.

1 Introduction

1.1 Background

The Internet is a valuable means of increasing the productivity of a digital economy, including in the education sector. However, the current digital divide and school connectivity gaps prevent some children and young people from accessing the wealth of information online.

Because of the country's challenging archipelagic and far-flung territory, 19 per cent of Indonesia's schools (42 159) are still without an Internet connection (Chabibie, 2020). The COVID-19 pandemic has further revealed the manifest and latent demand for broadband Internet and the connectivity gaps in the education sector.

In the five years between 2015 and 2020, the percentage of students living with Internet coverage and willing to connect via their schools fell from 26.19 to 12.83 per cent (BPS, 2020b). That trend reversed during the pandemic, as students became dependent on the Internet for the learning process. In other words, the pandemic showed that broadband could be meaningfully deployed for students and teachers.

At the same time, however, the new way of using the Internet for study that emerged during the pandemic renders it unaffordable for teachers and students. According to the ITU/UNESCO Broadband Commission for Sustainable Development, broadband services are affordable if they cost less than 2 per cent of monthly GNI per capita with a 2GB basket (mobile). Although Indonesia reached the target price of 0.85 per cent (2GB data-only) for mobile Internet service, the requirements for studying and teaching from home revealed the actual affordability level for education.

The gap occurs as the 2GB data plan allows only four hours of standard-definition video and is therefore insufficient for daily interactive video or teleconference classes. Moreover, for mobile data with voice and a high-consumption basket (140 minutes, 70 SMS, 2GB) the price is still above the target (2.51 per cent), while a 5GB fixed-broadband basket is at 7.57 per cent (Broadband Commission for Sustainable Development, 2021). The target price of 2 per cent of monthly GNI per capita with a 2GB (mobile) or 5GB basket (fixed) is therefore insufficient to meet the new demand for interactive video-based distance learning.

During the pandemic, the Ministry of Education, Culture, Research and Technology provided a subsidy to enable all students and teachers to study or teach from home. However, more than 40 per cent of the students and teachers targeted had no Internet access and could not benefit from this support. This shows that Internet accessibility, affordability and penetration are still lacking in schools and homes, for various reasons such as: no access in the area concerned; expensive devices and service; or no previous need to subscribe.

In 2020, during the pandemic, the Ministry of Education, Culture, Research and Technology provided IDR 7 200 billion, or 7 per cent of the national education budget, to subsidize Internet access for students and teachers who had access and a device, and had subscribed to a service. However, this support reached only 35 725 387 students and teachers out of the targeted 59.5 million beneficiaries. This means that 23.8 million students and teachers (40 per cent) were excluded (Makarim, 2021).

In view of these access gaps, the ministry extended the programme to 2021. However, given the high cost of the programme and the lopsided spending on the demand side that still excluded 40 per cent of the target beneficiaries, and despite the fact that the World Health Organization has not announced the end of the pandemic, the ministry returned to in-person teaching in 2022. The Internet subsidy has thus officially ended, as has the Joint Ministerial Decree[1] signed on 21 December 2021 for offline classes during the COVID-19 pandemic.

This decision indicates that, even though it has a mandate to use 20 per cent of the national budget for all sectors[2], the education sector cannot afford to support demand in order to close the digital divide. It underscores the critical need for supply-side policy and programmes.

The supply-side policy and programmes currently focus on 9 113 villages and subdistricts that lack adequate Internet access. The Ministry of Communication and Information Technology, through BAKTI and universal service obligation programmes, has made significant progress towards delivering 4G service to connect the 3T (frontier, outermost and underdeveloped) areas in Indonesia. Some unserved schools may be in the 3T areas and the USO programmes may therefore provide a solution for accessibility issues. However, the schools outside the 3T areas that lack access will have to wait for further supply-side interventions. Without assistance from the USO programme, they will have to wait until their markets mature to levels that are financially attractive to an operator. Given Indonesia's challenging geography, the current structure of the industry and existing technology, the path to closing the school connectivity gap may be longer than expected by stakeholders.

This country assessment therefore aims to identify the policy measures needed to close school connectivity gaps. In addition to a cross-sectoral policy analysis, it discusses emerging initiatives to address the problem in the Indonesian context, i.e. Wireless Open Access Networks for delivering service inside and outside 3T or USO areas, and alternative funding models developed by Giga and the Boston Consulting Group to serve rural schools. The recommendations made in this assessment and alternative approaches to solving school connectivity issues will serve to identify a new connectivity model. Finally, the assessment also proposes a strategy for implementing the model by opening the possibility of combining national funding and global resources for school connectivity programmes.

1.2 Content of the policy assessment

This country-level policy assessment was undertaken to address Internet connectivity gaps in schools. It describes:

- the telecommunication regulatory landscape, to identify the barriers to market access and investment in connectivity and service deployment in underserved areas and rural communities, with a particular focus on school connectivity;
- the telecommunication governance structure of ministries/agencies at the national level and other authorities at the subnational and local levels;
- opportunities, gaps and challenges relating to the contributions of the telecommunication and digital industries and relevant civil society bodies to ensure connectivity in underserved areas and rural communities, with a focus on school connectivity;

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1 Joint Ministerial Decree issued by the Ministry of Education, Culture, Research and Technology, the Ministry of Religious Affairs, the Ministry of Health and the Ministry of Internal Affairs (Nos 05/KB/2021, 1347 2021, HK.0.1.08/MENKES/6678/2021 and 443-5847 2021).

2 Law No. 20 2003, on the National Education System, Article 49 (1).

- the roles and functions of BAKTI in financing and procuring infrastructure and capacity-development projects and programmes, and in managing USOs to identify the scope of support required for school connectivity;
- the funding opportunities from the supply and demand sides, the gap between them and the challenges to addressing school connectivity;
- emerging innovations and ideas for cutting the cost of connectivity, such as WOAN, and alternative funding models put forward by Giga and the Boston Consulting Group for redistributing national resources for school connectivity.

2 School connectivity amid digital transformation and the pandemic

2.1 Indonesia country profile

User experiences: trends and outlooks for schools and communities

Indonesia is ranked 48 out of 79 countries, with a score of 29/120, on the Global Connectivity Index 2020, in terms of ICT investment, ICT maturity and digital economic performance. It is thus categorized as a Starter in the Index Cluster, a category below the Adopters and Frontrunners (Huawei, 2020). Indonesia's position is influenced, in part, by the coverage – or absence thereof – of educational opportunities and knowledge-based economic productivity. This is associated with a global pattern of urban and rural disparity of connectivity, with more than half of schools and communities located in underserved or unserved areas and thus prevented from developing into an innovative economy (Kastrop et al., 2019). Indonesia must enhance its digital economy by closing the connectivity gap in educational facilities if it is to graduate from the Starter to one of the higher categories.

Indonesian schools can be divided into four categories based on socio-geographic features, demand for connectivity, infrastructure and service availability.

(a) high-demand, high-capacity schools have a high demand for connectivity, are surrounded by high-capacity infrastructure and are located mainly in more urbanized areas;
(b) high-demand, low-capacity schools have a high demand but are located in areas of low connectivity and are primarily in peri-urban locations;
(c) low-demand, high-capacity schools have low demand for connectivity even though they are located in areas with high infrastructure capacity (this unique profile is commonly found among schools in 57 localities already covered by the Palapa Ring);
(d) low-demand, low-capacity schools are found in areas that are geographically and economically challenged and account for 18 to 19 per cent of all schools (41 000 to 42 159 schools) (Chabibie, 2020).

The regional disparity in Indonesia confirms this contributing factor. Currently, 19 per cent of schools (42 159) have no Internet connection. Even though 175 356 schools (81 per cent) are connected (Chabibie, 2020), not all students have the opportunity to engage in digital learning at school.

A deeper look reveals that even among those with supposed access to connectivity, not all students enjoy the opportunity for digital learning at school: only one-third of students have Internet access at home (ITU & UNICEF, 2020) and 35.97 per cent at primary school (BPS, 2020a). With the onset of the pandemic, the opportunity for home-based schooling via Internet connectivity became even more limited. Teachers in connected areas were also confronted with affordability issues, as at least 62 per cent used their budget for Internet access (UNICEF, 2020). Furthermore, the role of the school as a physical hub of Internet access is waning. Between 2015 and 2020, students in this category were found to least prefer accessing the Internet from school. In 2020, the share of schools providing such access fell from 26.19 to 12.83 per cent in comparison to other places, such as home (96.32 per cent), public areas (34.58 per cent) and moving vehicles (23.84 per cent) (BPS, 2020b).

Those circumstances widened the urban–rural digital divide. Whereas 68.23 per cent of students in urban areas enjoy Internet connectivity and can therefore continue studying, only 47.76 per cent of their fellows in rural areas have such access; the rest are at risk of losing their learning momentum (BPS, 2020a). This makes it even more challenging for Indonesia to attain a PISA score of 451 on literacy by 2035 (Chabibie, 2020).

Finally, there is currently no institutional subscription scheme enabling students and teachers to access the Internet with a high level of privacy and security.

Prices and affordability gaps

Indonesia's education sector has an affordability issue. Whereas the price of Internet service via mobile phone is 0.85 per cent (data-only of 2GB), which is well within the target price of 2 per cent of monthly GNI per capita, the price of mobile data with voice and a high-consumption basket (140 minutes, 70 SMS, 2GB) remains above the target (2.51 per cent) and a fixed-broadband basket of 5GB costs 7.57 per cent (Broadband Commission for Sustainable Development, 2021).

The COVID-19 pandemic has exacerbated this affordability issue. Before the pandemic, demand was modest and most students used broadband mainly to download learning material. The interactive video and teleconference applications needed to work and study from home during the pandemic require more bandwidth and data consumption. The requirement also shifted from school to individual connectivity.

The Ministry of Education, Culture, Research and Technology, in an endeavour to address the issue, allocated IDR 7 200 billion (USD 500.58 million), or 7 per cent of the national education budget, to subsidies for student and teacher connectivity. This measure targeted close to 60 million beneficiaries but managed to reach only 35.7 million, or 60 per cent. It was nevertheless significant enough to enhance mobile Internet affordability almost to the fixed-line monthly broadband cost of 7.57 per cent of monthly GNI per capita.

Network limits and prospects for extending access coverage

Only 60 per cent of all students and teachers are connected. Out of nearly 1 000 licensed telecommunication providers in Indonesia, only 22.21 per cent currently serve fixed-line networks (BPS, 2020b), despite a 13.76 per cent increase that includes 602 Internet service providers, network access points and Internet telephony services.

Fibre-to-school broadband coverage is limited to urbanized areas and serves only 9.7 million subscribers, or 4 per cent of the population/16 per cent of households (World Bank, 2021). This figure includes schools, health facilities, and government and business offices.

About 70 per cent of the 42 159 schools without an Internet connection are covered by a base transceiver station (Chabibie, 2020). However, this number can only estimate connectivity prospects, which is calculated based on the overlay with school location. Turning it into actual connectivity would require the operators to introduce institutional and school-based group subscription schemes, which is the only way to enable schools to connect to 4G, or at least 3G, as an alternative to fixed access, and improve students' opportunities for decent access to digital and online learning.

Public infrastructure plans (telecommunications and energy)

BAKTI is charged with increasing the density of fixed access and 4G coverage. In parallel, it is also implementing two significant public infrastructure plans in the digital sector. The Palapa

Ring is a national backbone network connecting the remaining 58 unconnected districts out of the total of 514 in the country. The Multipurpose Satellite Initiative, which includes broadband capability, aims to expand coverage to public and critical facilities in unserved areas.

In terms of electricity, Indonesia is currently focused on increasing generating capacity to 40 575 Megawatts and extending the network of 47 723 kilometres (PLN, 2021). This is in response to the fact that most remote areas remain off grid, making rural connectivity a real challenge. In this context, about 8 500 schools are without electricity (6 800 elementary schools, 1 100 junior high schools and 550 senior high schools) (Chabibie, 2020).

Socio-geographic specificities

As alluded to earlier, schools can be classified in four categories in terms of connectivity, in line with socio-geographic features: the high-high cluster in the more urbanized areas; the high-low cluster in peri-urban areas; the low-high cluster (schools covered by the Palapa Ring in 57 regencies); and the low-low cluster, comprising schools in areas facing geographical and economic challenges (Chabibie, 2020).

Skills required for digital transformation

The PISA survey (OECD, 2019) of 15-year-old Indonesians shows that Indonesian students have the lowest reading proficiency, with a score of 371, and thus ranks 71st out of 79 countries. This can be attributed to limited access to the Internet, which, if expanded, helps build the skills that are needed to distinguish facts from opinions (Azzahra & Amanta, 2019) and become one of the prerequisites for reading proficiency.

Rural areas are supposed to have decent enough Internet access to download videos. This facilitates interactive learning, encourages reading proficiency and contributes to good PISA scores, for example, in maths and sciences. While the education system may determine the PISA score, the score of students and teachers disconnected during the COVID-19 worsened. Even before the pandemic, a PISA 2018 system-level analysis of factors contributing to student performance in reading disclosed that Internet connection to school computers had the highest correlation coefficients (0.73, $p < 0.05$) compared to other indicators on material resources. Moreover, Internet availability gaps also had the highest negative correlation with reading capacity (-0.69, $p < 0.05$).[3] The analysis showed that the highest connectivity gaps will therefore significantly reduce PISA reading scores.

The attempt to increase literacy skills through digital learning that is planned (Chabibie, 2020) appears to be based on the general perception that there is comparatively less demand for bandwidth in rural areas. And yet, rural people are more interested in watching and listening (video)[4] than in reading and writing (text). Therefore, school connectivity, particularly in rural areas, should provide decent Internet access, enabling a level of video and interactive learning that encourages proficiency in reading and in other PISA areas such as maths and sciences. However, providing video without proper design could distract students and lower their abilities to read and write. Already during the pandemic, close to 60 per cent of students found it difficult to follow the online learning material. Slightly more than half had difficulty focusing during online sessions and interacting directly with the teachers (Chabibie, 2020).

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[3] The detailed analysis is available in Chapter 5 of *PISA 2018 Results (Volume V): Effective Policies, Successful Schools*, on material resources available at school.

[4] This fact was disclosed during the pilot test of TV White Space in Yogyakarta (USAID, Indonesia Rural Connectivity Pilot, final report, March 2015) and confirmed by the Internet service provider Jogja Medianet, which facilitates connectivity for agribusinesses, schools and health clinics.

Following the COVID-19 pandemic, It will be critical to do the utmost to connect all schools, students and teachers as society moves towards the new normal and future digital lifestyle and transformation – even though it has traditionally been more expensive to provide connectivity in rural areas than in urban areas.

2.2 Policy context

Education

School connectivity is governed by Minister of Education Regulation No. 38/2008 concerning ICT Management, which establishes the Jaringan Pendidikan Nasional (JARDIKNAS), or National Education Network. This is a nationwide online network infrastructure development programme that connects all educational institutions, national and local education offices, universities and schools throughout Indonesia, with a view to the equitable distribution and expansion of access to education, improved quality, and more relevant and competitive education. The expected benefits include improved speed of information services; integrated, interactive, complete, accurate and accessible integrated education data and information services; the inception of a culture of transparency and accountability; improved access to a variety of teaching materials; and more efficient educational activities.

The Law on the National Education System stipulates that a minimum of 20 per cent of the State budget is allocated to education.[5] However, that funding will not always suffice to meet all demands for school connectivity, which may be cross-sectoral. Infrastructure provision, for example, is a supply-side issue beyond the purview of the Ministry of Education, Culture, Research and Technology. Only in an emergency such as the COVID-19 pandemic could the ministry allocate funds for connectivity, and again, only in terms of demand (affordability).

School infrastructure, structure, equipment and needs

Currently, Indonesia's device affordability is at 37.9 out of 100 points (The Economist Group, 2021). While the infrastructure and physical design of schools have generally been standardized, equipment and devices are another issue, particularly in terms of the format of education delivery, i.e. digital or hybrid. A national education programme that applies the bring-your-own-device concept could be one solution, although it also risks further excluding students who are already facing affordability issues. This has implications for needs downstream, i.e. how to regulate applications and contents.

Digital literacy programmes (regional, national, donors, NGOs and local communities)

Indonesia's USO programme covers only last-mile connectivity on the supply side. This is based on the assumption, on the part of contributors, that the provision of infrastructure in particular areas would naturally spur greater demand. The first government-funded pilot rural telecommunication deployment in 2004, for instance, focused only on extending the network at the last mile to villages. Capacity development and technology adoption were expected to be the responsibility of the community development authority under the Ministry of Internal Affairs. Deploying a transformation programme to thousands of villages, however, proved to be too great a challenge in terms of technical and financial capacity.

[5] Law No. 20 2003, on the National Education System, Article 49 (1).

In 2015, the government expanded use of the USO Fund to the connectivity ecosystem. This includes the provision of backbone and distribution systems, alongside applications, devices, capacity building, research and other components.

International donors, NGOs and communities conducting adaptive capacity programmes have been mostly successful only in specific targeted pilot areas. One of the success factors has been the presence of rural champions, who dedicate their time and energy to help push digital skills and therefore market maturity. The replication and scaling up of such successes tends to be challenging. With about 35 000 villages to cover, it would be impractical to make sure there are enough champions to replicate these pilot successes.

Pushing school connectivity would require a massive number of rural champions, not only to replicate successful pilot schemes but, more importantly, to help shift the orientation to sustaining rural Internet access with increased productivity instead of collecting revenue from the immature market. Rural champions can play a crucial role in promoting a more integrated programme for meaningful use of broadband technology. If one productive digitized sector exists in each village, the network's extension to the school becomes more affordable. However, this shift in orientation remains challenging, even after decades of USO programming and sector transformation from analogue to digital telecommunications.

Electricity/energy

As a matter of policy, electricity distribution aims to provide sufficient amounts of adequate and affordable electrical energy.[6] In practice, private companies are allowed to generate electricity but only the State-owned company has the right to distribute it to the end users. Given that most remote areas still rely on off-grid systems or have limited operating times, making the school a local hub would require a more reliable electricity supply.

Fiscal policy

During the COVID-19 pandemic, the subsidy to meet demand for individual connectivity ate up an unsustainable 7 per cent of the national education budget. Access in schools and for individuals must be reconfigured to reduce the high service costs of the local loop and, above all, international bandwidth (during the pandemic, most learning processes relied on application servers located outside Indonesia). However, as long as multinational corporations established overseas are not taxed, domestic providers investing in infrastructure will remain hesitant to increase spending on rural connectivity, for example via the USO contribution. As far as they are concerned, the benefits of the market maturity resulting from their infrastructure support go to global players.

The fiscal issue of multinational corporations based outside the country poses a financing challenge to school connectivity programmes. The COVID-19 pandemic drove the peak traffic growth rate of international traffic to 47 per cent against the forecast 28 per cent (TeleGeography, 2021). In terms of price, however, even in urban areas where the infrastructure cost is considered low, for instance, programme prices remain high. Most of the cost is incurred for the international bandwidth needed to access applications through offshore servers. In order to obtain revenues, the system and the company residing outside the country utilize Indonesia's infrastructure and other production systems – yet they are not subject to Indonesian tax and other fiscal regulations, including USO contributions. It is thus understandable that the Government should insist on

[6] Law No. 30/2009, on Electricity.

data localization for the public service. If a multinational is willing to establish the application and data servers in Indonesia, the demand for international bandwidth is also expected to decrease.

Procurement

The procurement scheme for rural access has evolved. The earlier government asset procurement process specifications were relatively straightforward but faced inventory and management issues. The procurement system then shifted to an outcome-based approach where the government procures services from providers and all the assets belong to the provider. This approach helps reduce the need to maintain equipment and replace obsolete technology. It is also compliant with the financial regime for government asset management and maintenance of quality of service.

ICT/digital policies, cross-sectoral policies

Government action for school connectivity has three objectives: enhancing accessibility, penetration and affordability. While accessibility is mainly the concern of the telecommunication and digital infrastructure sectors, penetration and affordability are cross-sectoral concerns. In terms of school connectivity, penetration is the ratio of individual and institutional subscribers to target beneficiaries. It is determined by price, content relevance and meaningful use in both the digital and education sectors. Affordability, on the other hand, is first addressed by the telecommunication/digital infrastructure sector, especially with regard to the provision of local-loop infrastructure and the minimum bandwidth required. When price is linked to the specific use of applications and content, spending to enhance affordability is borne by the users, in this case, the education sector.

Level of policy implementation

Although the education sector has made access more affordable in school connectivity programmes by providing subsidies for the data quota, 40 per cent of the targeted beneficiaries are excluded due to limited access to services and devices. A policy for assisting students and teachers to access devices is in the pipeline but faces procurement process issues.

The accessibility programme is the responsibility of the infrastructure sector. The role of the telecommunication/digital infrastructure sector is defined in Law No. 36/1999, on Telecommunications, which introduces competition and shifts infrastructure provision to the private sector. Market-driven competition, which created rural triviality, was mitigated by a law that pledges universal service, under which an initial contribution of 0.75 per cent of gross revenue from industry was allocated to support last-mile connectivity in rural areas. After 15 years, the contribution was increased to 1.25 per cent and the scope expanded to cover the backbone and the establishment of broadband ecosystems.

2.3 Concluding remarks

Indonesia is in the lowest category on the Global Connectivity Index 2020 based on ICT investment, ICT maturity and digital economic performance. Connecting every school to the Internet so as to enhance educational opportunities and productivity in the knowledge-based economy could help it graduate to the next category.

In terms of affordability, the gap widened during the COVID-19 pandemic. Despite massive spending out of the national budget by the Ministry of Education, Culture, Research and Technology, 40 per cent of students and teachers remained unconnected owing to accessibility issues.

The Ministry of Communication and Information Technology, through BAKTI and USO programmes, has made significant progress in delivering 4G service to frontier, outermost and underdeveloped, or 3T, areas. While some unserved schools within the 3T areas can expect to benefit from USO programmes, those that lack access but are located outside the 3T areas must wait for their markets to mature to the point that they are financially attractive enough to incite providers to provide adequate services.

3 Governance

3.1 Institutional framework

Mapping the institutions involved

School connectivity programmes involve organizations at ministry level, government agencies at national and subnational level, and education facilities as the programme beneficiaries.

The Ministry of Communication and Information Technology is responsible for the digital/ infrastructure sectors and hence for addressing gaps in supply. It is mandated to improve Internet service affordability by using the BAKTI USO Fund to roll out infrastructure, particularly for unserved and underserved people in 3T areas. The non-3T areas are targets of policy intervention for industry efficiency. Figure 1 depicts the gaps between demand and supply (Katz & Berry, 2016) and the sectors concerned.

Figure 1: Map of demand and supply gaps

Source: Adapted from Katz & Berry (2016)

Entities in charge (responsibilities and mandate)

Ministries

- Ministry of Communication and Information Technology (digital sector policy)
- Ministry of Education, Culture, Research and Technology (education policy)
- Ministry of Finance (taxation and finance)

Agencies

- BAKTI, Ministry of Communication and Information Technology (infrastructure access)
- Pusdatin/Pustekkom, Ministry of Education, Culture, Research and Technology (content development and adoption)
- Local education agency, Ministry of Home Affairs and Ministry of Religious Affairs (local distribution of funding and resources)

Education facilities

- Schools (utilization)

Mechanisms for coordination with stakeholders and partners

Ministries

- Ministry of Communication and Information Technology (policy target, propose a budget, budget priority, business environment)
- Ministry of Education, Culture, Research and Technology (policy target, ICT utilization, identification of gaps, programme budgeting, planned adoption)
- Ministry of Finance (fund governance, budget allocation)

Agencies

- BAKTI, Ministry of Communication and Information Technology (contracting agency)
- Pusdatin/Pustekkom, Ministry of Education, Culture, Research and Technology (content and adaptation instrument)
- Local education agency, Ministry of Home Affairs and Ministry of Religious Affairs (budget proposal, disbursement, quality assurance)

Education facilities

- Schools (curriculum delivery)

3.2 Regulatory framework

The regulatory framework influences market access and the level of competitivity; it therefore affects infrastructure network service, including quality and speeds.

Referring to the policy and regulatory framework of the G5 benchmark (ITU, 2019), Indonesia has been advancing from a G1 (State monopoly)[7] to G2 (duopoly to liberal market for mobile)[8] and G3 (independent telecommunication regulatory authority, the BRTI)[9] framework to level the playing field in the sector. As it approaches the G4 stage, it has designated three director-generals as ex officio BRTI Commissioner.[10]

Looking ahead to G5, Indonesia will require a separate but networked regulator. The President took the decision to close down the BRTI and transfer the regulatory role back to the Ministry of Communication and Information Technology.[11] At the same time, the Omnibus Law (Law No. 11/2020) introduced a very gradual deregulation process, in order to facilitate cross-sectoral coordination.

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7 Article 10 of Law No. 36/1999, on Telecommunications, prohibits monopolistic practices in the telecommunication industry.

8 By virtue of Article 61 of Law No. 36/1999, on Telecommunications, the Government aims to manage the transition from a monopoly to a telecommunication/Indosat duopoly.

9 In order to prevent monopolistic practices pursuant to Law No. 36/1999, on Telecommunications, the Government issued Communication Ministry Decree No. 31 2003 establishing the BRTI.

10 See Communication Ministry Regulation Nos 25 2005 and 67 2003, on governance and working relations between the ministry and the independent regulatory authority. This set of regulations may entail a contradiction between empowering versus limiting the decision-making authority of the BRIT.

11 The decision to close down the BRIT (along with other institutions) is set out in Presidential Decree No. 112/2020 of 26 November 2020.

As it moves towards a G5 intramodal competition framework, Indonesia faces the challenges of integrating domestic and international regulatory frameworks. Whereas from G1 to G3, almost all regulatory subjects are under Indonesia's jurisdiction, the current domestic market is dominated by global players established in other countries (e.g. OTT services).

Market status and competitivity

Competition between status-quo versus pro-reform policies result in changes in market access. The policies may affect the scheme for licensing, spectrum, infrastructure sharing, ownership limitations, taxes, and so on.

The status quo

- *Market-driven with vertical integration of industry structure.* The vertical integration of a State-owned enterprise that owns the optical fibre backbone until it reaches the consumer has a long history of limiting service efficiency to such an extent that it affects affordability in areas with market efficiency gaps. The incumbents are hesitant to adopt the open-access concept or a vertical separation structure in order to create a level playing field for efficient competition.
- *Analogue switch-off in progress.* Implementation of the initial switch-off plan, which was to be completed by 2018, has been delayed by the status-quo policy. As a result, adoption of new technologies – a crucial element for reaping the benefits of the digital dividend – has also been delayed.
- *Limited passive infrastructure sharing,* mainly regrading towers. A vertically integrated industry limits the possibilities for the incumbent to share dark-fibre capacity with new players. Fibre ducts have to be shared and local governments must contribute to lowering fibre-ducting infrastructure costs.
- *Restricted virtual mobile network operator.* Service providers that do not own the wireless network infrastructure over which they provide services to customers enter into business-to-business (B2B) relations with vendors or infrastructure owners. In such cases, the infrastructure industry may own all the assets and then make B2B arrangements with subscriber management services to access the market and act like a virtual mobile network operator.

Evolution of market access by an international player

- *Evolving monopoly–duopoly – technology adoption – mobile liberal – market-driven – merging.* Indonesia has been moving from monopoly to market-driven regulation. Competition has led to improved affordability and the presence of mobile technology makes the impact even more significant. At the same time, however, competitive service and price have restrained investment in rural areas, prompting the Government to establish a USO scheme in order to secure the necessary resources for rural investment. At later stages, an overcrowded market reaches saturation level and leads operators to merge.
- *The evolving role of the State is a State-driven independent regulatory body – soft-touch regulation.* In the earlier stages, the State kept control of infrastructure and related services in order to maintain equity of service and cross-subsidize regions. This natural monopoly created a telecommunication industry that is vertically integrated from backbone to retail. BRIT introduced the mobile market-driven sector and maintained a level playing field among operators. In 2020, the President of Indonesia shut down BRIT and transferred regulatory authority back to the Ministry of Communication and Information Technology, an indication that the market mechanism and anti-monopoly systems had matured. It was also at that time that soft-touch regulation was introduced.
- *Issue of taxation system to access OTT services.* OTT services, which provide an alternative technology for voice and text services, have disrupted the telecommunication business

model by taking revenues abroad. The fall in domestic revenues affects the USO contribution and other taxes that are required for reinvestment in domestic infrastructure. Currently, no robust regulatory framework exists to address this new supply factor.

- *Foreign direct investment policy unbundles infrastructure and contents.* The first step in opening broadcasting and digital investment is to unbundle the regulations that split infrastructure companies and content providers. This can start with content industries and later also be applied to infrastructure provision. Such as vertical separation of industry layers has transformed state-centered or domestic dominated business into more competitive industry.

Impact on service, network, quality and speeds

Impact on service

- School connectivity would benefit from an environment that allows more competition and access to the market, which in turn would improve connectivity quality and price. Following the digitalization and emergence of technologies that allow various degrees of convergence, policies could be introduced to unbundle different service layers from physical infrastructure, content, application and mobility-as-service. The result would be a divergent-to-convergent service with an unbundled licensing framework of layered service types, e.g. infrastructure as a service, software as a service, platform as a service.

Networks, quality and speeds

- School connectivity requires adequate connectivity networks. State-owned enterprises usually deploy the network and thus create a strong, vertically integrated industry. However, this could render the networks redundant and limit efficient backbone use. In such a situation, new players need to deploy their backbone in the same area.
- It is critical to ensure that school connectivity has regulatory safeguards and that the industry envisions future technology. As network quality is primarily determined by prior investment and anticipated technological obsolescence, even when new technologies are present, their adoption would be a consequence of the return on prior investment. For example, in the USO programme, shifting to 3G infrastructure for school connectivity in rural areas may not be the most appropriate step when 4G is being rolled out in urban areas.
- Decent speed for school connectivity could be hindered by sub-optimal network management and operation, and by local-loop quality bottlenecks. A highly competitive market could lead to a reduced service experience. High investment and falling revenues could prompt operators to promise a high speed of service but reduces the clarity of the service-level agreement.

Regulatory incentives for connectivity

School connectivity should be kept up to speed with new technology.

- Regulations that limit the introduction of new technology could affect the spectrum's status quo. The current licensees, who invested in spectrum operations, may object to changes in spectrum allocation, thus possibly delaying the introduction of new technologies in schools. The postponement of the analogue switch-off in 2018 affects the availability of spectrum for new technologies. It is hoped that the new Omnibus Law No. 11/2020 will set a new timeline for the adoption of new or more technology neutral regime, including the Government's newly established plan for analogue switch-off by 2022.

Consumer protection and privacy (data and child online protection)

Initiatives

- In order to protect schoolchildren, government agencies and community groups have initiated child online protection programmes in which they have invited individual companies and organizations to engage. The Government uses the TRUST+™ Positif database to block content based on reports from the general public, individuals or institutions. ICT Watch, for its part, established a website in 2002 (ICT Watch, 2021) that encourages Internet service providers to apply filters for inappropriate content.

Protection effectiveness

- Child online protection in the context of school connectivity faces formidable challenges, and the bottom-up approach is often of questionable effectiveness. For example, 41 per cent of children do not reveal their actual age, which has obvious implications for their safety. Combination of fake age and actual personal data and behavior leave a digital footprint that increase the risk of child victims. Moreover, between 67.1 and 78.3 per cent of schools do not apply any restrictions in terms of inappropriate use (Gayatri et al., 2015). After a decade, the situation has not improved. The Commission for Women's Empowerment and Child Protection found that 1 940 children had been victims of online hazards and perils from 2017 to 2019 (CWECP, 2020).

Regulatory barriers identified

Restrictions apply in some investment areas but they concern minimum investments, i.e. the minimum amount to invest in a start-up. Regarding financial businesses specifically, Bank Indonesia applies investment restrictions in a principled and strategic response to the development of digital financial services while safeguarding consumers (Baker McKenzie, 2021). By and large, the Omnibus Law has offered various incentives for investment in the digital sector. It includes implementing regulations,[12] which were previously closed (e.g. tower, retail media) or partly opened (e.g. network service of 67 per cent foreign direct investment but now open to 100 per cent foreign investment in telecommunication business lines).

There is one area in which the law may slightly slow the process of acceleration in digital business (Baker McKenzie, 2021). Investors may observe some regulatory barriers, such as those aiming to combine global and domestic resources to address digital infrastructure issues, which are currently disrupted by OTT services. These disruptions require offshore business measures, including digital tax, e-commerce and foreign OTT regulation. However, as the domestic systems cannot deal with the offshore businesses, there is a potential for slight delays.

Investors may also face uncertainty elsewhere, particularly in matters where the decision requires the "approval of the Ministry of Communication and Information Technology" without predefined criteria. This approach leads to flexibility in the assessment of the new business application, one example being the definition of "new technology". The ministry approval of the technology could imply business certainty of new opportunities for joint or flexible use of radio frequency spectrum.

[12] This includes Government Regulation No. 46, of 2021 on Post, Telecommunications and Broadcasting, and Presidential Regulation No. 10 of 2021, on Capital Investment Business Fields.

4 Opportunities, gaps and challenges

4.1 Overall funding and financing

School and connectivity

The primary sources of funding for school connectivity in 3T areas are the USO Fund (1.25 per cent of gross revenue), the spectrum fees received by the Ministry of Communication and Information Technology (<96 per cent of the earmark) and the subsidy for affordability paid by the Ministry of Education, Culture, Research and Technology (7 per cent of the education sector budget).

In theory, at least, those funds combined could cover broadband access for all schools at prices that are affordable (maximum 2 per cent of monthly GNI per capita) for all students and teachers. Any additional service subsidy required is not expected to exceed the capacity of the education budget.

Access to and use of funding

BAKTI is mandated to provide connectivity access to schools in the designated 3T areas, which are all equally eligible for USO funding. While additional funds from spectrum licencing fees may influence the potential coverage of broadband services (e.g. future multifunctional satellite and optical fibre), private operators are still required to cover the blank spot outside the 3T areas. As the USO Fund addresses only the supply side in 3T areas, a school located outside those areas would need demand-side interventions in order to be able to afford the services from a commercial network.

4.2 Universal service framework

Responsible entity

The USO programme is a supply-side intervention involving primarily infrastructure provision. In implementing it, the Ministry of Communication and Information Technology determines the government target and eligibility of the activity to be funded. The Minister gives a direct mandate to BAKTI, as the contracting agency, and tasks it to coordinate with other ministries to align cross-ministerial programmes.

Contributing players and amount contributed

All telecommunication/digital service operators contribute to the USO Fund (in 2005 initially 0.75 per cent of their gross revenues and since 2009 increased to 1.25 per cent). In 2019, the Fund had an endowment of IDR 2 900 billion (USD 201.26 million).

Budget, projects and programmes

The budget to implement the USO programme, which increases annually, is allocated to various projects promoting broadband accessibility in public facilities. These include deploying 7 905 4G base transceiver stations in 3T areas in 2021 and 2022, and constructing a multifunctional satellite that will be brought into operation in 2023 which will provide 150 000 locations with 150-Gbit/s service and a data limit of 30.37 million gigabytes per month. The USO Fund also finances the Palapa Ring availability payment, ensuring investment viability for public–private partnerships in socially and politically demanding areas.

Implementation, monitoring, evaluation and review

Eligibility for USO funding has expanded from last-mile connectivity to ecosystem establishment in rural areas and, most recently, backbone investment in optical fibre and multifunctional satellites.

As eligibility has expanded, the annual contribution to the USO Fund of 1.25 per cent of the operator's gross revenues has become insufficient to cover all mandatory spending under BAKTI's contract.

OTT services have recently disrupted the infrastructure investment business model to the extent that no operator is willing to increase the USO contribution. The telecommunication operators' lucrative revenues from voice and text services have been eroded by the alternative technology used by OTT companies, which are established outside the country's jurisdiction and thus are not obliged to contribute to the USO Fund.

Review of and lessons learned from USO project implementation

In reviewing the lessons that can be learnt, it is clear that the Ministry of Communication and Information Technology needs to maintain the USO programme's cash flow and, to that end, requires other sources of funding in the form of non-tax revenues. Spectrum fees are the least earmarked non-tax revenues that the ministry has, but only 4 per cent are returned to the telecommunication sector.

The Ministry of Communication and Information Technology could reinvest more allocation from the spectrum fees with the operators in order to generate more public benefit from broadband access. Spectrum licensees could be enabled, through more ministry investments in the requisite infrastructure, to penetrate the market in previously unviable rural areas. Such investments could include support so that the distribution network can access the backbone and passive infrastructure such as public ducting, which currently requires a high level of investment for low business viability.

Using spectrum fees to provide infrastructure could enable operators to utilize their licensed spectrum and make services available at more affordable prices to communities in rural areas, including their schools.

Scope and sources of funding, beneficiaries and administration

Scope of funding

Law No. 36/1999, on Telecommunications, obliges "every telecommunication network operator and telecommunication service operator to contribute to universal services". This contribution can consist of telecommunication facilities/infrastructure or take some other form. In 2000, Government Regulation No. 52 created the USO Fund to provide access to telecommunication services. The USO Fund converts the option for the operator to "play" or "pay" into an obligation to "pay" in rural areas.

Sources of funding

The Government initially in 2005 required all providers to contribute 0.75 per cent of their gross revenues to the USO Fund. That amount was increased to 1.25 per cent by Government Regulation No. 7/2009.

Beneficiaries

USO-designated areas were initially defined in 2005 as having a "public phone within walking distance", the aim being to connect villages with point-to-point radio technology from the last-mile fixed network using satellite technology. The definition has since evolved and currently encompasses public phone provision and individual mobile coverage. The Internet was introduced in 2010, with points of presence in subdistricts and mobile Internet service at rural public facilities. Broadband access was introduced in 2014, with the target to deliver 1 Mbit/s on the mobile service and up to 10 Mbit/s on fixed access, including connections to schools.

The present immediate target is 4G service coverage for all people in 3T regions. The USO programme focuses on accessibility in all economic sectors, while the Ministry of Education, Culture, Research and Technology subsidizes Internet access at schools, especially during the COVID-19 pandemic.

Approaches to funding

The Ministry of Communication and Information Technology selects USO operators, initially the Balai Telekomunikasi dan Informatika Pedesaan (BTIP), subsequently the Balai Penyedia dan Pengelola Pembiayaan Telekomunikasi dan Informatika (BP3TI), followed by the current Badan Aksesibilitas Telekomunikasi dan Informasi (BAKTI). The ministry uses government-licensed auctions to choose a telecommunication technology based on the area's demand, targets and characteristics.

In the selection process, the ministry determines functional requirements based on technological neutrality. The operators selected must deliver subsidies for villages through Internet access and services. In the early stages of the USO programme, funding was only available for last-mile connectivity.

In 2007, the Ministry of Communication and Information Technology expanded USO services to include information technology and broadband services. Authorized services were required to consist of ICT services and a round-the-clock public phone service, be technology neutral, prioritize local content, and provide an Internet- and broadband-ready solution.

Given the current demand for broadband, the Government extended the Fund’s scope to the establishment of broadband ecosystems, including backbone networks and community development programmes.

Fund administration

The USO Fund has an annual budget of more than USD 170 million. Experience, evidence and the latent demand for broadband revealed during the COVID-19 pandemic has led to a new government commitment for increased funding, including the amount transferred from spectrum fees. As a result, the budget commitment has increased about tenfold, enabling the programme’s expansion from the last mile to the establishment of broadband ecosystems, including all mandatory expenses such as backbone availability payments, 4G base transceiver stations and the new multipurpose satellite initiative. The Fund is governed by the policy and regulations of the Directorate-General of Post and Telecommunications, and managed by BAKTI as a not-for-profit public service institution

Programmes

The Palapa Ring development programme was a national strategic project aimed at developing a national optical fibre backbone network connecting all cities/districts with optical fibre networks. It involved a public–private partnership with Western, Central and Eastern packages. The programme funding of USD 1.5 billion was used to provide 4G Internet access with speeds of up to 100GB per second in even the outermost lying regions of the country, and to deliver more than 34 998 kilometres of submarine cables and 20 921 kilometres of land cables, for a total network length of about 12 000 kilometres. The aim was to connect more than 500 regencies in 11 provinces across the country, involving 90 districts/cities (57 for services and 33 for interconnection). The programme also had a non-public–private partnership component, carried out by PT Telkom, to connect 457 districts/cities. In order to sustain the service, the Government used the availability payment scheme to relieve the operator of demand risk. This scheme transfers the investment and operation financial risk of the operator to the government. The programme was concluded in January 2020.

As of July 2019, 1 068 base transceiver stations were providing services in 24 provinces and 137 districts, particularly in rural areas where private mobile operators had not established networks.

The SATRIA satellite system is intended to provide fast Internet connectivity throughout Indonesia. Financed through a public–private partnership, work on the system started at the end of 2019 and the launch target is the end of 2022. While the system aims to provide nationwide service, it is understood that it should follow policy in respect, for example, of 3T areas as the priority target of USO Fund spending.

Public Internet access services are provided at specific public locations, primarily at rural facilities requiring telecommunication and information facilities and infrastructure, e.g. schools, vocational training centres, community health centres, tourist locations, village halls and government offices.

4.3 Issues for consideration

This report raises a critical issue that must be resolved:

"Given that the combination of supply-side action on the part of the Ministry of Communication and Information Technology and demand-side subsidies from the Ministry of Education, Culture, Research and Technology has made broadband services available to only 60 per cent of target beneficiaries, how can school connectivity costs be reduced for 100 per cent of target beneficiaries to 2 per cent of monthly GNI per capita?"

The COVID-19 pandemic and reflection on affordability programmes in the education sector have shown that international bandwidth to access application servers comes at a high cost. There are several ways to address the issue: first, obtain international resources to reduce local-loop costs; and second, explore the possibility of reconfiguring bandwidth cost factors. International resources are expected from the OTT business that obtain the financial benefit of infrastructure deployment, but are not paying a USO contribution. Many multinationals and OTT services are willing to explore greater market penetration, which may also provide an opportunity for international cooperation on school connectivity programmes.

4.3.1 Using WOAN to cut local-loop costs

Local-loop costs consist of infrastructure network and spectrum costs. In terms of the infrastructure network, the local loop performs at a sub-optimal level because current spectrum licences hinder market penetration by the latest and more resource-efficient technology. As far as spectrum costs are concerned, the production cost and price of infrastructure networks may fall as the technology matures and economies of scale kick in. However, spectrum costs tend to rise as demand for wireless solutions goes up. Competing use of new wireless technology and previously deployed networks could also increase spectrum costs. The greater cost-effectiveness that might be obtained by sharing or transferring spectrum to newer players is also limited by the general norm that licences are not transferable.

A more cost-effective and efficient local loop could be attained by separating the spectrum from the technology delivering the service. Long-standing policy paradigms and regulations that apply a static spectrum management approach have resulted in a bottleneck in the use of scarce spectrum resources. By implementing more recent dynamic patterns of use and deploying cognitive radio, the authorities could dynamically manage spectrum allocation and pricing.

WOANs have the potential to ease the bottleneck, enabling new and smaller players to use capacity for a specific purpose and promoting wholesale price economies of scale. WOANs "couple" spectrum resources and network technology licences to deliver use. Instead of auctioning simply "the spectrum", they auction the scheme for the best total "capacity" for the spectrum and the networks. The open access aspect is implemented wholesale, to allow other companies to use – on a non-discriminatory basis – the shared capacity via a dynamic arrangement with regard to time, area and demand variations (Cramton & Doyle, 2017).

The following section discusses the advantages and disadvantages of WOANs based on an academic review, the empirical perspective of the first WOAN implemented in South Africa (Lewis, 2020), and the policy and regulatory context in Indonesia.

The advantages of WOANs

The advantages of WOANs include the following:

- the potential to increase spectrum efficiency thanks to dynamic allocation and pricing;
- a specific purpose or use, e.g. in a rural area with a dispersed population, could lead to cost-sharing with the general population;
- the open-access principle allows new entrants to serve a niche market with less investment;
- retail businesses or even subscriber-management agencies could take part without breaking the rules of spectrum licensing.

The disadvantages of WOANs

The disadvantages stem from controversies over uncertain practical implications, failure to maintain open-access principles, formation of a new type of monopoly, and flaws in benefit redistribution, as follows:

- there is no evidence of success outside of academic literature and theoretical proof under ideal conditions;
- if the WOAN company has a subsidiary at the next layer of the industry, the conflict of interest will limit the open-access concept (to reach the wholesale level, e.g. 30 per cent of national capacity, a consortium of industries is often required);
- the WOAN could be monopolistic if there is no alternative to access the market in certain specifically designated areas;

- benefits (from cost savings in the local loop or productivity from the WOAN) accrue to the licensor or licensee, but are not redistributed to society, meaning that the objective of affordability would not be achieved.

The implications for school connectivity and the USO programme in Indonesia

Whilst WOANs might improve affordability they could lead to a drop in the USO programme that affects accessibility. Particularly in similar cases in Africa, where the WOAN was not part of the USO mechanism, the spectrum was undervalued as measured by current technological capacity. Two critical policies may affect the USO programme: the WOAN company is not a subject of a USO contribution and the government might waive the spectrum fee, since the bid is for network capacity. Such a policy is not feasible for Indonesia, where the Government aims to consolidate non-tax revenues to support the USO programme: it would reduce the amount collected for the USO Fund, and waiving the spectrum fee would deprive the USO Fund of a form of non-tax revenue.

Any measure to improve affordability by cutting local-loop costs must ensure that the benefits are redistributed to the underprivileged people living in underserved and unserved areas, and to other stakeholders, i.e. the private sector, the public authorities and communities. Failure to do so would perpetuate national inequality directly and over the long term.

4.3.2 Alternative funding models for redistributing national resources for school connectivity

School connectivity funding models take account of national resource allocation, stakeholder contributions and benefit redistribution in order to address spatial and social inequality. They may involve contributions by various stakeholders.

In the case of Indonesia, the Giga Meaningful School Connectivity report (2021) proposes four country-specific models for financing and delivering school connectivity:

- Model A: Coverage as a service – revenue-sharing, commercially operated private company/consortium;
- Model B: Government increases school funding, government contribution operating model;
- Model C: One-off government subsidy with spectrum auction and USO financing;
- Model D: Community contribution, operated cooperatively and on a voluntary basis.

The report suggested that four pilot projects be trialled to obtain a proof-of-concept validating the scheme and to gain additional insights, especially into the possible implications for existing ecosystems.

The report divided the funding methods into two categories: those for well-developed regions such as Java and Sumatra, and those for the less-developed regions of Kalimantan, Sulawesi, Nusa Tenggara and Papua.

4.3.3 Derived funding methods for well-developed regions

Demand subsidies

Demand subsidies rely on extended government support for affordability in areas where the private sector has invested commercially. During the pandemic, the Ministry of Education, Culture, Research and Technology deployed 7 per cent of its national budget to subsidize

data quotas. The private sector, which enjoyed a significant increase in earnings as a result, was reluctant to give back to the USO Fund due to the OTT-induced disruptions to its business model. Acting on demand is only a temporary solution. Considering that the Government's funding capacity is limited and that affordability remains an issue, the sustainability of this model is questionable.

Proposed model improvement: Two strategies for extending demand subsidies could be explored. First, irrelevant content and services could be blocked and the possibility of unnecessary services continuously assessed in order to reduce costs. Second, earnings could be increased by promoting the meaningful use of connectivity in the public sector, in order to aggregate the captive demand from all users in other sectors. The increased earnings would improve the systems' financial viability.

Prerequisite in upcoming 5G spectrum auctions

Recourse to spectrum auctions assumes that the commercial sector can deliver connectivity efficiently. However, that approach could result in a limited response to the auction or decreased service. In addition, Indonesia has excluded the option of "play" in rural or remote areas, focusing instead on "pay" to the USO Fund.

Proposed model improvement: The Government must maintain quality of service if it insists on using the model. This involves project delivery quality assurance with early warning indicators for misaligned objectives. Spectrum auctions result in long-term commitments; without a strategic assessment and systemic approach to predict impact, the risk of failure could grow over the years. Moreover, to sustain commercial interest, the prerequisite should be linked to an incentive, either counted as a USO contribution or deducted from the spectrum fee for every act of compliance with the project objectives.

Build–operate–transfer

The build–operate–transfer method has been used in BAKTI programmes, where procuring partners set up the network and mandate subsidies applied for the contract duration. This model, however, could not be used outside 3T areas.

Proposed model improvement: Extending BAKTI's coverage to more developed regions would require a set of strategies ensuring that no mature and lucrative market was unintentionally included in the programme. Conversely, the strategies should also ensure that no target beneficiaries are excluded in error. The first step would be to determine a clear demarcation between commercially viable areas and economically or socially required policy targeting. The second would be to prepare an exit strategy for when mounting demand could sustain the service.

Revenue sharing

Revenue sharing relies on private individuals or community groups who own networks. It is an informal and technically illegal solution, especially when it generates public risk. However, owing to the flexible nature of entrepreneurs, it may be possible to link revenue sharing more broadly with a formal operator or more significant player. Regulatory measures would limit this flexibility in terms of eligibility for licensing and the financial capacity of upfront capital expenditure to increase service levels.

Proposed model improvement: The improvement aims to maintain affordable capital expenditure and should therefore focus on the most critical aspect or change the service parameters to

be relevant only to a specific need for school connectivity. The more significant player could formulate a specific cooperative contract to ease the local adaptation to formality with an extended possibility for outsourcing network roll-out and maintenance to the local community.

4.3.4 Derived funding methods for less-developed regions

Demand subsidies

This method relies on extended government support for aggregating demand and, therefore, the revenue to improve financial viability in areas where the private sector has invested commercially. In less-developed regions, there is nothing to stop BAKTI from extending accessibility action to affordability programmes. BAKTI can allocate USO funding for action on demand. However, if the target area is outside the 3T areas, the subsidy needs to be sourced elsewhere.

Proposed model improvement: In areas outside BAKTI jurisdiction, the operator should be encouraged to actively develop a programme to aggregate demand for multisector beneficiaries. The involvement of local players is essential to convert a non-customer or new group of users.

USO financing

Along with BAKTI's vision and mission, school connectivity has been a programme priority, and BAKTI should therefore consider allocating USO funding to meet demand, even if the funding for school connectivity has to compete with other public facilities. Moreover, the 3T areas have been steadily shrinking in the wake of successful government efforts. Again, target areas outside 3T areas will have to source school subsidies elsewhere.

Proposed model improvement: There is a greater chance that the target area may soon fall outside of the BAKTI jurisdiction, or the build–operate–transfer task may have reached the transfer period. Before exiting the contract, the operator should actively develop a programme to aggregate demand. Similarly, local players must be involved in subscriber management, so as to convert non-customers or new groups of users. Moreover, public service demand could be a captive market sustaining the service.

Regulated advertising model

In this model, the provider ensures reliable access in less-developed regions by cross-subsidizing income generated through advertising in developed regions. At the same time, this approach potentially exposes students to inappropriate content or disruptions from adverts. Internet adverts constitute a disturbance, and users tend to avoid them or just view the first few seconds. There is always the possibility that both the student and the commercial industry miss out on the benefits of implementation.

Proposed model improvement: Should this method be allowed, advert delivery will have to be regulated. Instead of the traditional pop-up ad, the programme designer could adopt a "branded-content" approach, ensuring that all adverts are within the content video and/or support educational content. Besides ensuring the advert's visibility, this approach also prevents hidden and inappropriate ads from appearing on educational platforms.

Community contribution

This method can be equated with the traditional community-based or village model. The challenge is that most villages will have relatively minor and unstable possibilities for cost sharing, especially since the population in many villages and islands has little disposable income to sustain the network.

Proposed model improvement: The village model should be combined with a community-based productivity approach. The village funding available and the village-owned enterprise should be used to enable the community to increase productivity using digital technology. Currently, affordability is contingent on individual income. Community groups and rural cooperatives could improve product quality or services and raise sale prices by using the Internet for business. The increased value and volume of sales would see revenues go up, enabling the community group to afford higher-quality access that could be shared with schools and community members. Again, increasing income and ability to pay within the district will heighten the model's feasibility.

Government co-investments with service providers

This method assumes that the interests of the government and service providers converge. The challenge is that financial viability is so low as to be unattractive for service providers.

Proposed model improvement: The programme should include financial and economic feasibility matrices to maintain service provider interest. Like any other commercial utility company, service providers need a certain level of financial viability in the form of return on equity, cost-benefit ratio, net present value, internal rate of return, etc. The Government should provide a minimum level of support for the financial metrics of interest to service providers. Meanwhile, the Government should also work to increase village productivity and aggregate public sector demand, in order to limit the time needed to implement the exit strategy.

An alternative approach: a global effort to reduce international bandwidth costs

The Boston Consulting Group provides simulations for all the models in the Giga report. In general, efforts to obtain affordable connectivity by reducing local-loop costs leave significant gaps. The proposed pilot would disclose whether domestic resources could fill those gaps.

As for the other cost component, policy-makers should consider more strategic action to reduce international bandwidth costs. The disruptive OTT business model is an aggravating factor in that it results in lower revenues for domestic contributors to the USO Fund and thus in even fewer domestic resources for local-loop costs. Under this new business model, almost all the profits go to OTT companies that are located outside the country and make no USO or fiscal contribution towards providing connectivity at an affordable price. This is a global issue, and few attempts have been made internationally to revisit how the global industry could be structured to encourage growth in a healthy environment. It is imperative that connectivity in rural, remote areas, especially in schools, should be addressed internationally and by consolidating global and domestic resources.

Given current economic systems and the limited possibilities that countries have to consolidate global resources for connectivity, the international community should consider forming a new entity that would promote global cross-subsidies for underprivileged populations living in unserved and underserved regions. The concept is similar to that of a USO fund but would play out at the international level and take the form of a global universal service fund. A mechanism in every individual country would collect the funds, which would then be consolidated and redistributed for equal service worldwide. Under this scheme, domestic authorities and international agencies (including donors and wealthier economies) would work together to address gaps between peoples, regions and nations.

4.4 Recommendations for BAKTI

This assessment report has outlined series of alternative solutions for addressing school connectivity gaps. The recommendation varies to very local, domestic to global efforts. The global effort might take a long time to have an impact on the ground in Indonesia. The Ministry of Communication and Information Technology and its agency, BAKTI, are therefore crucial stakeholders in addressing school connectivity issues in 3T areas, especially in terms of demand. The section below contains several recommendations to enable BAKTI to extend and intensify current services to the education sector.

Strategic recommendations

The strategic recommendations listed below relate to policy and could be submitted for endorsement to the higher authorities at the ministerial or presidential levels.

- BAKTI should extend its services outside the 3T areas to underserved areas, on the basis of a legal instrument carrying the same weight as that designating the current 3T areas (e.g. presidential decree).
- If an area-based designation outside the 3T areas is too excessive and carries too great a risk of inclusion errors, point-based assignments could be considered, with specific targets being schools and other educational facilities.

Tactical recommendations

The tactical recommendations below address resource allocation within and among ministries.

- The COVID-19 pandemic has highlighted the urgent need for access to education and shown BAKTI to be the most prominent agent for providing access in rural areas. Improved Internet access in schools, for students and teachers, will significantly affect the nation's digital future; USO school connectivity programmes should therefore be the top priority.
- USO network deployment should be designed to take into account the distribution of schools. Support from access suppliers should have one outcome, and affordability funding from the Ministry of Education, Culture, Research and Technology should be consolidated to extend access to other schools.
- A systematic plan should be drawn up to improve school connectivity within designated areas, on the basis of the 3T areas and a point-based programme for non-3T areas.

Operational recommendations

Operational action aims to maximize the impact on the education sector under the existing BAKTI policy and area designation. Considerations include:

- Keeping the designation area and applying an exit strategy when the area has reached market maturity; relocating when necessary to places where demand is higher.
- Deploying the SATRIA satellite system to establish schools in the most remote areas as connectivity hubs for the surrounding area and where students and teachers live.
- Deploying the pilots proposed in the Giga Meaningful School Connectivity Report and evaluating the results for potential further deployment, replication and scaling up.

4.5 Guidelines for applying USO funding

Specific terms and conditions apply to the possible use, disbursement and accountability reporting of USO funding. Any new initiative or model that uses USO funding to pilot, replicate or scale up a programme must comply with all those terms and conditions. General guidelines for programme designers are set out below.

USO funding for programmes in socially and politically demanding areas

The 3T areas are socially and politically demanding; any school-connectivity programme in such an area must take priority, especially if there is no network in the neighbourhood. A bottom-up process acting on demand would be sufficient to obtain support from BAKTI.

USO funding for affordability in frontier areas

This is the case of schools located in areas that are connected but in which affordability is an issue that prevents students and teachers from subscribing. If the school is also in a 3T area, BAKTI could deploy the Internet access programme for the school.

USO funding for market efficiency gaps

Market efficiency gaps are conceptually the operator's responsibility. The Government should establish a business environment conducive to more efficient operations. While the 3T designation does not apply in such areas, which therefore do not come under BAKTI's remit, there is room to use USO funding for 3T contagion areas. Such a programme must bundle adjacent areas in a cluster of services. BAKTI could support the part of the cluster in 3T areas having a network of schools with an availability payment scheme and let the service providers or operators provide market-based services in the adjacent non-3T areas. Public–private partnerships for such clusters of schools could increase access and lower the price of services.

Areas not falling into one of the above three categories should be categorized as commercially viable and therefore not eligible for USO funding. An exception can be made in cases when USO funding is used to provide services not just in unserved and underserved areas but also for underprivileged groups. Currently, each ministry provides this demand-side support. If BAKTI could consolidate both supply-side and demand-side government support as a national resource, it could optimize programme accessibility, affordability and penetration.

5 Conclusions

Indonesia is in the lowest category on the Global Connectivity Index 2020 in terms of ICT investment, ICT maturity and digital economic performance. It should close the Internet connectivity gap in every educational facility so as to ensure educational opportunities, a productive knowledge-based economy and, ultimately, graduation to a higher category.

Internet service affordability is another factor contributing to the urban–rural digital divide, which has widened during the COVID-19 pandemic. Despite national spending by the Ministry of Education, Culture, Research and Technology, 40 per cent of students and teachers remain unconnected for reasons related to affordability.

Although Indonesia has reached target prices for mobile Internet service of 1.17 (pre-paid) and 1.40 per cent (post-paid), the requirement to study and teach from home has led to a surge in demand at the same time as it has highlighted the high cost of Internet use in education. The way in which the Internet has been used to study during the pandemic makes it unaffordable for teachers and students.

The Ministry of Communication and Information Technology, acting through BAKTI and USO programmes, has made significant progress in delivering 4G services to frontier, outermost and underdeveloped areas (3T areas). While some unserved schools are located in the 3T areas and can therefore benefit from USO programmes, others outside such an area must wait for their market to mature to a level that is financially attractive to an operator.

In 2020, the Ministry of Education, Culture, Research and Technology subsidized 60 per cent of students and teachers at a cost equal to 7 per cent of the national education budget. It thus subsidized data quotas for students and teachers who had access and devices. To guarantee connectivity for all 59.5 million target beneficiaries would require spending 11.6 per cent of the ministry budget, far above the target price of 2 per cent of monthly GNI per capita (Broadband Commission for Sustainable Development, 2021).

To enhance accessibility, the Government increased the allocation for rural connectivity programmes from spectrum fees, thereby multiplying BAKTI's programme budget by ten. Despite this increase, the area designated for USO deployment by BAKTI is strictly limited to the 3T areas determined by presidential decree. The programme may therefore exclude schools in non-3T areas. At the same time, the Ministry of Education, Culture, Research and Technology, which can access 20 per cent of the national budget, is not responsible for acting on the supply-side (infrastructure).

Despite the best efforts of the digital/telecommunication and education sectors, the residual gaps are indicative of a critical policy issue, as revealed by further analyses. Without proper policy intervention, the education sector will continue to suffer the severe impact of connectivity affordability and accessibility gaps. The following policy interventions are recommended to address these gaps:

- Option 1: Issue a new presidential decree expanding BAKTI's programme for school connectivity beyond the current 3T areas.
- Option 2: Expand the current Internet access programme beyond the 3T areas to connect schools that are most in need, targeting schools in underserved areas.

- Option 3: To enhance affordability, have BAKTI focus on coverage programmes (e.g. subsidized base transceiver stations), not only in 3T areas, but also where students and teachers live, and the schools become the universal connectivity target.
- Option 4: If BAKTI has implemented all supply-side interventions, but affordability remains an issue, the Ministry of Education, Culture, Research and Technology could consider providing demand-side subsidies for underprivileged groups of students and teachers.

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Office of the Director
International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435
Fax: +41 22 730 5484

Office of Deputy Director and Regional Presence
Field Operations Coordination Department (DDR)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdeputydir@itu.int
Tel.: +41 22 730 5131
Fax: +41 22 730 5484

Digital Networks and Society (DNS)
Email: bdt-dns@itu.int
Tel.: +41 22 730 5421
Fax: +41 22 730 5484

Digital Knowledge Hub Department (DKH)
Email: bdt-dkh@itu.int
Tel.: +41 22 730 5900
Fax: +41 22 730 5484

Partnerships for Digital Development Department (PDD)
Email: bdt-pdd@itu.int
Tel.: +41 22 730 5447
Fax: +41 22 730 5484

Africa

Ethiopia
International Telecommunication Union (ITU) Regional Office
Gambia Road
Leghar Ethio Telecom Bldg. 3rd floor
P.O. Box 60 005
Addis Ababa
Ethiopia

Email: itu-ro-africa@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon
Union internationale des télécommunications (UIT)
Bureau de zone
Immeuble CAMPOST, 3e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé
Cameroon

Email: itu-yaounde@itu.int
Tel.: + 237 22 22 9292
Tel.: + 237 22 22 9291
Fax: + 237 22 22 9297

Senegal
Union internationale des télécommunications (UIT)
Bureau de zone
8, Route du Méridien Président
Immeuble Rokhaya, 3e étage
Boîte postale 29471
Dakar - Yoff
Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 859 7010
Tel.: +221 33 859 7021
Fax: +221 33 868 6386

Zimbabwe
International Telecommunication Union (ITU) Area Office
USAF POTRAZ Building
877 Endeavour Crescent
Mount Pleasant Business Park
Harare
Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 242 369015
Tel.: +263 242 369016

Americas

Brazil
União Internacional de Telecomunicações (UIT)
Escritório Regional
SAUS Quadra 6 Ed. Luis Eduardo Magalhães,
Bloco "E", 10º andar, Ala Sul (Anatel)
CEP 70070-940 Brasilia - DF
Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados
International Telecommunication Union (ITU) Area Office
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown
Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343
Fax: +1 246 437 7403

Chile
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Merced 753, Piso 4
Santiago de Chile
Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Colonia Altos de Miramontes
Calle principal, Edificio No. 1583
Frente a Santos y Cía
Apartado Postal 976
Tegucigalpa
Honduras

Email: ituteguciglapa@itu.int
Tel.: +504 2235 5470
Fax: +504 2235 5471

Arab States

Egypt
International Telecommunication Union (ITU) Regional Office
Smart Village, Building B 147,
3rd floor
Km 28 Cairo
Alexandria Desert Road
Giza Governorate
Cairo
Egypt

Email: itu-ro-arabstates@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia-Pacific

Thailand
International Telecommunication Union (ITU) Regional Office
4th floor NBTC Region 1 Building
101 Chaengwattana Road
Laksi,
Bangkok 10210,
Thailand

Mailing address:
P.O. Box 178, Laksi Post Office
Laksi, Bangkok 10210, Thailand

Email: itu-ro-asiapacific@itu.int
Tel.: +66 2 574 9326 – 8
+66 2 575 0055

Indonesia
International Telecommunication Union (ITU) Area Office
Sapta Pesona Building
13th floor
Jl. Merdan Merdeka Barat No. 17
Jakarta 10110
Indonesia

Email: itu-ro-asiapacific@itu.int
Tel.: +62 21 381 3572
Tel.: +62 21 380 2322/2324
Fax: +62 21 389 5521

India
International Telecommunication Union (ITU) Area Office and Innovation Centre
C-DOT Campus
Mandi Road
Chhatarpur, Mehrauli
New Delhi 110030
India

Email: itu-ro-southasia@itu.int

CIS

Russian Federation
International Telecommunication Union (ITU) Regional Office
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation
Email: itumoscow@itu.int
Tel.: +7 495 926 6070

Europe

Switzerland
International Telecommunication Union (ITU) Office for Europe
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: eurregion@itu.int
Tel.: +41 22 730 5467
Fax: +41 22 730 5484

International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland

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