

## Meaningful school connectivity: An assessment of sustainable business models

Giga in collaboration with Boston Consulting Group (BCG)



### Foreword by Giga

As 2030 looms closer, work is still needed to address the digital divide. Half of the world's population has no regular access to the Internet. This lack of connectivity means exclusion, marked by the lack of access to the wealth of information available online, fewer resources to learn and to grow, and limited opportunities for the most vulnerable children and young people to achieve their full potential. It was with this mindset that ITU and UNICEF joined forces in 2019 to create Giga, a global initiative to connect every school to the Internet and every young person to information, opportunity, and choice.

In 2020, when the COVID-19 pandemic hit, the depth of the digital divide was exacerbated which further demonstrated how vital it was for countries to have reliable ICT networks and services. More than 90 per cent of children in 190 countries were affected by school closures, putting at risk the education of 1.6 billion students and deepening the already existing inequalities in access. Connectivity is increasingly considered "SDG Zero" – digital access is the railroad upon which quality education, youth empowerment, skills for employability, etc. can be brought to each and every community, thus preventing intergenerational poverty. Access to the internet accelerates the progress of many SDGs, in a similar way to how Giga feeds into several other initiatives led by UNICEF and ITU, such as Reimagine Education and the ILO-ITU Digital Skills for Jobs Campaign, to achieve their missions toward quality education (SDG4) and critical infrastructure (SDG9), among others.

We have been delighted to have the Boston Consulting Group (BCG) support Giga as a Knowledge Partner as we work to address the imbalance between services available to those who are connected, and those currently left behind by a connectivity gap. In this report, we explore potential sustainable funding models for school connectivity which will be a valuable resource for any national or municipal government looking to provide sustainable solutions. The analysis builds on previous Giga research (<u>Connecting the Dots</u>) and the experiences in Giga countries, as well as the contribution of a number of industry experts. We would also like to acknowledge the contribution of ACTUAL, a Giga knowledge partner whose jointly developed open-source mass customization model was used as a foundation for the business models developed in this report.

Utilizing Giga's 2024 target of a minimum connectivity speed of 10Mbps per school, this report explores six guidelines to help countries overcome the challenge of low levels of school connectivity in a sustainable manner. The research identifies 8 key operating models and suggests a roadmap for countries looking to roll out school connectivity.

With case studies already developed for several Giga priority countries, this work is a valuable tool for governments and other stakeholders to identify the most appropriate technical solutions and sustainable funding to deliver meaningful school connectivity.

We thank our partners and governments that are already part of Giga and look forward to welcoming many others in this unprecedented, ambitious effort to transform the world through education and technology.



MR. FAYAZ KING Deputy Executive Director, Field Results and Innovation UNICEF

Ms. DOREEN BOGDAN-MARTIN Director, Telecommunication

Development Bureau International Telecommunication Union



### Foreword by Boston Consulting Group (BCG)

The COVID-19 pandemic has changed education drastically all over the world. Half of all students globally are still affected by school closures with over 100 million more struggling to achieve reading proficiency. Students in high-income countries lost 53 instructional days on average, while those in lower-middle-income countries lost 115 days.

The pandemic has also revealed how digital technologies make the world more deeply interconnected and interdependent than ever before, but also more divided. The required overnight shift to remote teaching and learning, in education systems which were not digitally mature, has heightened learning inequality, increased student isolation, narrowed and privatized educational experiences, and homogenized teaching and learning.

To help close the Digital Divide, Boston Consulting Group (BCG) is proud to be the Knowledge Partner to Giga - the bold initiative of UNICEF and ITU that aims to connect every school to the internet and every young person to information, opportunity, and choice.

In this report, we present school connectivity operating models, unique to each country's typology, that hold the most promise for delivering digital infrastructure to schools. To ensure global, sustainable school connectivity, we've explored, on a country-level, connectivity configurations, operations, funding methods and the underpinning business models that can drive long-term, sustainable internet access in countries with the greatest need. By detailing test-cases for specific countries, we demonstrate how this framework can be impactfully applied to a country's individual context.

Long-term investment in delivering and operating critical digital infrastructures is foundational for unlocking the full potential of education. When carefully planned and adequately resourced, sustainable business models for connectivity can equip learners with independence and digital skills not only for education, but also for work and life.

We thank our partners in this effort to increase access to education and technologies that hold the potential to transform the wealth and wellbeing of countries around the world.

#### MR. FRANCK LUISADA

Managing Director & Senior Partner Global sector leader of telecommunications Boston Consulting group (BCG)

William



### BCG scope as Knowledge Partner to Giga

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"I'm proud that BCG is partnering with ITU to close the Digital Divide globally. Helping to accelerate Giga, UNICEF and ITU's co-operation to connect all schools, will be incredibly important in closing the digital divide. Every one of the 369 million young people<sup>1</sup> currently unable to access the Internet deserves information, opportunity and choice"

#### Rocio Lorenzo,

Managing Director and Partner, BCG

"I am pleased to welcome BCG to ITU and the Giga family as a Giga Knowledge Partner. BCG's expertise and long-standing record as a leading strategy advisor will help Giga optimize its country operating set-up and bring us closer to our vision of having every school and every child connected to the Internet"

**Doreen Bogdan Martin,** Director, ITU

### **ITU-BCG** partnership

Boston Consulting Group (BCG) and the International Telecommunication Union (ITU), the UN specialized agency for ICTs, have engaged in a global partnership to help close the digital divide through <u>Giga</u>, the bold initiative of UNICEF and ITU that aims to connect every school to the Internet and every young person to information, opportunity, and choice

#### Goal of BCG as a Knowledge Partner to Giga

As a Knowledge Partner of Giga, BCG has thus far helped to further develop school connectivity operating models, based on different country typologies, forming a basis for helping countries achieve universal connectivity. BCG has also helped identify enablers of success from top countries across key dimensions such as: financing; roles of public and private sector; government skills/capacity challenges; and synergies and economies of scale between the different efforts of Giga and other ITU programs in order to expand and scale connectivity solutions to additional countries. The operating models include how connectivity is configured, how it operates, and how the business models would work for the network so that it is sustainable. BCG also developed frameworks comparing the pros and cons of each operating model depending on the type of country involved.

BCG has conducted deep-dives on 5 countries to test the theory developed in practice by looking at: Brazil, Indonesia, Sierra Leone, Rwanda, and Honduras. In addition, BCG has briefly considered 2 other case studies: Nigeria & Kenya, to help the incumbent Giga country teams accelerate their efforts

#### Scope of BCG engagement

**Business model** in this case is defined an interlinkage of technology, operating model, funding structure, and cost structure that define the overall approach to the infrastructure deployment. More specifically, BCG focused on assessing sustainable business models, that is, one that can maintain itself indefinitely and is not dependent upon external (not-for-profit) grants and donations. What BCG has not considered at this stage when it comes to connecting schools globally is topics outside of infrastructure, e.g., teacher training and device strategies. Though imperative in reaching school connectivity, the focus of BCG's engagement thus far has not been on these topics

1. Over 3.7 billion people in the world do not have access to the Internet, of which 369 million are young people



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# Scope of report focuses on sustainable business models for infrastructure to reach school connectivity



#### Definitions

- Business model is defined as an interlinkage of technology, operating model, funding structure, and cost structure that define the overall approach to the infrastructure deployment
- A sustainable business model is one that can maintain itself indefinitely and is not dependent upon external (not-for-profit) grants and donations

#### **In-scope activities**

- Further develop school connectivity operating model, based on different country typologies, forming a basis for helping countries achieve universal connectivity
- Identify enablers of success from top countries across key dimensions such as: Financing; Roles of public and private sector; and Government skills/capacity challenges; and synergies and economies of scale
- Connect the dots between the different efforts of Giga and other ITU programmes in order to expand and scale connectivity solutions to additional countries
- Develop frameworks comparing the pros and cons of operating model depending on the type of country involved
- Apply frameworks to current active Giga countries as case studies including Brazil, Indonesia, Sierra Leone, Rwanda, Honduras, Nigeria and Kenya

#### **Out-of-scope activities**

• We have not considered topics outside of infrastructure, e.g., teacher training and device strategies–although, which are also imperative in reaching school connectivity



### We have conducted 40+ expert interviews & leveraged a variety of secondary sources to create this report



#### **Development banks**

- Head of division at African Develop. Bank
- Lead specialist at Interamerican Development Bank

#### Private companies and investment funds

- Partner at Blue like an Orange Sustainable Capital
- Director at CourseNetworking USA
- Head of division at Ericsson
- Member board of directors at Mawingu Networks
- Associate Director at Novartis
- VP at Qualcomm
- Director at Qualcomm
- Head of division at Qualcomm
- Sr. Director at Qualcomm
- Partner at SoftBank

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### How to read this document

FRAME & UNDERSTAND Chapter 1

- Familiarize yourself with the problem of low school connectivity in many parts of the world
- Gain an understanding of the specific reasons behind coverage and usage gaps in many emerging markets
- Grasp the criticality of improving school internet connectivity, in a sustainable way, for both educational and overall economic improvements
- Learn how business models can be used an important framework to solve the connectivity divide

#### **DIG DEEP** Chapter 2 and 3

- Dive into specific business model elements behind school connectivity (technology, cost structure, funding structure and operating model)
- Discover the parameters, drivers and key considerations that are crucial to setting up each business model elements
- Learn from real world case studies the challenges and key success factors for implementing school connectivity business models

ENGAGE Chapter 4

- Digest our recommendations for implementation, including a suggested roadmap through each phase of a project
- Discover how governments and other stakeholders can be actively engaged to ensure sustainable project success



## Report includes thorough case studies ...

This report touches upon the following topics for a set of countries:



Country & school overview



Connectivity status & developments



### Service provider landscape

1. For Nigeria we have provided an overview of the three above mentioned chapters (country & school overview; connectivity status & developments; and service provider landscape). For Kenya we have considered only "electricity as a business model" - one of the funding models considered in this report

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### ... for 7 countries in total, 5 in-depth & 2 light-touch



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### **Executive summary**

Over 3.7 billion people in the world do not have access to the Internet, of which 369 million are young people. As school internet connectivity and education quality are correlated, tackling this lack of connectivity helps in achieving **SDG 4 (QUALITY EDUCATION)**. Connectivity is a key driver of access to information, opportunity, and choice for young people, and of economic development and community wellbeing.

The lack of connectivity is attributable to both the **COVERAGE GAP** (affecting 7% of individuals worldwide) and the **USAGE GAP** (affecting 40% of individuals worldwide). This digital divide has become even wider during the COVID-19 pandemic, with not only students, but also wider communities being affected.

Specific causes of these gaps are country-dependent, and sustainable business models to connect schools are essential to bridge them. A **SUSTAINABLE BUSINESS MODEL** is one that can maintain itself indefinitely and is not dependent upon external (not-for-profit) grants and donations.

Business models as defined in this paper consist of the following elements:

- **TECHNOLOGY:** refers to the decision around the technology to be applied, balancing both the quality desired and the availability of funding.
- **COST STRUCTURE:** comprised of both upfront & ongoing expenditures, which are affected by regional characteristics, as well as by decisions made regarding technology, operating model and funding structure.
- **FUNDING STRUCTURE:** refers to the source of funding for the project of school connectivity, with various options emerging from the combination of

commercial, government and community-based funding.

• **OPERATING MODEL**: refers to the set-up to execute, build, operate and maintain the infrastructure, and varies in terms of the roles taken by different parties (e.g., government, communities, service providers).

#### Drawing from case studies conducted in this report, countries can improve low levels of school connectivity by following the next lessons:

- **OPTIMIZE LOCALLY:** Divide countries into homogeneous areas to find optimal funding models; this holds true especially for countries with large differences in GNIpc
- **COMBINE FUNDING MODELS:** Apply multiple funding models where possible to minimize funding gap; this holds true especially for developing countries where the funding gap is larger
- MERGE ELECTRIFICATION & CONNECTIVITY: Consider providing internet as well as electricity (and other utilities) for off-grid communities
- AFFORDABILITY IS KEY: Ensure schools (and communities) can sustainably pay for connectivity, so that long-term connections can be established
- NGOs EMPOWER COMMUNITIES: Whilst indefinite NGO funding is not sustainable, NGOs can play important roles of mentorship and training of communities, leading to long-term sustainability
- **REFORMS ENABLE SUSTAINABILITY:** Reforms are necessary in many countries to promote long-lasting transformation. This includes legal, cultural, and in the SP landscape



In the Connecting the Dots report (2021), Giga identified 86 thousand schools unconnected in the 17 countries mapped, which affect 25.8 M students and teachers

#### % Schools with internet speed >5 mbps<sup>1</sup>







86 thousand schools (11%) are currently unconnected in the 17 countries<sup>2</sup> mapped by Giga in the Connecting the Dots report



It will take US\$453M of upfront capital expenditure and US\$305M of annual operational expenditures to connect them



With sustainable funding, 25.8 M students and teachers will benefit from connectivity

## With a combination of sustainable funding business models, we can finance ~90% of costs required for school connectivity

For the five countries modeled<sup>1</sup>, 90% of costs could be covered by using commercial funding models<sup>2</sup>...

Annualized P&L for school connectivity in selected emerging countries<sup>1</sup> (USD M)





... Which extended to the 17 countries

1. Brazil (North and Northeast regions), Honduras, Indonesia, Rwanda and Sierra Leone; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



### Six guidelines can help countries overcome the challenge of low levels of school connectivity in a sustainable manner





Divide countries into homogeneous areas to find optimal funding models



Combine funding models



Merge electrification & connectivity

Apply multiple funding models where possible to minimize funding gap

Provide internet and electricity to increase revenues streams and share costs



Long-term affordability & demand stimulation



NGOs empower communities

Ensure schools (and communities) can sustainably pay for connectivity







Reforms enable sustainability



Reforms are necessary in many countries to promote long-lasting transformation



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# Large part of the world population is without internet connection, and schools are no exception

Large percentage of population with no access to the internet globally ...

Percentage of population not using the internet (%)



#### Source: ITU data, Giga school mapping, BCG analysis www.gigaconnect.org | info@gigaconnect.org

## ... which is reflected in school connectivity and needs to be tackled in a sustainable matter





# Lack of connectivity is attributable to both coverage & usage gaps, affecting 7% & 40% of individuals globally

## ~50% of the world's population is not using the internet...

Percentage of individuals using the Internet, by region and development status, 2019



- The African population (28%) is far below the world average (54%), in terms of % of individuals using the internet
- Individuals in developed countries are twice as likely to be internet users compared to those in emerging markets, and more than four times as likely compared to those in LDCs

LDC – lesser developed country Source: ITU (2019), World bank (2019, 2021), BCG analysis www.gigaconnect.org | info@gigaconnect.org

### ...driven by gaps in coverage & usage



# Specific causes of these gaps are country-dependent & include e.g., cost, computer ownership & electricity

#### Emerging markets face different sets of barriers



In Brazil, only 10% of the land area is covered with a 4G network, servicing 85% of the population. In hard-to-reach areas, e.g., parts of the Brazilian Amazon, internet connection is non-existent

Only 47% of the population uses internet, while coverage (at least 3G) is at 74%. This is driven by a low 55% electricity penetration, high illiteracy rates (38%) and poverty rates that are up to 80%

Honduras

1 × 1

Only larger cities are covered by 4G network, connecting 75% of the population but only a fraction of the land area. However, only ~41% uses a network, leaving a usage gap of about ~3M people



Though 95% of the land area is covered by a 4G network, only 9% of the population uses this network. This is mostly driven by the high cost of use, ~7% of GNI<sup>1</sup> per capita



Sierra Leone's mobile internet coverage is 86%, yet internet use is low at 17%. This is driven by only 23% of the population having access to electricity & the high cost at ~16% of GNI<sup>1</sup> per capita

## Even with available internet, low computer ownership poses an additional challenge

Percentage of households with Internet access at home and with a computer, 2019



Households with internet access at home

Households with a desktop computers, laptops or tablets<sup>2</sup>

1. GNI: Gross National Income; Source: ITU (2020), World bank (2019, 2021); 2. Data on mobile phones is insufficient to calculate regional aggregates. Source: BCG analysis

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# The digital divide is especially pressing for schools, where educational quality hinges on connectivity

The correlation between school internet connectivity and education quality is clear...

Education quality (learning-adjusted years of schooling)



#### ...and has been proven to lead to growth in GDP

- The recent Covid-pandemic has increased the need for internet connectivity, as the impact on learning outcomes in all countries, but especially in emerging markets, has become apparent
- By closing the digital divide, and thereby seeing an increase in education quality, individuals can find and keep employment and earn more over their lifetime
- On a country-wide level, a more skilled & productive labor force is created. This likely leads to an increase in GDP, increased consumer spending, increased number of jobs, and increased economic development
  - Schools can enable benefits not only for the students, but also for the wider community school serves as hub for connectivity
- Increasing education therefore allows for closing the gap between emerging and developed countries
- This positive reinforcing cycle only works if students receive good quality education uninterruptedly. In order to achieve this, sustainable business models to connect schools are required

"Countries with higher levels of internet connectivity in schools also tend to have higher average student performance levels on standardised tests. Expanding access to the internet in schools and embedding the use of technology in educational practices could equalise opportunities for students from an early age, with benefits that proliferate through childhood and adulthood."

The Economist in the Economist Intelligence Unit Connecting learners: Narrowing the educational divide

Source: World economic forum global competitiveness index, World bank human capital index, Economist Intelligence Unit report, BCG analysis www.gigaconnect.org | info@gigaconnect.org



## A 4-element business model framework is a useful approach for improving school connectivity

BUSINESS MODEL in this report is defined an interlinkage of technology, cost structure, funding structure, and operating model that define the overall approach to the infrastructure deployment



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4 interacting business model elements (technology, cost structure, funding structure & operating model) are key to school connectivity





### Summary Technology



Minimum internet speed defined to enable meaningful connectivity

Meaningful connectivity allows for skill development & safe navigation

Giga's target for meaningful connectivity for 2024 is set at 20 Mbps...

... Implying that some technologies are sufficient, whilst others must be excluded

Trade-offs exist between technologies and regional analysis is required

The consensus among ~30 experts interviewed was in favor of setting a minimum connection speed target to reach meaningful school connectivity

Meaningful school connectivity means fast, reliable & affordable access, allowing for skill development, ownership of a 'smart' device & ability for safe navigation



Giga's target for meaningful connectivity for 2024 is set at 20 Mbps per school, with an absolute minimum of 10 Mbps; a more nuanced recommendation is available in the deep-dive



To achieve the ~20 Mbps downloading speed target, a fiber, WISP, satellite, 5G or 4G connection is necessary. 2G & 3G are not sufficient to reach meaningful connectivity



Clear trade-offs exist between suitability of each technology in terms of capacity, latency, scaling, etc. with analysis of specific needs required before roll-out in specific regions



# Meaningful connectivity means fast, reliable & affordable access, allowing for skill development, ownership of a 'smart' device & ability for safe navigation

## Giga set a minimum bandwidth target to ensure meaningful connectivity for all students ...

The consensus among ~30 experts interviewed was in favor of setting a minimum connection speed target

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I do believe a minimum speed should be defined keeping in mind the real situation the countries have in terms of infrastructure deployment.

Lead specialist at Interamerican Development Bank

The minimum bandwidth needed to host an online cloud-based platform like ours, is 10 Mbps. It's very little. You can then open a document, read a document, take an assessment, give feedback, ask questions, and watch YouTube videos

Director at CourseNetworking USA

## ... which allows for skill development and ability for safe navigation



Target needs to change over time as technology develops

## Giga's target for meaningful connectivity for 2024 is set at 20 Mbps per school, with an absolute minimum of 10 Mbps



Level of detail	IN 20 Mbps per school •	SHORT: Giga's view on meaningful connectivity is to deliver a minimum of 10 Mbps per school, but Giga will advise on a target for 20 Mbps per school where reasonable	
	20 Mbps per school 1 Mbps per 20 students Monthly minimum of 100 GB	<ul> <li>NUANCED:</li> <li>Giga's view on meaningful connectivity is to deliver a minimum of 10 Mbps per school, but Giga will advise on a target for 20 Mbps per school where possible</li> <li>For larger schools, 1Mbps / 20 students is the target. This means ~15 Mbps for an average sized school of ~300 students</li> <li>The monthly minimum on data is 100 GB. Giga will advise on a target of 200 GB per month</li> </ul>	
	20 Mbps per school 1 Mbps per 20 students Monthly minimum of 100 GB Download speed of 20 Mbps Upload speed of 5 Mbps	<ul> <li>IN DETAIL:</li> <li>Target of 10 Mbps per school. Even in case of small schools, 10 Mbps should be minimum</li> <li>For larger schools, 1Mbps / 20 students is the target. This means ~15 Mbps for an average sized school of ~300 students</li> <li>The monthly minimum on data is 100 GB. Giga will advise on a target of 200 GB per month</li> <li>Giga's minimum download speed for meaningful connection is 10 Mbps with an upload speed of 2.5 Mbps. As a target. Giga will advise for double the minimum download speed</li> </ul>	





# Although the connectivity target is set at 20 Mbps, there is room to grow the target overtime – allowing for hybrid learning capabilities





## To achieve ~20 Mbps downloading speed, a fiber, WISP, satellite, 5G or 4G connection is necessary—2G & 3G are not sufficient

Fiber		Fiber: In terms of capacity, fiber's characteristics allow for strong performance vis-à-vis other connectivity methods, as it can support more than 10 Gbps. In addition, it has the lowest latency (11-14 ms). It is especially suitable for dense urban, urban, and long-haul applications, and may proof to be more expensive to extend to low-density areas. Scaling of local capacity is relatively easy with minor incremental updates required.
WISP		<b>Local WISP operated networks</b> : A wireless Internet service provider (WISP) allows subscribers to connect to a server at designated hot spots (access points) using a wireless connection such as Wi-Fi using a dedicated (high-speed) microwave backhaul connection to a fiber network which can be up to 25 km away. WISPs are important in closing the digital divide, as semi-rural and areas where fiber would expensive, can be easily addressed and serviced with, easy to install microwave radios. In addition, it the set-up can easily serve the community at affordable price levels in both rural and urban settings.
Sat		<b>Satellite:</b> Capacity of satellite is low to medium, with a maximum of up to 150 Mbps. Latency differs between satellite types, with GEO having a low latency at more than 500 ms, whereas LEO (e.g. Starlink) has a latency of 20-40 ms. Satellite systems can provide global coverage, or at least provide coverage to entire countries. Contrarily however, scaling of local capacity is very hard, requiring high density of satellites. Whereas GEO satellite has a wide, but fixed coverage, therefore not allowing well for the buildout of new areas, Starlink, once launched, has global coverage.
5G		5G: Capacity of 5G vs. 4G has increased substantially and can be about 20 times faster than 4G LTE. Latency times have been reduced further to <50 ms. Though still relatively infant, it relies on LTE technology. Coverage thus far remains relatively limited but can serve as a key technology for digital learning and connectivity.
4G		<b>4G:</b> Capacity of 4G is low to medium, with a maximum speed of up to 300 Mbps, though in practice, speeds of 100 Mbps are considered to be the maximum. With 4G, latency times have been reduced from 120 ms (3G) to 60 ms (4G), thereby providing low to medium latency. 4G is suitable for suburban and rural areas with the buildout of new areas preferably using mid and high bands. In terms of scalability of the solution, it is highly dependent on the spectrum available in the respective area.
3G	θ	Not sufficient for meaningful connection
2G	0	

Source: BCG experience re. technology capabilities. Notes: Satelite may be challenged for video-enabled due to cost for traffic. WISP will only work for Hybrid-ready for smaller schools/communities with up to ~300 students. www.gigaconnect.org | info@gigaconnect.org



## Clear trade-offs exist between suitability of each technology with functionality analysis needed before roll-out in regions

Characteristic		Teri	Satellite			
	Fiber	WISP	4G	5G	GEO	LEO (e.g., Starlink)
Capacity (speed)	Highest Can support >10 Gbps	Highest Can support >10 Gbps	<mark>Medium</mark> Maximum of 300 Mbps	High (mmWave) – too nascent to provide exact capacity	Low-Medium Generally, <50Mbps	Medium 50Mbps-150Mbps
Latency	Lowest 11-14 ms	Varies Depends on distance	<mark>Medium</mark> ~40 ms	Low (exact latency not yet fully known due to nascency)	High >500 ms	Low 20-40 ms
Most suitable at	Dense urban/urban, long-haul	Urban, rural, hard- to-reach areas	Suburban/rural (urban areas often suitable, but fiber may be preferred)	Suburban/rural (urban areas often suitable, but fiber may be preferred)	Entire countries/ regions covered with single GEO	System provides global coverage
Scaling of capacity <sup>1</sup>	Easy Minor incremental updates required	Easy Many microwave radios can be installed	Medium Spectrum limitations (however not for local scaling)	Medium Spectrum limitations (however not for local scaling)	Very hard, e.g., requires additional satellites	Very hard e.g., requires additional satellites
Buildout of new areas	Hard Expensive to extend to low-density areas	Medium Dependent on buildout of fiber termination points	<mark>Medium</mark> Mid-, high bands preferred	<mark>Medium</mark> Mid-, high bands preferred	Easy Global coverage in place	Easy Once launched LEOs have global coverage

1. Increased capacity per user, or more users added; Source: ITU, BCG analysis www.gigaconnect.org | info@gigaconnect.org



4 interacting business model elements (technology, cost structure, funding structure & operating model) are key to school connectivity



### Summary Cost structure



Technology, operating model & funding structure are key determinants of cost

Smaller school sizes present a greater challenge to widespread connectivity

Infrastructure availability and technology needs also greatly affect costs per school

Optimal technology should be determined with regional analysis

Number of schools unconnected stands as the main cost driver for countries



Cost structure of business model is influenced by choices made regarding technology, operating model and funding structure

School size varies substantially between countries, with smaller ones increasing considerably the investment required per student, given limited economies of scale



Fiber and satellite stand as most expensive solutions on an annualized basis (high capex for fiber; high opex for satellite), but also provide specific benefits over other technologies



Thorough assessment on regional basis is needed to determine the optimal technology to reach meaningful connectivity whilst closing the funding gap



Even though costs per school remain within similar magnitudes, countries require substantially different sizes of investment given different amounts of schools unconnected

### **Disclaimer | BCG and Giga do not take a view on which technology should be used and recommend to send out RFPs in a technology-agnostic manner**



The cost model presented in this section assumes a technology mix for school connectivity based on a set of assumptions. It is not a reflection of BCG/Giga's view on what the technology mix should be, but rather a reflection of what technologies could be currently used for "last-mile connectivity" of schools

- The cost model presented in this section follows that of the open-source model developed by ACTUAL and Giga, with additions of electricity and indirect costs estimated by BCG. The ACTUAL model focuses on "last-mile connectivity" and its outputs are the Capex and OPEX requirements to connect schools. It considers, for example, that schools that are close to fiber will be connected with it. Once the distance to a fiber node is increased, alternative technologies are considered
- In some countries, the expansion of the fiber backbone may be desired. The model, however, focuses specifically on last-mile connectivity.
- In sum, the model assumptions used do not imply we believe this is the only correct technology mix to be used (more options are possible). Rather, it serves as a suggestion for the technology mix and therefore as the input to the funding analyses. As RFPs would be sent out in a technology agnostic manner, real costs may be lower/higher vs. those modelled

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RFP
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BCG & Giga recommend to send out RFPs in a technology-agnostic manner, and therefore, the actual technology mixed used to connect schools may differ greatly from that as modeled in this section. Nevertheless, we believe that it provides a good high-level indication of what funding would be needed and how different countries compare to each other

- Whilst each technology has clear advantages and disadvantages to ensure meaningful connectivity for schools, BCG and Giga do not take a view on which technology is superior to the other
- Each technology has a clear cost-benefit trade-off and different strengths & weaknesses depending on the way in which it is used. As such, we recommend to always send out RFPs for school connectivity in a technology agnostic manner to ensure (commercial) parties optimize for the specific regional challenges
- The key objective in these RFPs should be meaningful connectivity at a cost that allows for sustainable (indefinite) connection for schools

Cost structure of business model is influenced by choices made regarding technology, operating model and funding structure



### Technology

- The target internet speed for schools is a key determinant of Capex and OPEX needs. Higher connection speeds allow for broader learning opportunities but can significantly drive costs up.
- The size of schools is also a key driver of costs smaller schools require lower speed targets, but also enjoy considerably lower economies of scale.
- The school connectivity starting point, its location and electricity access are also relevant technology determinants and cost drivers

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



### **Operating model**

- The type of party carrying operational responsibility is a key driver of costs. For example, in Brazil, large SPs can work together with a long tail of smaller 3rd party ISPs, who tend to operate at lower costs in specific regions
- The partnership model is another relevant cost determinant. For example, private sector involvement is generally correlated with better financial performance



### Funding structure

• The type of funding partners involved possess large influence on Capex and OPEX needs. For example, working together with in-depth experts, e.g., SPs, may provide lower costs due to higher scale advantages, whereas working with infrastructure investment funds could provide less of such benefits

### The three key determinants of the cost structure are driven by multiple factors

Dimension	School's values				
Technology					
Internet speed target	5-10 Mbps	10-20 Mbps	≥20 Mbps		
School size	Small (<200 students)	Medium (200-500 students)	Large (>500 students)		
Client groups	School only		Community		
Connectivity starting point	Above minimum (10 Mbps)	Yes, but too low (<10 Mbps)	No		Capex a
Electricity penetration	Yes, trustworthy	Yes, but not trustworthy	No		Орех
School remoteness	Remote	Rural	Urban		need
Operating model					
Operational responsibility	Telecommunications comp.	Local electricians	Service Providers		
Partnership model	Public	Public & private	Private		
Funding structure					
Funding partners	Government only	Community	Commercial	~~	

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



## **CAPEX** | Number of schools to be connected and type of technology are key drivers of CAPEX needs



Source: BCG analysis

1. Telco & (optional) electricity; 2. MNO/ISP & (optional) electricity; 3. E.g. Install 4/5G modem equipment and cabling to receive cellular signal and share internet connection via (W)LAN); 4. One-off technology costs

www.gigaconnect.org | info@gigaconnect.org



### **OPEX** | Number of schools to be connected, operation & maintenance cost, as well as ISP service fees are key driver of OPEX needs



1. Telco & (optional) electricity; 2. Telco & (optional) electricity; 3. One-off technology costs; 4. Not frequently provided by ISP www.gigaconnect.org | info@gigaconnect.org

# Smaller school sizes present a greater challenge to promoting widespread connectivity, as they lead to higher investments requirements per student



School size varies significantly between countries, with avg. school in Rwanda ~6x larger than in Honduras...

School size (avg. number of students per school)





... which affects considerably the investment required per student

Cost of school connectivity per student (USD)<sup>1</sup>



1. Including CAPEX, OPEX and Indirect Costs (estimated at 30% of total costs) Source: Giga data, BCG analysis www.gigaconnect.org | info@gigaconnect.org


## Investment requirements are also greatly affected by different technology needs of countries, with fiber having the largest impact on CAPEX costs



Countries have distinct technology needs to connect schools...



% of schools to be connected with each technology



... which leads to substantial cost differentials between them

#### One-off capex investment required per school (USD)



Disclaimer: The technology mixes presented are not a reflection of BCG/Giga's view on what they should be, but rather of what technologies could be used for "last-mile connectivity" of schools, based on the ACTUAL model.

Source: Giga data, BCG analysis

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## Thorough assessment on regional basis needed to determine the optimal technology to reach meaningful connectivity whilst closing the funding gap...

Whilst fiber has high upfront costs, it has low operational expenditure and long depreciation period, which equalizes its avg. annual costs to those of WISP; 4G remains as the most affordable technology to connect schools



1. Average of five countries: Brazil, Honduras, Indonesia, Rwanda, Sierra Leone; 2. Average for a 20-year period, assuming that capex must be reinvested with recurrence equal to the depreciation period (e.g., every 20 years for fiber) Source: Giga data, BCG analysis

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## ... Especially given that costs of technologies vary between countries

CAPEX requirements to connect one school with technology (USD)



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### CAPEX costs vary between countries since...



... Variable parameters (such as the average distance to network nodes) differ depending on infrastructure availability, country size or population density



... Labor, fees and hardware costs differ and cause smaller, but noticeable variations in Capex values

# OPEX accounts for the largest portion of annualized spend, but CAPEX represents a considerable one-off investment

Example of model for Sierra Leone



1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs Notes: P&L and Cash Flow Statement is simplified and only include cost side; capex depreciation periods of 20 years for Fiber, 4 years for WISP, 4G and Satellite and 10 years for solar roofs were considered. Source: ITU, BCG analysis

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#### In the end, the number of schools unconnected stands as the main cost driver for countries



Connectivity CAPEX 📃 Connectivity OPEX 🔜 Electricity CAPEX & OPEX 🔚 Indirect costs<sup>1</sup>

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; 2. Number of schools off-grid is also relevant in determining total costs, which explains differences in values. Source: ITU, BCG analysis

www.gigaconnect.org | info@gigaconnect.org



4 interacting business model elements (technology, cost structure, funding structure & operating model) are key to school connectivity



### Summary Funding structure

7 funding archetypes were identified, from which multiple models derive

Thinking in terms of archetypes allow for scalability & replicability of funding

Country-specific situations drive applicability of funding archetypes

Start with private sector funding and keep funding changes over time in mind



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- We have applied a set of archetypes to classify funding models. Seven archetypes were identified: three primary archetypes, and four secondary archetypes.
- The primary funding types are **commercial-provided**, **government-contributed**, and **community-based**.
- A combination of these models lead to secondary archetypes: **PPPs, Community Connectivity Council, Co-Co Collaboration**, and **Full Ecosystem**
- Thinking in archetypes helps in recognizing patterns between countries and can serve as a means for gaining insight into the underlying structures of a country that lead to a particularly suitable funding model. This allows for more scalability & replicability.
- **Commercial-provided models** are common when higher potential returns are possible for MNOs/ISPs
- **Government-contributed models** are possible with government willingness and investment capacity (e.g., manageable debt levels)
- **Community-based models** are possible when regulation allows for it and more likely to succeed when there is a closely-knit community sense. Most common when there's demand for internet but private parties are not interested to serve
- Experts suggest to start with private sector funding, which reduces the total amount required from government funding and/or community funding
- Most developed countries rely (almost) solely on private sector funding
- In emerging countries, private sector involvement is likely to be low in initial phases, as this phase is riskier than later in the operational phase



#### Seven country archetypes arise based on funding opportunities

Note: If a country is <10% dependent on a certain type of funding, it's recommended to disregard this funding type in classifying its archetype. In addition, a costbenefit analysis should be conducted, as complexity is added when adding an additional funding type

1. Development finance institution (DFI) and Multilateral development bank (MDB), e.g., World Bank, African Development Bank, etc.

Source: Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org 3 primary archetypes (commercial-provided, government-contributed and community-based) and 4 secondary archetypes were identified:



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# **Primary archetypes—comparison** | country-specific situation drives applicability of specific funding archetypes

	Commercial-provided	Government-contributed	Community-based
Description of likely characteristics	<ul> <li>Higher potential returns for MNOs/ISPs</li> <li>Higher GDP community</li> <li>Lower cost of infrastructure roll-out (lower labor costs, easier landscape or climate)</li> <li>Lower expected cost of OpEx vs. potential revenue generated</li> <li>More transparent &amp; lower risk government policy</li> <li>Supportive government framework</li> </ul>	<ul> <li>Reasonable government debt levels and allocated budget</li> <li>Lower potential returns for MNOs/ISPs</li> <li>Lower GDP of community</li> <li>Higher cost of infrastructure roll-out</li> <li>Higher expected cost of OpEx vs. rev.</li> <li>Private sector unable to meet demand (e.g., due to monopoly)</li> </ul>	<ul> <li>High demand for internet services, however relatively lower opportunity for MNO/ISP returns and absence of existing connectivity providers</li> <li>Enough available spectrum that can be used without a license</li> <li>Spectrum licensing framework that supports communities</li> <li>Local knowledge / ability to install, maintain &amp; operate networks</li> <li>Closely-knit community sense</li> </ul>
Successful examples of countries	<ul> <li>Wide variety of nations, including but not limited to: UK, France, Italy, South Africa, Germany, USA, etc.</li> <li>Image: Image: Im</li></ul>	The Australian government has provided funds on a competitive basis to carriers to address broadband and mobile telephone blackspots and gaps in service provision     The address broadband and mobile telephone blackspots     and gaps in service provision     The address broadband and mobile telephone     blackspots     and gaps in service provision     The address broadband and mobile telephone     blackspots     and gaps in service provision     The address broadband and mobile telephone     blackspots     and gaps in service provision     the address broadband and mobile telephone     blackspots     and gaps in service provision     the address broadband and mobile telephone     blackspots     and gaps in service provision     the address broadband and mobile telephone     blackspots     address broadband and mobile telephone     blackspots     and gaps in service provision     the address broadband and mobile telephone     blackspots     and gaps in service provision     the address broadband and mobile telephone     blackspots     address broadband and mobile telephone     address     address broadband and mobile telephone     blackspots     address     address broadband and mobile telephone     address     addr	<ul> <li>Despite potential for addressing connectivity needs there are still few community networks in emerging markets. The primary constraint is the lack of conducive regulatory environments in most countries</li> <li>South Africa has successfully set-up several community-led initiatives, though the majority is still provided by commercial parties</li> <li>Another successful, large-scale project, is Guifi in Spain</li> </ul>

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# **Primary archetypes—Government** | Country-specific situation drives applicability of specific funding archetypes

	Government-contributed
Description of likely characteristics	<ul> <li>Reasonable government debt levels &amp; allocated budget: Government has to be able to pay for connectivity</li> <li>Lower potential returns for MNOs/ISPs: Commercial involvement would be preferred choice to reduce pie of funding required to be paid for by government</li> <li>Lower GDP of community: Often correlated with no involvement of MNO/ISPs</li> <li>Higher cost of infrastructure roll-out and/or OpEx vs. potential revenues: Often correlated with no involvement of MNO/ISPs; relevant particularly in more rural areas</li> <li>Private sector unable to meet demand: May happen in case of monopoly/duopoly and unwillingness to cooperate or lack of skills</li> </ul>
Successful examples of countries	<ul> <li>The Australian government has set up a Mobile Black Spot Program</li> <li>This program provides funds on a competitive basis to carriers to address broadband and mobile telephone blackspots and gaps in service provision</li> <li>The program is focused on areas where communities benefit most, such as economic centres, emergency service facilities, health clinics, schools, indigenous community centers, and local government sites</li> <li>The Government has committed \$380 million to the Mobile Black Spot Program to invest in telecommunications infrastructure to improve mobile coverage and competition across Australia</li> <li>Investment resulted in \$836 million in investments through co-contributions from local state territory governments of mobile network operators, and community organizations and led to installment of 1,200 new base stations across Australia</li> </ul>

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# **Primary archetypes—Commercial** | Country-specific situation drives applicability of specific funding archetypes

	Commercial-provided	
000	<ul> <li>Higher potential returns for MNOs/ISPs: Which ensures the market is attractive for commercial firms to be involved</li> <li>Higher GDP community: Community can pay for connectivity either directly or indirectly</li> <li>Lower cost of infrastructure roll-out (lower labor costs, easier landscape or climate): To ensure initial costs can be contained</li> <li>Lower expected cost of OpEx vs. potential revenue generated: To keep running costs low</li> <li>More transparent &amp; lower risk government policy: Risk-return has to be in line with MNO/ISP expectations</li> </ul>	
Description of likely characteristics	Supportive government framework That allows for commercial involvement without insurmountable entry barriers	
Most common model of providing internet connectivity. There's a wide variety of nations that can serve as an example, including but not limited to: UK, France, Italy, South Africa, Germany, and USA		
Successful examples of countries	"Funding telecommunications infrastructure through private equity or debt is overwhelmingly the most typical case in well- functioning markets. However, where the business cases are built on a narrower basis of profit opportunity, private funding may be problematic. In these cases, the government and communities, which tend to have different assessments of risk and required return than private investors, may have a role to play." World Bank	
	Innovative Business Models for Expanding Fiber-Optic Networks and Closing the Access Gap	

### **Commercial-provided archetype | Wide range of potential private** investors that can be involved in funding meaningful school connectivity



1. Technology becoming increasingly less complex. Requirement of local knowledge who can solve 1st line problems Source: Expert interviews, BCG analysis

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### Deep-dive on commercial — direct funding | Several potential partnership models can be explored

Example of partnership	Example by experts
Long-term contract for service with mixed portfolios	If you go line by line, certain bits will always remain uneconomic. Maybe you could create a portfolio of investments. One subsidizes another. If you let them cherry pick, you'll need charitable intervention Head of division at African Development Bank
Adding % of connected population as part of license (Brazil)	Brazil is an interesting case. They said: okay you get the license, but you have certain built-out conditions. In 4G the licensee was required to cover 85% of the population within 3 years. They met their overall 85% coverage, but half the rural areas have no coverage at all. When they issue 5G license then they'll require 100% Lead at World Bank
Gov't co-invests alongside service provider	To me it's about making sure infrastructure is there. Once it's there, it's in the best interest of the private sector to reach out to schools & communities in such a way that it's more sustainable <b>Lead specialist at Interamerican Development Bank</b>
Provide access to current infrastructure	<sup>CC</sup> Infra funds are interesting, particularly if you have models where you can leverage existing infrastructure. You add all gov't infrastructure and fiber into a SPV to attract new equity to finance the further build out. Head of division at African Development Bank
Guarantees vs. USFs (Rwanda)	<sup>CC</sup> There's also places where you have a government that's undisciplined in its spending and its willingness to cooperate. There, you need to think of guarantees. Head of division at African Development Bank
Bidding process with minimum subsidy amount (Paraguay)	We allow the government to launch bidding so that telcos can provide most efficient way using a minimum subsidy. They need to indicate minimum subsidy needed from government. It's the model we've followed in Paraguay, and will follow in Guatemala, Honduras, Dominican Republic <b>Lead specialist at Interamerican Development Bank</b>
Source: Expert interviews, BCG analysis www.gigaconnect.org   info@gigaconnect.org	48 <b>June 2</b> 48 <b>June 2</b> 48 <b>June 2</b> 48

### **Primary archetypes—Communities | Country-specific situation drives** applicability of specific funding archetypes

	Community-based		
Description of likely characteristics	<ul> <li>High demand for internet services: To ensure there's an incentive for community-based internet connectivity</li> <li>Relatively lower opportunity for MNO/ISP returns &amp; therefore absence of existing connectivity providers: Community-based networking initiatives are more likely to exist in the absence of alternatives</li> <li>Enough available spectrum that can be used without a license: To ensure a high quality service, e.g., Wi-Fi</li> <li>Spectrum licensing framework that supports communities: To ensure legal guidelines are in line with community networks</li> <li>Local knowledge / ability to install, maintain &amp; operate networks: In order to ensure that the network can be set up, but can also be fixed / maintained when needed</li> <li>Closely-knit community sense: So that there's an incentive to help the wider community &amp; ability to take leadership</li> </ul>		
<b>EVALUATE:</b> Constant of countries	<ul> <li>Despite potential for addressing connectivity needs there are still few community networks in emerging markets. The primary constraint is the lack of conducive regulatory environments in most countries</li> <li>South Africa has successfully set up several community-led initiatives, though most of the the country's connectivity is still provided by commercial parties. One example is the Zenzeleni Network in South Africa. Zenzeleni (which means "Do it yourself" in Xhosa) is a community-owned wireless internet service provider based in rural South Africa. Its model aims to significantly cut costs of telecommunications, retain expenditure within communities as a form of social entrepreneurship, and support the development of a rural digital ecosystem towards bridging the digital divide</li> <li>Other small community networks can be found in countries like Zambia and Mexico</li> <li>Another successful, large-scale project, is Guifi in Spain. Guifi.net is a free, open and neutral, mostly wireless community network, with over 35,000 active nodes and about 63,000 km of wireless links.</li> </ul>		



# **Community-based archetype** | Zenzeleni Community Networks built a successful community-based model in rural South Africa

Zenzeleni (which means "Do it yourself" in Xhosa) is a South African community network through which rural communities have ownership of their telecommunication businesses, allowing them to maximize value and benefits.

In Zenzeleni, community members set up and maintain solar powered mesh network stations at a fraction of the cost offered by traditional operators, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses.



History

Zenzeleni Community Networks was created by the University of the Western Cape in partnership with the Mankosi community, in one of the most disadvantaged areas of the Eastern Cape, South Africa. Following the success of Zenzeleni Makosi, the community network has expanded both geographically, e.g., to the village of Zithulele, and in scope, mentoring other communities.



#### Funding model

Zenzeleni generates revenues by two means:

- Community hotspots: Community can access internet by purchasing a Zenzeleni data voucher which grants access to public internet hotspots.
- Dedicated access points: Dedicated access points for specific locations (e.g., home, business or organization), which is billed at a flat access monthly cost.

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#### **Operating model-**

Zenzeleni is comprised of two key actors:

- Zenzeleni Cooperatives are the internet service providers. Cooperative members are chosen by the community and their role is to own, govern, operate and maintain the network within their respective communities.
- Zenzeleni non-profit company supports communities in seeding new cooperatives guiding and training them to design and register their business. It also supports existing cooperatives by administering the common network, mentoring their operations and offering expert support.

Source: Zenzeleni website, Zenzeleni materials, expert interview with C-suite executive of Zenzeleni, press search, BCG analysis www.gigaconnect.org | info@gigaconnect.org



#### **Community-based archetype** | Guifi.net is a free, open, and neutral, mostly wireless community network, with >35k nodes and ~63k km of wireless links

History

- Guifi.net began in 2004 as a telecommunications technology project in the Osona region (Spain) to solve the difficulties of broadband Internet access in rural areas, given the lack of interest of traditional operators to provide service.
- Whereas Guifi.net started out using WiFi radio links only, community members began deploying common fiber optics

#### **Funding model**

- The governance tools of the commons network state that operators, when carrying out their activity through Guifi.net must allocate a part of the fees that they charge for towards activities like maintenance, updates, and development of the network
- Guifi.net's cost-sharing mechanism of the external connectivity, which comprises an equal membership fee for each participant plus a proportional distribution of the remaining costs according to the resource consumption, yields a cost assignment

#### **Operating model-**

- Even though community networks can be somewhat fragile due to the problem of free riding (tragedy of the commons), succession, and volunteering supply, Guifi.net has set up a clear stakeholder & governance architecture, thereby finding a good way to address these challenges.
- The guifi.net community has five main stakeholder groups according to their roles in the ecosystem and their motivations for participating in it: the volunteers, the governing bodies, the professionals, the customers, and the public administrations. These are non-profit, for-profit, and public interest groups
- One of Guifi.net's major contributions to community networks is having shown the possibility of building and operating a network infrastructure that is conceived as an open Common Pool Resource with the participation of for-profit companies and governments in addition to volunteers and beneficiaries

Source: Guifi.net, expert interviews with co-founder & employee of Guifi.net, BCG analysis www.gigaconnect.org | info@gigaconnect.org



### Various operating models derive from the archetypes identified

Archetype	Operating model	Key considerations	
Government-	1a Additional budget from education department	Structural increase in budget per student must be feasible & sustainable in the long-term	
contributed	<b>1b</b> Budget/contributions from other ministries (e.g., infrastructure, ICT, or energy)	<ul> <li>Structural increase in budget per student must be feasible &amp; sustainable in the long-term</li> <li>Question regarding willingness of other ministries to contribute specifically to school connectivity</li> </ul>	
	1c Savings from other budget lines	• Willingness to leverage savings for school connectivity (e.g., USFs often not used for this purpose)	
Community-based	2a Increased school fees	Ability & willingness of parents and/or communities to increase school fees	
	2b Community contribution	<ul> <li>Practical considerations such as billings (e.g., scratch cards)</li> <li>Ability &amp; willingness of communities to pay for internet, as well as alternatives available that are more convenient (no need to travel to school location)</li> <li>Implication on relationship with MNOs/ISPs</li> </ul>	
Co-co collaboration or PPP	3a Service fees (non-school): Projections that growth in consumer demand for connectivity will recoup costs of investments in backbone	<ul> <li>Projections in growth of consumer demand will have to be projected accurately</li> <li>Willingness of an investor / MNO to take on demand-side risk</li> </ul>	
	3b Local and regional business growth (tax revenue-linked financing): Increases in profits/GDP for local business, start-ups & individuals due to connectivity	<ul> <li>Not yet applied in practice on large scale (as far as we know)</li> <li>Long discussions about monetization terms &amp; conditions, as well as calculations to be made</li> <li>Willingness of an investor / MNO to take on demand-side risk</li> </ul>	
Public-Private	4a PPP with MNO/commercial business models	• Willingness of private players to collaborate, linked to the commercial value provided to MNOs	
Partnership	4b Mandated cross-subsidization	(lower capex, higher data use, better coverage leading to	
	4c Regulated advertisements	<ul> <li>Operational models that are most suitable for optimal collaboration</li> </ul>	
	4d Fine system	Costs to community by including private sector involvement	





The decision tree below is non-exhaustive. More direct & indirect funding methods exist

# Long-term sustainability of funding method depends on ability to monetize internet access & receive government funding



1. Internet access available, but not affordable for school; 2. Internet access available, but only partially affordable for school; 3. No internet access today Source: Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org |

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# Experts suggest to start with private sector funding, which reduces the total amount required from government funding

The private sector is an important element in funding Giga projects ...

"I think we have to start with a presumption that it's private and work from there. Public, historically, has been difficult for telecom, especially in highly restrictive markets"

Head of division at African Development Bank

"It is important to engage with the private sector early. Developing a financing package, which works for everyone, collaboratively as it moves along should help for a more efficient outcome ultimately."

Partner at Blue Like an Orange Sustainable Capital

1. Representing separate organizations Source: Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org ... however, the private sector is unlikely to provide enough capital for connectivity ...

"Government should not rely on the private sector to solve all connectivity issues. They need to understand, likewise to the energy sector, that there's a specific role for them [gov't]"

Lead specialist at Interamerican Development Bank

"Gov't involvement is key. At the end of the day, we're a company. The way to make it sustainable is if the government can pick it up too and work in an integrated & holistic approach with us"

**VP at Qualcomm** 

...which can be complemented predominantly by public sector funding

"The key is that you need to have strong support by the government. Not only politically and will, but also financial support. It has to become a part of government's annual budget"

Lead at World Bank

"The government has to play a very, very big role. Private sector involvement is important as well, but the government needs to take lead"

#### **Director at CourseNetworking USA**



### Involvement of type of funding likely to change over time, with initial phase being more risky than operational phase



Note: Some long-horizon commercial companies exist that could finance full project duration, e.g., development banks/impact funds, but refinancing after initial capex phase could be required; Source: World Bank, expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org

"The roles of the public and private sector may change over time as well with, for example, the government playing an initial role to design, construct, and operate until such time as the market opportunity clarifies and then commercializing the entity. Conversely, the private sector may initially build and operate the network before transferring to the public sector."

#### World Bank

Innovative Business Models for Expanding Fiber-Optic Networks and Closing the Access Gap

"You need to create a financial model first. How long will the project take? What is the capex/ opex, revenue, etc.? What is the cash flow? Once you know that, it's clearer what money can fund that period. Alternatively, you can bring in capital at different phases. There will be some refinancing risk, but there are ways to mitigate some of that. There's early-stage investment, and then the operational phase, where you should be able can point to a lower risk at that point. There's then greater visibility on revenue"

Partner at Blue like an Orange Sustainable Capital 4 interacting business model elements (technology, cost structure, funding structure and operating model) are key to school connectivity





### Summary Operating model



Eight operating models for school connectivity were identified



Operating models can be community, government or commercially-focused, with a wide variety of options for Public Private Partnerships

Country-specific situations drive applicability of operating model



Operating models vary in terms of the roles taken by the different parties, with clear advantages of some models in specific contexts

PPP typically structured via Special Purpose Vehicle or Joint Venture



The most typical ways to structure PPP projects are via SPVs or JVs, where the latter is more attractive in case government stays actively involved

Working together with NRENs may be an interesting operating model



NRENs have several attractive features as an operating model in countries with wellconnected NRENs



### We have identified eight key operating models, with a wide variety of options for Public Private Partnerships

Non-exhaustive



Note: If a country is <10% dependent on a certain type of funding, it's recommended to disregard this funding type in classifying its archetype. In addition, a cost-benefit analysis should be conducted, as complexity is added when adding an additional funding type 1. Development finance institution (DFI) and Multilateral development bank (MDB), e.g., World Bank, African Development Bank, etc. Source: Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org |



# The eight operating models vary in terms of the roles taken by private and public parties ...

Private-focused	Model	Description	Examples
	Private company or consortium	Management option that is frequently used in developed countries, in which one or several private companies are involved in the roll-out and operation of the infrastructure to connect schools	<ul> <li>BoFiNet (Botswana)</li> <li>ALTÁN Consortium (Mexico)</li> <li>Eassy.org (South Africa)</li> </ul>
	Concession	A concession agreement gives a private company the right to operate a specific business within a government's jurisdiction or on another firm's property, subject to particular terms. Under a concession, the private contractor may fund the infrastructure itself	<ul> <li>Red Compartida project (Mexico)</li> <li>Peru RNDFO (Peru)</li> <li>Chorus UFB (New Zealand)</li> </ul>
	Lease	An operating lease is a contract that allows private parties to use the infrastructure owned by the government, but does not convey ownership rights of the asset. The operating expenses are paid for by the contractor, which also receives all revenues	
	Turnkey	Turnkey is a contract under which a private party fully designs and implements the project. The telecommunications infrastructure would be ready-to-use on the handover to either government or another private sector company	<ul> <li>Magellan Advisors (Colorado, USA)</li> <li>ZTE (Spain)</li> <li>Even Telecom (Mexico)</li> </ul>
	Contract	Government uses one or multiple different contractors for specific activities of the deployment or operation of the infrastructure and assumes a managing/control role	<ul> <li>KT Rwanda Networks (Rwanda)</li> <li>Alcatel Submarine Networks (France)</li> </ul>
Government- focused	State/government	The government can run the management of the infrastructure as a public service. This could be the case in countries that have monopolistic state-owned telecommunication companies, or in countries where there's no interest from private parties to participate	<ul> <li>Cable Consortium of Liberia (Liberia)</li> <li>Burundi Backbone System (Burundi)</li> <li>Gamtel (Gambia)</li> </ul>

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### ... With different responsibilities assumed by them

Model	Main variants	Ownership of capital assets	Responsibility of investment	Assumption of risk	Duration of contract
Private company or consortium	<ul> <li>Build-Operate-Own (BOO)</li> <li>Design-Build-Finance-Operate (DBFO)</li> </ul>				Indefinite
Concession <sup>1</sup>	<ul><li>Franchise</li><li>Build-Operate-Transfer (BOT)</li></ul>				3–7 years
Lease <sup>1</sup>	<ul><li>Build-lease-transfer (BLT)</li><li>Lease</li></ul>				3–20 years
Turnkey <sup>1</sup>	• Turnkey	•			1-3 years
Contract <sup>1</sup>	<ul><li>Outsourcing</li><li>Maintenance/operational management</li></ul>				1-5 years
State/government	<ul> <li>Public Design-Build Operate (DBO)</li> </ul>				Indefinite
		Public	Priva	te	Private/public

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1. Can also be between two private parties, however, focus here is on PPP; Source: World Bank, Investopedia, UNESCAP, expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org

#### Each management option has its own distinct pros and cons

Model





Private company or consortium	<ul> <li>Known for fast roll-out</li> <li>Better financials (both management of costs, and optimization of revenues)</li> <li>Long-term sustainability in case of profitability</li> </ul>	<ul> <li>Very common in developed markets, but demand could potentially be lower in several emerging countries</li> <li>Only works in markets where there is demand and an ability to pay</li> </ul>
Concession	<ul> <li>Private sector tends to operate and manage the commercial network better vis-à-vis states/governments</li> <li>Private sector bears a significant amount of the risk</li> <li>Flexibility of counterpart in case of disappointing results in terms of service delivered</li> </ul>	<ul> <li>Negotiations between parties can take a long time</li> <li>Contingent liabilities to the government remain</li> <li>Complex to implement and administer</li> </ul>
Lease	<ul> <li>Can be implemented relatively quickly</li> <li>Significant private investment possible in case longer-term agreements are chosen (divergence in timing of 3-20 years in general)</li> </ul>	<ul> <li>Little incentive for private sector to invest</li> <li>Risks remain with the public sector</li> <li>Government has to build infrastructure or has to have infrastructure in place already</li> <li>Regulatory oversight required</li> </ul>
Turnkey	<ul> <li>Owing to the fact that the contractor or developer gets paid only on project completion, there's an incentive to finish the job swiftly and efficiently</li> <li>As all constructions decisions are the responsibility of the builder or developer, inexperienced owners are saved from having to make decisions on complicated construction matters</li> <li>Easier to manage/coordinate (one invoice)</li> </ul>	<ul> <li>Risks are with the public sector/private buyer, besides in construction phase</li> <li>For operation, the right capabilities need to be contracted, or built inside the government/3<sup>rd</sup> party buyer</li> </ul>
Contract	<ul> <li>Can be implemented relatively quickly</li> <li>Least complex in terms of PPP categories</li> <li>Government can ensure quality of telecommunication infrastructure</li> </ul>	<ul> <li>Efficiency gains may be limited with little incentive for private party to invest</li> <li>Annual costs for government may be relatively high due to shorter time frames</li> <li>All risks remain with the public sector</li> </ul>
State/government	<ul> <li>No need for profit margins. Therefore, in theory, service can be more affordable, and the subsidy from the public can be lower</li> <li>Only incentive (in theory) is to connect schools to the internet</li> </ul>	<ul> <li>Many examples (e.g., Rwandan NBFON, Oman Broadband Company, and Australian NBN) have not lived up to expectations</li> <li>Generally, has a longer roll-out period and is run less efficiently</li> </ul>

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# PPP typically structured via Special Purpose Vehicle (SPV) or Joint Venture (JV), where the latter is more attractive in case government stays actively involved

SPV

 $\mathbf{J}\mathbf{V}^{1}$ 

(PPP)

Public Private Partnerships (PPP) can be structured via several methods...



...The most typical ways to structure PPP projects are via Special Purpose Vehicles (SPV) or Joint Ventures (JV)

- A Special Purpose Vehicle is a distinct legal entity that has been established to separate the telecommunication infrastructure from a corporations or government agencies. In this way, there's fully integrated cooperation between stakeholders that carry ownership in and responsibility for the operations of the SPV
- A separate legal status is formed to mitigate financial risk or isolate financial risk for both the private party and the government
- In an SPV, all there can be a wide divergence between funding and/or operational responsibilities of the parties involved
- A Joint Venture is a symbiotic business alliance whereby complimentary resources are mutually shared
- It is often used in case the government wants to ensure a continued interest in the mgmt. and operations of the telecommunication infrastructure
- A JV is easier to incorporate in the parent company, once the private company is ready to take over full ownership and buy-out the government (if applicable)



# Working together with NRENs may be an interesting operating model, especially as they increasingly connect primary and secondary schools

Approximately 50% of EU-based NRENs already connect primary and secondary schools—mirroring public founding and funding<sup>1</sup>

Percentage of EU NRENs connecting<sup>2</sup> different user types (%)



NRENs have several attractive features as an operating model in countries with wellconnected NRENs

- High-quality inter and intranet, given NRENs' primary focus of providing universities and research institutes with best-in-class connectivity
- Scale benefits, especially in locations where universities and research institutions are situated
- High level of public funding (e.g., by national gov't, EU) well-aligned with public initiative to improve primary and secondary education
- Besides as an operating model, NRENs can serve as important enables and/or partners in rolling out school connectivity, due to their experience, expertise, existing backhaul, reputation, etc.

1. NREN (National Research and Education Network) organizations are specialized internet service providers dedicated to supporting the needs of the research and education communities within their own country; 2. Numbers don't add up to 100%. Likely because this information was gathered in a survey by Geant and therefore not all respondents may have filled in an answer Source: GEANT, RNP, BCG analysis



#### Government and market assessments identify the ideal operating model(s)



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### Six guidelines can help countries overcome the challenge of low levels of school connectivity in a sustainable manner



**Optimize locally** 



Divide countries into homogeneous areas to find optimal funding models



Combine funding models



Merge electrification & connectivity

Apply multiple funding models where possible to minimize funding gap



Long-term affordability & demand stimulation



Provide internet and electricity to increase revenues streams and share costs



NGOs empower communities





NGOs play important roles of mentorship and training of communities



Reforms enable sustainability



Reforms are necessary in many countries to promote long-lasting transformation



### Key findings across country of focus show some common challenges

Learning		Description	Examples of applicable countries <sup>1</sup>
	Optimize locally	Even though equality is important, regional differences prohibit a unified approach across countries. Optimal business models can only be identified once local characteristics are considered, with no "one-size- fits-all" solution existent	<ul> <li>Urban-rural division in Rwanda and Sierra Leone</li> <li>North/Northeast vs. other regions in Brazil</li> <li>Province division in Honduras and Indonesia</li> <li>South, central and north belts in Nigeria</li> </ul>
×	Combine funding models	A combination of funding models is needed in most countries, since single solutions usually are not capable of providing enough funding in areas with low commercial opportunity. To that extend, the government must play a key role in financing the "funding gap". Besides this, anchor clients stand as a good option to provide stable revenues and thus decrease risk.	<ul> <li>This applies to all countries that experience a funding gap when using private-sector only funding</li> </ul>
<u></u>	Merge electrification & connectivity	Electrification is still an issue in many countries and is required for connectivity. Merging internet and electricity offers provides additional revenue streams and allows for cost-sharing, with electricity as a business model being an adequate solution for the areas that lack electricity. However, additional costs will be required (e.g., one-off and ongoing costs of solar panels)	• Model relevant in off-grid areas of Honduras, Kenya, Nigeria, Rwanda and Sierra Leone
<i>•</i>	L-T affordability & demand stimulation	Affordability is key across all countries. Any implementation of funding model needs to ensure schools (and communities) can sustainably pay for connectivity in the long-term, which also required demand stimulation to increase sustainable contribution over time	<ul> <li>Honduras, Kenya, Rwanda and Sierra Leone have internet prices above ITU's recommended level for affordable connectivity (2% of GNI per capita)</li> <li>Prices in Brazil, Indonesia and Nigeria are below ITU's recommendation, but given inequality, internet is currently unaffordable to many</li> </ul>
	NGOs empower communities	In community contribution models, NGOs can play an important role of mentoring and training communities to set-up and maintain the infrastructure.	<ul> <li>Community contribution models could be relevant in specific areas of all countries analyzed</li> </ul>
× 2 ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	Reforms enable sustainability	Long-term reforms are needed in countries where, for example, excessive regulation and taxation hinders the development of widespread connectivity. Governments' support in implementing funding models is also key. For example, Zenzeleni Community Networks became possible in South Africa with the exemption of operation fees.	<ul> <li>Funding models such as tax revenue-linked financing, tax exemptions, 5G auctions etc. require government support in countries like Rwanda, Honduras and Brazil</li> <li>In Nigeria, regulatory asymmetries between states hinders the deployment of country-wide broadband infrastructure</li> </ul>



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### Roadmap for rolling out school connectivity in a country is an iterative 5step process with frequent government touchpoints



- The suggested roadmap for rolling out school connectivity in a country is an iterative 5-step process
- Governments and state-actors play a leading role in setting the conditions for sustainable and equitable provision of digital education and should therefore be involved from the start, even if no funds will be provided
- Designing and implementing the business plan is an iterative process, and the conclusions should be continuously refined and improved upon based on the data and feedback collected





# The suggested road map for rolling out school connectivity begins with framing the initiative—target-setting & understanding potential barriers & facilitators



"Having a clear and early commitment to connecting a certain number of schools is fundamental. By setting a clear target, you create an impetus to get started, which is felt by all stakeholders."

#### Head of division at African Development Bank

#### Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

#### A. Frame the initiative

The first step is target-setting. This entails understanding the number of schools without a sufficient internet connection at present, and then setting a target number of schools the project aims to connect. Corralling stakeholders behind this overarching vision of the project and the strategy to get it accomplished are critical.

It is also important in this phase to identify the legislative and/or policy facilitators and barriers to the project that are currently in place. For example, a USF fund might not be available in some countries, so alternatives will need to be found. After understanding the "as is" picture, the national government must be aligned to ensure any present and future boundaries and facilitators are accounted for and that the targets are in line with government policies.

**Example outputs**: Selection criteria of which schools to connect; names of key organizations in driver seat; overview of key legal & policy barriers in place; government alignment with project



# After "Framing", the technological features that will enable meaningful school connectivity must be specified & solicited from commercial partners



"You need to be able to watch a video, answer some questions, read a document, and do a quiz to test students, to figure out whether they really understand the content. That should be the minimum. The technology that provides it matters less, as long as we can work without disruption. That is the main standard."

#### **Director at CourseNetworking USA**

#### B. Determine technological needs

Once the target number of schools to be connected has been determined, the minimum internet speed for meaningful school connectivity should be specified.

Several parameters should be considered when determining the technology needed to meet these goals. For example, climate, existing backhaul, topography, and remoteness should influence the optimal mix of technology.

RFPs should be sent out to commercial parties in a technologyagnostic way—describing 'must-have' functionalities. In addition, it is important to note that

the bandwidth and other characteristics of the network can be upgraded in the future, as technology develops quickly and (education) software will increasingly require better performance capabilities.

**Example outputs**: Overview of key activities that should be able to be conducted by students; establishment of minimum internet speed aimed for (must be higher than Giga's); list of suitable technologies


## Once the "Technology" has been specified run a cost-side analysis to determine the level of financing required upfront & on an ongoing basis



### C. Conduct a thorough cost analysis

Based on technological goals and parameters, a cost-side analysis should be performed – both the required upfront investment and ongoing operational costs should be considered. Following from this, the required level of annualized revenues to ensuring sustainable financing can be determined. This will serve as an input for the funding assessment.

"In order to execute the project effectively, get granular with the costs at the get go. Dive into details determine what needs to be spent now vs. later, see what's absolutely necessary and prioritize. Don't forget to leverage the strength and size of your partners like gov't purchasing agencies."

#### **Director at CourseNetworking USA**

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org **Example outputs**: Estimation of capex per region; estimation of opex per region; breakdown of annualized cost per technology; average cost to connect per school and per student



### Once the costs are determined and it is known how much funding is needed, "Funding models" could be considered, that can be broken down into archetypes



20

"Possible funding models are highly country-specific. For example, in one country gov't support may be the only option, while in a neighboring country many alternative commercial models may exist. However, for all countries, all stakeholders must recognize that funding should be sustainable—allowing the infrastructure to continue at least 5 years out."

#### Head of division at African Development Bank

#### Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

### D. Investigate potential funding models

Next determine the 'archetype' that most closely describes the country of interest. Understand macro-level socioeconomic data, the SP landscape, and the relevant legislative environment. Once the 'archetype' has been decided, a decision tree (shown elsewhere) should be followed to identify specific sources of funding appropriate to the archetype.

Each funding model comes with different investment and contribution cash flows which must be considered alongside the cost analysis. Practical implications (e.g., payment methods in the case of community contributions) of specific funding types should be considered. Finally, considering legal & policy barriers is key, as some funding models may simply not be possible (e.g., some countries don't allow for community-based models)

**Example outputs**: Legislative overview determining excluded models; analyses on local country dynamics to determine optimum funding models; and long list & short list of potential funding models



## Use the country's archetype, most promising funding methods & unique country characteristics to identify the optimal operating model



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"The ideal operating model will come down to balancing the ability to fund capex and opex in a sustainable way. Different project and country-level factors will help you determine the level of capex vs. opex needed, and the operating model will flow from that"

#### Lead at World Bank

#### E. Determine what operating model to use

Country-specific situations, combined with the chosen archetype and possible funding methods, lead to an optimal operating model. Each operating model comes with specific upsides and downsides, and it is recommended that RFPs are sent to multiple parties.

In this phase, the project team should determine what should be the role of each relevant party (e.g., government, companies, community) in the deployment and operation of infrastructure, including the ownership of assets, responsibility for investments and assumption of risks.

The terms and conditions of the chosen operating model should be worked out in detail, especially when working together with commercial parties to ensure the needs of the students are put first. If the government stimulates demand for private sector involvement (see section "Government actions" on how to do this), more operating model options become available.

**Example outputs**: Long-list of potential private parties, development banks, and other organizations to work with; analysis of driver tree for operating model; and overview of key considerations for each model



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## Governments could stimulate participation of private sector by focusing on three main areas

**Note:** Financial support directly to the private party is not covered here, as that is covered in the funding section of this report



#### Cost containment

- Reducing import tax for materials & hardware
- Tax incentives for businesses that thrive on telecom; Special Economic Zones
- Ensuring regulatory environment is attractive, but also provide regulatory support for infrastructure sharing
- Allow for land appreciation, so that companies do not have to buy or rent the land
- Spectrum costs reduction in hard-to-connect areas
- Allow for fast approval processes and provide clear communication on timelines
- Allow for data affordability, e.g., decrease data tax/assign sufficient spectrum to avoid price inflation
- Increase access to electricity, including off-grid
   energy solutions
- Allow use of government assets to roll-out more cheaply, e.g. right-of-way, electricity poles, existing fiber networks
- Aid in reduction of any other type of red tape



#### Revenue enhancement

- Provide devices or subsidies for devices to otherwise economically unattractive areas and/or remove taxes & fees on devices. In addition. Remove barriers on important devices
- Educate communities on benefits of connectivity and provide training on how to use it
- Address safety and security concerns that communities may have and build consumer trust
- Accelerate the digitalization of public services
- Create packages for investors (i.e., provide access to otherwise unattainable investments), such as general infrastructure or energy assets that are state-owned or where a monopoly is in place
- Allow for pooling of existing governmentowned infrastructure to allow for steady revenues



#### **Risk reduction**

- Provide detailed insight into costs, including detailed calculations of capex & opex required and estimates of potential revenues on a per-area basis
- Provide transparency & certainty about government policy, regulation & anticipated changes
- Provide backstop/first loss guarantees e.g., against USFs
- Partner with other countries to allow for risk pooling to reduce sovereign risk
- Government finances initial phase with high risk and provides full clarity to private sector before hand-over
- Gather granular & trustworthy demand data related to mobile internet adoption and access to/quality of connectivity
- Set public priorities, targets & budgets based on data-driven assessments



## Governments could stimulate participation of private sector by focusing on three main areas



#### Cost containment

Governments could decrease the cost of spectrum fees, reduce import duty taxes, and ensure red tape is managed, for example rights of way"

#### Manager at GSMA

• No financing company will come forward unless they know what the cost and expected outcomes are. People have to agree on how much something will cost

#### Partner at SoftBank

"There's a big issue with financing that many people don't understand, which is the cost of financing in developing markets. The government could offer pre-paid contracts to provide access to financing"

#### Member BoD at Mawingu Networks



#### Revenue enhancement

"If you cannot provide a level of return which is market-level, then it will be extremely difficult to access large amounts of capital. My view is that we need to think of a layered capital approach"

Partner at Blue like an Orange Sus. Capital

"The most important challenge is on the demand side. There are some levers on the policy front. Spectrum is important. a very direct policy incentive is giving a discount in return for deployment plans to cover schools" Manager at GSMA

"Governments need to decide whether they want to provide demand-side or supply-side subsidy. Making sure infrastructure is there is key. It's then in the best interest of the private sector to reach out to schools & communities"

Lead specialist at Interamerican Dev. Bank



#### **Risk reduction**

"The most important way to reduce risk is through information. The more information you have, the less risk there is. You can also provide guarantees, risk tools & insurance"

#### Member BoD at Mawingu Networks

I would suggest to provide a guarantee against a USF. The money is just 'sitting there' for many countries. Why don't we just use it?"

Head of division at African Dev. Bank

"If you can risk mitigate enough, you can get the private sector to come in. You could work with tools like first-loss guarantees, and other payment risk mitigating instruments which could potentially be provided for by international organizations" Partner at Blue like an Orange Sus. Capital



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## Brazil case study



Source: BCG Analysis www.gigaconnect.org | info@gigaconnect.org

### **Country profile | Brazil**





- Government debt: 99% of GDP
- Government's education budget on a per-student basis: \$2,121
- Broadband a universal service: No (only telephony)
- Operational USF available: Yes, but unknown whether it can be used
- Total amount allocated: BRL 24B

30 🕂 giga



## Brazil is a sizeable country with large inequalities between and within regions, requiring a regional-based approach

Context: Brazil is a sizeable and relevant market. In terms of connection, the 4G network covers 88% of the population but only ~10% of the land. Fiber network covers ~96% of the population. The school system differs per region with far reaching effects on quality. Differences in socioeconomic indicators affect school connectivity, with majority of unconnected schools in North and Northeast. Even though the price of a data basket of 1.5 GB is below ITU's suggested affordable level, it is unaffordable to poorer sociodemographic areas. Thus, a regional focus is required in determining what sustainable business models to use in rolling out school connectivity



Given the geographical challenges in Brazil, it is challenging from an economic point of view to cover the entire country in fiber. Instead, the suggested technology division<sup>1</sup> looks as follows:

- Fiber: 10%
- LTE: 12%
- WISP: 71%
- Satellite: 6%

### **Cost structure**

An average of \$18 per year per unconnected student would be required to connect the remaining 20% of schools. This is excluding any upgrades that would be required for connected schools.

Average school size is relatively high (306). This leads to an average cost of \$5,605 per year per school



Four different funding models are advised that, together, could close the currently existing funding gap in Brazil:

- One-off subsidy by the government
- Open access
   network operator
- Government increases school funding
- Community pays for connectivity



In terms of operating model, the following is advised:

- A PPP concession set-up for the one-off gov't subsidies, except USF financing (state driven)
- State driven for the gov't budget increase
- Private company/consortium set-up for the open access network op.
- Cooperative set-up for the community contribution

Additionally, working with RNP (NREN) is recommended for Brazil





## Specific funding and operating models can be used to promote school connectivity, involving commercial parties, government and community

Funding model		Explanation	Operating model	
A	One-off government subsidy	The 5G auction, fine system (TAC), USF financing and tax exemptions are (implicit) one-off subsidies. USF financing is gov't-driven. The 5G auction, fine system and tax exemptions models are implicit PPP models given the need for agreement from both the gov't and commercial parties. Given low gov't influence on the telco market and healthy market competition in Brazil, a concession model is advised	>	Concession and State/government
В	Ongoing government budget increase	Falls within the government-contributed archetype. Therefore, the state/government-driven operating model is advised		State/government
С	Open access network operator (revenue-sharing)	Open network concepts are already used by companies in Brazil and fit within the commercial-provided archetype. Therefore, a private company/consortium model is recommended. Gov't interventions supporting legislative frameworks that encourage open access networks would facilitate the operating model	>	Private company/ consortium
D	Community contribution	The community contribution model builds on the community-based archetype. As the Brazilian market is large - esp. in the population dense areas of the North and North-East – commercial funding is attractive. Therefore, a cooperative model is advised	>	Cooperative



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### Country & school overview

Connectivity status & developments

Telco landscape

Recommendations

Funding models

Short-term next steps



6

### Brazil is a sizeable and relevant market, with large differences between regions in terms of economic wellbeing



211M inhabitants 71M total households 5,568 municipalities 17 cities with pop. >1M BRL 7.4T GDP 2021-24 ~2.4% y-o-y 8.5M km2

 $\bigcirc$ 

Brazil

### A regional focus is required to determine what sustainable business models to use in rolling out school connectivity

per capita income ...

4,923



Distribution of cities in Brazil, regarding population sizes, varies considerably ...



People per social class per region (%) 13 26 42 45 50 51 53 44 37 25 23 Northeast North South Southeast CenterWest Class A 📕 Class B 📕 Class C 💻 Class D/F GDP per capta (BRL thousands) 42 40 38 21 17 Northeast North South Southeast CenterWest

... with North & Northeast facing substantially lower



 $\bigcirc$ 

Source: IPCA Maps, Falke Education report, BCG analysis www.gigaconnect.org | info@gigaconnect.org

## Differences in levels of urbanization between regions lead to significant variances in school set up

#### % urban population



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## Regions also present different education outcomes as seen in literacy rate and graduation percentage

## Although N and NE has great part of eligible population enrolled ...



... These regions still have high illiteracy rate ...

#### Illiteracy rate per region (% pop over 15y)

### 

## ... And a lower portion of population finishing elementary school

% of people >25 years that finished basic elementary school



Note: Includes only primary + secondary education (not daycare, nor high school) Source: IPCA Maps, IBGE, Falke Education report, BCG analysis

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### 87 🔆 giga

## Inside of regions, cities with completely different social-economic realities can be found

**Example**: Pará—State in Brazil located in the North



Capital (Belém)

0.75

BRL 701 (urban)

35,557 (2%)

Source: IPCA MAPS, IBGE, BCG analysis www.gigaconnect.org | info@gigaconnect.org <BRL 2K/month < BRL 2.3k/month < 2.6k/month >BRL 2.6k/month

Human development Index

AVG income per capita

% people (>15y) can't read or write

Interior (Mocajuba)

0.56

BRL 231 (urban)

1,848 (7%)



 $\bigcirc$ 



## Even within cities, severe contrast exists in terms of socioeconomic factors











Source: Press search, Quora, Google Maps, BCG analysis www.gigaconnect.org | info@gigaconnect.org



# Differences in socioeconomic factors also have effect on school connectivity, with majority of unconnected schools in the North and Northeast regions

School connectivity map in Brazil: 75% of public schools connected to the internet, with predominant gaps in N & NE Giga school mapping of Brazil



No data Connected >5 Mbps Connected <5 Mbps No connectivity

## Socioeconomic factors closely correlated with school connectivity

In general, connectivity rates are lower in poorer, less urbanized areas of the country. These areas tend to have limited or no internet infrastructure, given lower commercial attractiveness.

Remote and rural areas (specially on North states) rely on alternative technology to connect schools and communities (like radio) and lack good quality of signal.

On the other hand, richer, more urbanized areas, on top of having better internet infrastructure, also count on higher school funding and digital literacy rates. These regions also have higher penetration of private schools, which tend to have higher budget per student.



Source: NIC, Communications Ministry, BCG analysis www.gigaconnect.org | info@gigaconnect.org



## North and Northeast regions have lower school connectivity rates, with large discrepancies between state and municipal schools



Clear discrepancy in school connectivity between states, with lower rates in North & Northeast



School connectivity status per region (%)





## Connectivity rates in these regions are also greatly affected by administrative level of schools



School connectivity rate per region and adm. level (%)

State level 📃 Municipal level



### Small size of schools also present a challenge for connectivity in North and Northeast regions, given higher capillarity needed for deployment and lower economies of scale





## e for connectivity in

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FBB growing steadily across the country, with higher

growth rates in North & Northeast

## Brazil experienced large growth in internet penetration in the last decade, but regional gaps still exist

MBB experienced massive growth after 4G auction (2012), with North and Northeast regions closing gap since 2015



Source: Anatel, BCG analysis www.gigaconnect.org | info@gigaconnect.org

### Fiber network maturity differs significantly per region



### Fiber penetration (Installed base/HHs)

High		Medium		Low	
AP	35%	PB	24%	 MS	15%
SC	34%	CE	22%	AC	15%
PR	32%	RR	21%	MT	15%
SP	29%	RJ	21%	SE	12%
RN	28%	RO	20%	BA	11%
MG	27%	GO	19%	PE	10%
RS	26%	ΡI	19%	AM	9%
		DF	18%	MA	8%
		ES	17%	PA	8%
				ТО	7%
				AL	4%

Source: Anatel, BCG analysis www.gigaconnect.org | info@gigaconnect.org



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## Prices of internet subscriptions increased in the last years, with operators offering higher speed plans



Revenues per user have been increasing, even though

## ... Given that more premium plans become the preferred choice of users



Speed mix (%)

Source: Price Tracker report, BCG analysis www.gigaconnect.org | info@gigaconnect.org



## Even though the price of a data basket of 1.5 GB is below affordable level, due to extreme inequality, it is unaffordable to many

1.4% of GNIpc spent on 1.5 GB data basket, which is below ITU recommendation for affordable internet ...

Spent on data-only mobile-broadband (1.5GB) as % of gross national income per capita-2019



... however, extreme inequality in Brazil makes it unaffordable to lower-income parts of nation



Share of national income (%)



Brazil's six richest men have the same wealth as the poorest 50 percent of the population, which is around 100M people

The country's richest 5 percent have the same income as the remaining 95 percent

16M Brazilians live below the poverty line



## In order to increase school connectivity rates, issues regarding coverage, affordability and digital literacy must be addressed



98 🔨 giga

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### **Overview of telco landscape in Brazil**

Characteristics	Description
Current status of fiber and 4G, WISP, and of satellite coverage in country	<ul> <li>Despite the large penetration of mobile services in Brazil, there is still inequality of access, especially in the states of the North and Northeast regions of the country</li> <li>In Brazil, ~88% of the population is covered with 4G. Yet less than ten per cent of the country surface is covered with 4G signal (high concentration of people around cities). Around 135m of Brazilians use mobile internet (~70% population)</li> <li>In the last few years however, significant progress has been made in terms of telecommunications infrastructure. The backhaul/fiber optic backbone network that served, in 2015, ~48% of the municipalities, serves ~82% in 2020, reaching 4,582 Brazilian municipalities</li> <li>The current fiber optic backhaul network connects municipalities that account for ~96% of the Brazilian population. However, there are 988 municipalities without optical fiber backhaul, most of them in the North and Northeast regions of the country.</li> </ul>
Few large players with long tail of smaller telcos	<ul> <li>ISPs reached 14,4m subscribers in 5287 cities, accounting on 40% of broadband market share and 60% of fiber deployment.</li> <li>ISPs grew mainly focused on smaller cities while traditional service providers expected to compete and to recover market share, expanding also out of capitals and big cities</li> </ul>
High taxes for telco companies, resulting in high cost of internet per capita	<ul> <li>Brazil has one of the highest tax burdens for telecom services, reaching 42% of net revenue. Total mobile sector revenues were \$18 billion in 2018, generating \$10 billion of direct economic value, which represent over 0.5% of Brazil's gross domestic product (GDP)</li> <li>Compared to other South American countries, 42% is especially high. The average tax for LatAm countries is 18%. The largest source of tax revenue is VAT, followed by COFINS, and FISTEL fees. Comparing with similar countries in LatAm:</li> <li>Argentina 25%/Colombia 24%/Uruguay 22%/Chile 19%/Peru 18%/Mexico 19%/Ecuador 12%</li> </ul>



## Overview of major upcoming changes in telco landscape and resulting school connectivity expected

C Major changes	Description
Spectrum auction for 5G network expected	<ul> <li>A spectrum auction for 5G network in Brazil will take place in November 21, with the following terms already announced:</li> <li>Coverage of federal roads without cell phone signal by 2025 (for 700 MHz buyer)</li> <li>Deployment of optical fiber to 1,280 communities (cities and districts) without such infrastructure</li> <li>Coverage of ~14,000 villages and localities which currently don't have cell phone signal with LTE</li> <li>Expansion of 13k km of fiber optic cables in the North region</li> <li>School connectivity was included as an extra commitment for winners of the 26Ghz frequency auction. Investments of BRL 7.6 bn in public schools will be required</li> </ul>
USF fund developments – Fundo de Universalização dos Serviços de Telecomunicações (FUST)	<ul> <li>The FUST law has recently been adjusted with the following major changes: <ul> <li>Telecommunication companies can replace the payment of up to 50% of FUST with the deployment of connectivity in selected areas;</li> <li>Application of funds can be made in poorer areas of high HDI cities (before, it could only be applied in low HDI municipalities, which covered only 356 municipalities); and</li> <li>Goal to connect 100% of public schools on high-speed broadband until 2024</li> </ul> </li> <li>The FUST has accumulated BRL 24bn from Telco taxes since 2001. With the new law, it is expected that BRL ~3.5Bn will be used to fund devices and internet plans in public schools. There is no mention thus far regarding building internet infrastructure for schools in rural/remote areas</li> </ul>
Government implemented plan ministry of education for connectivity-PGMU	<ul> <li>The plan requires optical fiber to be available in 99% of cities (5500) until 2024.</li> <li>The plan also determined that 1105 spots still unconnected with 4G mobile must be covered</li> </ul>



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### Broadband growth is being mostly led by ISPs, which have captured 94% of total net adds since 2015



Source: ANATEL, Ovum database, Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org



## ISPs have grown in relevance, reaching 14,4M subscribers (40% share) and ~5287 cities ...

#### ISPs have grown exponentially ...



1. Others include Cable modem, Satelite, xDLS, Ethernet, and other minor technologies Note: ANATEL; IBGE; BCG

www.gigaconnect.org | info@gigaconnect.org

#### ... expanding its geographical reach



103 🤸 🥵 gig



## ... and have sophisticated their service quality — currently with 73% fiber footprint and 70% speed mix > 12Mbps

#### Radio 15% 22% 36% 52% 67% 73% Fiber 73% 60% 45% 27% 14% 9% 21% 19% 19% 18% 18% 12% Others<sup>1</sup> 2015 2016 2017 2018 2019 2020

#### ISPs have improved in technology ...

Technology mix (%)



... an in delivered connection speed

1. Others include Cable modem, Satelite, xDLS, Ethernet, and other minor technologies Note: ANATEL; IBGE; BCG

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## ISPs are fully dominating and leading growth in new frontiers, while setting presence in mature markets

## In Frontier markets, ISPs capture 115% of net adds and have outgrown all other players

Subscribers' evolution on Frontier Markets (**5490 cities** with <28K households on social classes A and B), [M, '15–'20]

### In Mature markets, large players stronghold, ISPs have 14% share and capture 30% of net adds

Subscribers' evolution on Mature Markets (**80 cities** with <28K households on social classes A and B), [M, '15–'20]



1. Attractive markets defined as cities with more than 28.000 householders on social classes A/B 2. Others include: Algar, Blue, BT, Cabo, Datora, Nextel, Prefeitura de Londrina/Copel and Sky/AT&T; 3. Main players include: Tim, Claro and Vivo Source: ANATEL; IBGE; BCG analysis

www.gigaconnect.org | info@gigaconnect.org



## Close cooperation with RNP, the Brazilian NREN, is an interesting operating model to consider when connecting schools

## Although NRENs focus on universities and research institutes, recently more NRENs are (considering) adding primary and secondary schools

- A special type of operational model to be considered is a National Research and Education Network (NREN). NREN organizations are specialized internet service providers dedicated to supporting the needs of the research and education communities within their own country
- Although NRENs initially focused predominantly on universities and research institutions (and all EU-based NRENs still do), an increasing amount of NRENs has been focusing on primary and secondary schools, thereby providing a potentially interesting operational method in countries with well-connected NRENs present

Percentage of NRENs connecting different user types (%)



#### Brazil's established NREN, RNP, provides a potential operating model to connect basic education, especially in more rural areas

- RNP, the Brazilian NREN, has built and operated the national network for the research and higher education community. Currently, RNP provides connectivity through its own network to around 1,500 sites throughout Brazil, serving an estimated 4 million users
- Its funding comes from the Brazilian government through the Ministries of Eduction (MEC), Science, Technology and Innovations (MCTI), Health (MS), Defence (MD), and Citizenship (MC)
- RNP has recently launched Northeast Connected, a PPP to install thousands of kilometres of optical fiber and connect the states in 6 municipalities in the Northeast, including the schools. This is a partnership with ISPs to build metro networks, and with Power Distribution companies to provide pairs of idle optical fibers on transmission lines, leading to cost savings of ~\$38.2M
- Working together with RNP in connecting schools in Brazil would allow for
  - Scale benefits, especially in locations where universities and research institutions are situated
  - Reputational benefits, as RNP has been operating and working with the government since 1999
  - Access to funding and expertise, as several Ministries already work with RNP, as well as several commercial partners



Source: GEANT, RNP, BCG analysis www.gigaconnect.org | info@gigaconnect.org

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#### Non-exhaustive



# Several key issues need to be tackled to achieve meaningful school connectivity, of which funding models is one



### Regional differences need to be bridged

- Extreme regional differences exist in Brazil that lead to large discrepancies in educational standards between regions
- Mobile broadband costs in GNIpc is below the 2% recommendation.
   However, taking into consideration the regional differences, connectivity is unaffordable to people in the poorer regions of North and North-East Brazil
- These differences lead to the regions being less attractive to commercial parties, which exacerbates the problem



#### Regulatory framework

- Whilst regulatory reforms have been moving into the right direction (e.g., USF restructuring), further improvements are required
- One example is that the current idea of USF restructuring does not solve for equity and inclusion, but rather exacerbates differences (e.g., devices to regions already connected, rather than connectivity for the unconnected)
- Another example is that the TAC system often takes years between the handing out of a fine and the actual payment



### Demand needs to be stimulated

- As of now, not all regions in Brazil are economically attractive to commercial parties (with or without subsidies)
- In order to increase the economics for commercial parties, actions can be undertaken by the government to increase demand
- Examples include providing devices to inhabitants in the North and North-East, educating people about the benefits of internet usage, and making prices more affordable



### needs improving

- There's a significant usage gap in Brazil: whilst 88% of Brazilians are covered by internet, only 71% make use of 3G or 4G
- One of the key reasons for this usage gap is digital literacy
- This problem is worse in the North and North-East regions, as general illiteracy figures in these regions are higher vs. the average in Brazil (8% and 14% respectively vs. 6%)



### Funding models need to be identified

- Funding models that would lead to sustainable connectivity of schools need to be identified
- As tackling the aforementioned points may lead to changes in the underlying economics of the different regions, these funding models may have to be revisited over time
- A separate section has been provided on what funding models are deemed suitable to close the gap in school connectivity

Deep-dive provided



Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

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### Regional focus is needed given large socioeconomic differences

## Focus area 1: Urban areas in North and N-East<sup>1</sup>



1. Few large urban areas in North Brazil. Most located in North-East Brazil www.gigaconnect.org | info@gigaconnect.org

## Several urban areas, mostly in the North-East region, have high population density, yet have poor or non-existent school connectivity



The North-East region has 6 cities of >1,000,000 inhabitants and 1,240 cities of >10k inhabitants ...

Diatribuição da população em 2000



#### —Population in 000's—•





... yet school connectivity in many of these urban regions are of poor quality or non-existent





# The North and Northeast regions have high shares of rural schools, and still a quarter of urban schools have speeds below 5 mbps in these regions



#### Schools split in rural and urban areas





In urban areas, 29% of schools have speeds below 5 mbps



Connectivity in urban public schools (N and NE)



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## Urban areas can have very different demographic and socioeconomic conditions, leading to discrepancies in school connectivity levels

Belém

	and the second	
A CAL		-
E		
	ATT S	
Forta	aleza	

No. of inhabitants	2,694,697	1,499,286
Surface area	315 KM <sup>2</sup>	1,060 KM <sup>2</sup>
Population density	8,555 people per KM²	1,415 people per KM <sup>2</sup>
GDP per capita	23,437	20,821
Spend per capita	22,246 (Urban only)	19,436 (urban); 9,339 (rural)
Schools connected	87% in Ceará (capital is Fortaleza)	33% in Pará (capital is Belém)
Speed connected schools	18% with <5 Mbps; 82% with >5 Mbps	31% with <5 Mbps; 69% with >5 Mbps
Illiteracy (2010)	61,140 (2.3%)	35,557 (2.4%)

Source: iPC MAPS 2020, IBGE, BCG analysis www.gigaconnect.org | info@gigaconnect.org



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## Government financing could be a relevant funding method to reach school connectivity and minimize the funding gap in Brazil







## Back-up | Several funding methods considered for North and Northeast regions, of which six are viable options



115 🔨



# Fine system | The TAC system in place could be used as a source of financing for internet in remote locations, but adjustments are required



### What is the TAC ("Conduct adjustment term") system in Brazil?

The TAC system enables the exchange of fines of telco companies (relative to user rights, interruption of service etc.) for investments in various projects to strengthen backbone, backhaul and fiber networks

For the exchanges to happen, telco companies need to approve each individual agreement with The Board of Directors of Anatel



### For what can the fines be traded and how?

Instead of paying a fine, a minimum investment in a specific technology and in a certain location (last mile) could be suggested, generally in one with a with coverage gap. Another option is to provide connectivity along highways (backbone)

A downside of this funding model is that the agreements between Anatel, operators and the Accountability court can take several years



### The money could be used to connect schools

One area to be addressed is that TAC has not yet proven very efficient to connect remote locations. Operators can choose the locations, and tend to focus on smaller, but richer cities vs. areas without connectivity

Because of this, schools in remote areas have not been able to take advantage of these agreements yet. Adjustments could be made to ensure the money is spent where it makes a difference





# USF funding | The fund for universalization of telecommunications services (FUST) could be used to connect schools



FUST was created to ensure internet connectivity is universal

- Historically, the USF was set up to focus on regions that would not normally be served by private companies due to costs and low returns
- It demands a contribution of 1% of the gross operating revenue of telecommunications operators to the fund. This money was historically provided to the government and was used for purposes not necessarily related to connectivity



Project allows contribution to Fust to be exchanged for investment low HDI areas

- Recent restructuring, bill 1349/21, allows telecommunications service providers to apply the contribution referring to the FUST directly to infrastructure with 5G technology and above, in rural or urban regions with a low Human Development Index (HDI) and in which it is not economically viable to provide telecommunications services (negative NPV)
- Under the proposal, companies may deduct from their contribution the amount spent on these projects, if they are previously approved by the FUST's management committee



Congress allocates part of Fust to connect students and teachers

- The money released in 2021 should be used to contract mobile connectivity solutions
- Students belonging to families enrolled in the Federal Government's Registry for Social Programs and those enrolled in schools' communities are the benefactors
- As for teachers, the measure covers professionals from all stages of basic education





# Tax exemptions | A revision of telecom taxes could promote growth in investments in infrastructure



Brazilian high taxes leads the sector into a vicious cycle, shorting the investment of the sector ...





... and lower tax burden increases tax collection and reduces social inequality, starting a virtuous cycle



Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

118 **• · · · · · giga** 

## Open access network operator | Brazil's shared networks can accelerate the growth of service coverage areas for telecommunications operators



Traditional Telcos launched open network concepts, with spinoffs focused on infrastructure development



Oi InfraCo Reach 32mn HPs in 2024

Telefónica vivo FIBrasIL

TIM

FiberCo

Reach 5.5mn HPs in 2024 in median cities (TLF goal is 24mn HPs)



Reach 8.9mn HPs in 2025



ISPs and investments funds are partnering with them to offer services to the final customers in new regions

- EB Capital
- Highline Brasil
- Algar
- Brisanet
- Conexao Group
- Vero Telecom





Source: Service provider (SP) company websites, press search, Anatel, BCG research www.gigaconnect.org | info@gigaconnect.org

Regional focus is needed given large socioeconomic differences

## Focus area 2: Rural areas in North and North-East Brazil





# Rural areas in the North and North-East regions are generally less connected

North-East and North regions are less urbanized vs. most other areas in Brazil...



... with rural areas generally less covered by mobile and fixed broadband connectivity





### In rural areas, which have larger funding gaps, adding community collaboration can improve ability to promote school connectivity

In urban scenarios we believe that 6 funding models are most suitable ...

nding for urban areas Government financing is considered to be the most important funding method to reach school connectivity and minimize the funding gap

(Implicit) one-off government subsidy

5G Government Open access Fine increases funding auction system (TAC) USF financing Tax exemptions network operator Brazil has 5G Largest service Recent Highest tax School funding Telcos provide auction providers can restructuring of rate in LatAm can only be open access scheduled trade fines in USF fund could for service raised slightly infrastructure: School return for NPV-ISPs pay fee to providers: for the potentially allow for school telco in return connectivity negative reduction in contribution to could be connectivity connectivity return of for use of remain infrastructure connectivity prerequisite projects sustainable Source: BCG analysis 33 🏹 giga www.glgaconnect.org | Info@glga.partners

... whereas in rural locations, community coverage may be a good addition

In sum: Community contribution models are most suitable for rural areas with a coverage gap (or overpriced MNO), which is the case in rural areas in the North and North-East of Brazil

Community contribution models work best in scenarios where there is

- Sufficiently high demand for internet services
- Relatively lower opportunity for MNO/ISP returns & therefore absence of existing connectivity providers
- Closely-knit community sense
- Enough available spectrum that can be used without a license
- Spectrum licensing framework that supports communities
- Local knowledge/ability to install, maintain & operate networks





# Deep-dive on community contribution | A community contribution model is driven by local ownership leading to lower costs

## Local ownership of the community would lead to affordable, high-quality connectivity

The goal of community networks is to set up affordable, quality connectivity

### In the successful example of Zenzeleni Networks (see right side), community networks work as follows



The **local community** sets up and maintains the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses



The **technical set-up** consists of a Wi-Fi internet backhaul, a Wi-Fi mesh and hotspot, and is powered by a solar panel with a backup battery. Excessive power can be used to charge phones at a cheap price



**OpEx financing** comes from the community. People can buy vouchers for access or set up a dedicated line at home. Additionally, there some anchor clients in the form of NGOs and local businesses who can afford to pay a fixed fee. Schools can be connected for free



**The Zenzeleni Cooperative** pioneered a community network in South Africa. The keys to its success are the professional Not-For-Profit (NPO) structure, job creation in the community and smart financing

Financials	2017	2018	2019	2020
Hotspots	12	35	55	75
Anchor clients	2	5	8	21
<b>Data Usage</b> (TB/Mth)	0.5	6.0	13.5	23.0
Net (USD)	-203	-521	758	7,184
Gross margin	0%	-8%	21%	51%

1. Excluding USD338.000 grant by University of Western Cape for R&D and CapEx

Source: Include a source for every chart that you use. Separate sources with a semicolon; BCG-related sources go at the end www.gigaconnect.org | info@gigaconnect.org





### Meso

Zenzeleni not-for-profit company

#### **Obtains funding to:**

- Seed & establish the micro level ISP business
- Train & develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc.



#### Zenzeleni model based on meso & micro level organizations

- Model is based on inception & support of community-based micro-enterprises
- Two entities (meso & micro) work together to stimulate the digital ecosystem, e.g., health, entrepreneurship, etc.
- Government too has a role to create an enabling policy & regulatory environment and subsequently use the ecosystem to deliver its programs to stimulate growth in impoverished areas





### P&L of an average school in North & North-East | No model sufficient by itself to cover school's P&L, though clear differences in potential arise



#### Model 3: Open access network operator (rev-sharing)



#### Model 2: Ongoing government budget increase \$6,022 As a result of a 0.5% • \$2,142 \$2,882 increase in school funding<sup>2</sup> \$2.074 \$3,140 \$1,807

Government increases

school funding

#### Model 4: Community contribution model



Annualized connectivity capex costs Annual connectivity opex costs Indirect costs<sup>1</sup>

Costs

Gap

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; 2. Assuming the current government expenditure on education (as a % of GDP) in N and NE regions is proportional to the country's value. Note: Excludes profit margin for commercial parties. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



## Model 3 caveat: open access network (rev-sharing) | In reality, the gap will be much smaller as commercial parties could provide village connectivity

### The open access network operator model (revenue-sharing) is understating potential funding; however, a detailed region-specific analysis is required ...

- In this model, we assume that the school is connected by a local ISP, which is more nimble, flexible, and localized and therefore leads to a 'reduction in cost'. In addition, there's an incentive for the commercial player to receive additional funds through a model in which the school serves as the hub for connectivity
- Assuming efficient markets, a fully commercial revenue-sharing funding model is not feasible (as the opportunities would have already been seized). Therefore, government subsidy (or other donor-funding) would be required to change the projects from negative NPV<sup>1</sup> projects into positive NPV projects. In other words, the government would have to provide \$2,593 per school to commercial operators to make them indifferent about doing the investment
- In reality, however, once the infrastructure has been provided to the school, there's a financial incentive to connect the entire village, as this would increase the potential revenue from the village (\$1,571). Therefore, the actual gap as shown in the analysis below is smaller in practice. The gap will always be smaller (never larger) as commercial players have no incentive to connect the village otherwise, and would remain with the solution as worked out here
- We have modelled this funding model as such to be on the conservative side. A very detailed village-by-village assessment is required to determine what the precise gap would be



### ... which can be calculated on a village-by-village basis

The following information could provide a more realistic view on the decreased gap for revenue-sharing

Revenue side input

- Number of households passed to reach school connectivity
- Demand for internet services for those households passed
- Average GNI per capita of the specific village

#### Cost-side input

- Number of households passed to reach school connectivity
- Differential in opex and capex expected between large telco player and small, local ISP

1. Net Present Value Source: BCG analysis www.gigaconnect.org





# P&L total area N & N-E | No model sufficient by itself to cover all schools, though clear differences in potential arise



#### Model 3: Open access network operator (000's)





#### Model 4: Community contribution model (000's)



Annualized connectivity capex costs Annual connectivity opex costs

k costs 📃 Indirect costs<sup>1</sup>

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Source: BCG analysis

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# Summary of high-level assumptions | Modelling of funding method requires making assumptions for each of the funding models

### Four funding methods modelled for North & North-East Brazil; highly dependent on assumptions used

#### 1 (Implicit) one-off government subsidy

Includes 5G auction, fine system (TAC), USF financing, tax exemptions

For each of these models, we have assumed that a one-off subsidy from the government is provided to cover initial capex expenditures and accompanying indirect costs<sup>1</sup>. Why?

- 5G auction: Government takes an implicit discount on the price they can receive, equal to the cost of the school connectivity roll-out
- Fine system: Government foregoes fine income in exchange for rollout of infrastructure to schools
- USF financing: Government provides (albeit from a separate 'wallet') a one-off contribution to school connectivity
- Tax exemptions: Government foregoes potential tax income in exchange for rollout of infrastructure to schools



Recurring increase in annual government subsidy to schools

To make it sustainable, this government subsidy must be small enough to not be cut after changes in the government setup

Current assumption made is that a 0.5% (<u>percent</u>, not percentage points) increase in "government spend on education as a percentage of GDP" is reasonable to assume in the long-run

#### 3 Open access network operator

Main assumption is that rural/regional ISPs are more locally tailored and as such can deliver capex and opex at a discount vs. large incumbent telecommunication backbone providers

Key assumptions made are that capex can be 5% cheaper, and opex can be 10% cheaper as a result of

- More tailored approach
- Local resources (e.g., labor)
- Local equipment or relationships (e.g., for putting cables down)
- Etc.



Main assumption is that people that live around the school are willing to use school connectivity

Main assumptions have been made around

- Penetration rate (how much people currently use the internet)
- Addressable market (People living around school area within acceptable walking distance)
- Adoption rate (people willing to use school internet)

1. This implies a one-off government subsidy that will cover 4 years of 4G, WISP, and satellite connection (assumed depreciation period), and 20 years for fiber; Source: BCG analysis



#### Backup



# Detailed assumptions | These are the "what you need to believe" for these P&Ls to hold true & therefore what targets need to be met

#### Model 1: One-off government subsidy

- 5G auction: The reduction in the spectrum price paid by commercial parties is equal to the price of initial capex and the indirect costs attributed to the addition of the new last-mile connectivity
- Fine system (TAC): Fines that are handed out are enough to cover one-off capex and the attributed indirect costs. In addition, companies are willing to change their fine for an investment
- USF financing: The USF has enough funds and is willing to attribute enough financing North & North-East region to cover one-off capex and attributed indirect costs
- Tax exemptions: The government is willing to provide tax exemptions that equal the one-off capex and attributed indirect costs

#### Model 3: Open access network operator (rev-sharing)

- The basic underlying premise of this funding model is that gov't input is needed to 'close the gap', because in efficient markets, these areas would have already been covered by commercial parties otherwise. As such, this model cannot stand on its own
- The funding model for open access network operators is assumed to be equal to that of the community contribution model (see model 4)
- Next to revenue, this model allows for a cost-reduction. This cost reduction takes place because local players are more efficient on a small-scale or in the particular region. As such, a cut of 5% on capex and 10% on opex has been assumed vs. the usual cost assumptions
- In return for opening the network, large player gets a share of the revenue obtained by local player from connecting the community

#### Model 2: Ongoing government budget increase

- The current government expenditure on education (as a % of GDP) in N and NE regions is proportional to the country's value (6.32% of GDP)
- The government is willing to increase the education budget from 6.32% of GDP to 6.36%, which is equal to a 0.5% increase
- In addition, the implicit assumption is that the government will continue with the financial support, regardless of potential shifts in political priorities

#### Model 4: Community contribution model

- Around ~900 people on average live around each school (based on total population area, number of cities/villages, and no. of schools in region)
- Of these ~900 people, around ~14 are willing to use school connectivity in year 1, ramping up to ~90 people in year 10. This is based on the growth behavior seen in other countries with similar penetration rate, but with an assumed growth cap at 10% of population living around each school
- These 14 (Y1) to 90 (Y10) people are willing to contribute 1% of their Gross National Income (GNI) per capita. The reason 1% has been chosen is because the current country's average price is 1.4% GNI pc
- GNI pc is assumed to decrease with 2% per year, in line with the historic 5year average compounded annual growth rate

Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF) Source: BCG analysis

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## P&L total area N & N-E | Funding models can lead to school connectivity if positive assumptions are met



1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; 2. Brazil's current value is 1.4% (ITU); Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: ITU, BCG analysis

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# P&L total area N & N-E | Combining funding models leads to school connectivity in theory, however many hurdles need to be overcome

Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved ...



### ... however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter 'short-term next steps')
- In addition, the current model does not account for potential profit margins that commercial parties demand. These numbers have not been included to allow for flexibility in operating model choice (e.g., infrastructure may be provided on non-profit basis due to CSR efforts or by NREN cooperation)
- Even though the full potential of these models may not be realized in practice, this exercise still provides us with useful insights. It shows
  - Which models have the largest potential payoff in covering capex & opex
  - What prerequisites "need to hold" for the funding models to work
  - The potential upside of overcoming the hurdles that require solving

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

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# Further refinements are needed to the modelling exercise before implementing in practice

Rural/urban differentiation to tailor funding models: Currently, no differentiation has been made between rural/urban regions, as a region approach has been used instead. No data on rural/urban x region available

Smaller regions to optimize locally: Currently, the most granular the model could go (due to data availability) was on a regional level. Suggestion to analyze cities, and villages (or several villages) to determine optimal funding models (e.g., community contribution suitable mostly for villages with poor or non-existent infrastructure, or affordability issues)



**Further refine hypotheses:** Several assumptions had to be made top-down that require further refining with relevant bodies. For example, a 0.5% increase in student funding as percentage of GDP assumed to be sustainable, however the government needs to provide their input on what they deem acceptable

Expansion of the model to comprise the connection of whole communities: Currently, the model only considers the connection of schools, which may serve as an internet hub for the population living around them. However, the connection of whole communities (including households and businesses) could yield more satisfactory results, since revenue streams would increase, and fixed costs could be shared by more subscribers. As Giga's goal is to connect schools first & foremost, the modelling of the community connectivity is out of scope.

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



### **Brazil case study |** Table of contents

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# We recommend 3 short-term actions for the Giga/FCDO team in its journey towards realizing 100% school connectivity

Deep-dives on pages following





Push government to action by providing advice, recommendations, and independent analyses aligned with government policies & elections Start the roll-out of pilots (if needed, independent of the government) to battle-test suggested funding models & test the "what you need to believes"



Take full advantage of high number of organizations pushing for school connectivity in Brazil, starting with North & Northeast region



## Recommendations for short-term next steps

Push government to action by providing advice, recommendations, and independent analyses aligned with government policies & elections

#### Stay in close contact with government and government-officials, informing about Giga/FCDO recommendations on the following topics

- FUST: Support case for investments in rural, unconnected areas (rather than providing devices to well-connected areas). Working together with other active organizations (e.g., Lemann Foundation, CIEB, and NIC.br) may provide required leverage
- TAC system: Support case for the application of the TAC system in areas where it is most needed, in particular in locations where there are school connectivity gaps
- 5G auction: Provide support to the committee that will design plan for application of the fund for school connectivity that will be a prerequisite in the 5G auction.
- Tax exemptions: Conduct analyses on how to incentivize commercial players to invest in school connectivity in return for tax discounts. Share analyses and highlight benefits to government
- Ongoing government subsidy: Support small shifts and/or additions in budget for ongoing school connectivity; highlight that a small increase can provide a huge impact in school connectivity

In addition, continue leveraging existing relations with other Ministries (e.g., Ministry of Agriculture) and identify potential spill-over benefits for school connectivity. An example is that businesses can serve as anchor clients in community-based models



## Recommendations for short-term next steps

Start the roll-out of pilots (if needed, independent of the government) to battle-test suggested funding models & test the "you need to believes"

#### Suggestion to start with roll-out of ~10 pilots

- Open access network operator: Start with ~4 pilots (one in each area: rural North, rural Northeast, urban North, urban Northeast)
  - Determine how to best incentivize the local ISP players in the relevant area and what the 'minimum subsidy amount' is that they require to expand the network of service providers
- Community contribution: Start with 5 pilots in different rural areas of North & Northeast Brazil to test community contribution model. Start with pilots in rural areas that have strong community ties (with lower risk of theft) following the Zenzeleni model
  - First, Giga needs to set up a non-profit at the meso level. This could be done together with partners suggested on the next page
  - Next, 5 pilots in different rural areas with varying income levels could be set up so that the Zenzeleni model can be adjusted to fit Brazilian culture and community set-ups
  - It is important to chose areas where there are enough anchor clients to ensure the fixed revenue streams and optimize the model before tackling more difficult areas
- For the other models, one-off government subsidy & ongoing government subsidy increase, no pilots need to be conducted. However, in case the government is willing/able to move on any of these topics, Giga/FCDO should be ready to provide advice on what the operating model should look like and which schools/areas to connect first



# Recommendations for short-term next steps

Take full advantage of high number of organizations pushing for school connectivity in Brazil, starting with North & Northeast region



CENTRO DE INOVAÇÃO PARA A EDUCAÇÃO BRASILEIRA



CIEB & Nic.BR are both part of "Conectividade na Educação": seeks to gather different databases to support connectivity policies for Brazilian public education Non-profit association created to drive a systemic transformation, through innovation and technology, which promotes greater equity, quality and contemporaneity in Brazilian public education.

Created to implement the decisions and projects of the Internet Steering Committee in Brazil-CGI.br, which is responsible for coordinating and integrating Internet initiatives and services in the country.





higher education, research & innovation since 1992. Has recently conducted a pilot connecting primary & secondary schools

National Research & Education Network focusing on

Non-profit organization involved in a variety of projects in education across Brazil

oi

Telecommunication companies & ISPs: wide variety of telcos & ISPs have CSR budgets and/or expertise about school connectivity



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138 **Giga** 

## Honduras case study



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### **Country profile** | Honduras

<b>S</b> Key figures	<ul> <li>Population: 9.8M</li> <li>GDP: \$25.1B</li> <li>GDP per capita: \$2,575</li> <li>GDP growth: -3.8%</li> <li>Investments/GDP: 24.1%</li> <li>Urban population: 58%</li> </ul>	<ul> <li>Total population under 1</li> <li>Secondary completion ra</li> <li>Adult literacy rate: 87%</li> <li>% of schools connected:</li> <li>Connectivity starting poin</li> <li>Electricity penetration: 85</li> </ul>	8 years: 37.2% te: 40.5% 3.3% nt: 32.1% 5%
Demography of schools	<ul> <li># of schools in country: 16,590</li> <li>Average no. of students per school: 105</li> <li>Current # of schools with internet connectivity: 910 (5,94%)</li> <li>Current no. of schools with internet &gt;5 Mbps (%): 0</li> </ul>	<ul> <li>Cost to connect a school:</li> <li>Capex (once): Fiber (\$10,281) WISP (\$3,393), 4G (\$534)</li> <li>Opex (annually): Fiber (\$4,155), WISP (\$2,778), 4G (\$1,448)</li> <li>Division: 39% Fiber, 29% WISP, 32% 4G</li> </ul>	0% % population living in poverty 100%
Government involvement	GDP spent on education 6.1 3.1 3.6 0.4	6.3 7.7 Governme basis: \$856 Broadband Operationa Total amou	nt debt: 48.9% of GDP nt's education budget on a per-student a universal service: Yes al USF available: Yes unt allocated: \$16.7M

SL

Rwanda Indonesia Honduras Brazil

• Total amount allocated: \$16.7M

Nigeria



# Although connections are largely in place in Honduras, 94% of schools have no connection due to coverage issues, affordability and electrification of schools

Context: In Honduras, 4G only covers the larger cities, connecting 75% of the population but only a fraction of the land area. ~28% of the population uses the 4G network and an additional 13% uses the 3G network, leaving a ~3M people gap. Regardless of the connection in place, 94% of Honduran primary and secondary schools currently lack access to the internet and 44% of schools are not connected to electricity. The main topics to be addressed in Honduras are 1) upgrade rural areas coverage, 2) upgrade existing coverage, 3) increase affordability and 4) electrification of schools. The country has added to its national fiber backbone with 70% of the population living within a 25km range of the network.



Funding is required on all technologies. Somewhat higher weight on fiber, given large share of population living within 25km of fiber network and therefore is a feasible option. The share of funding is determined as follows:

- Fiber: 39%
- WISP: 29%
- 4G: 32%

### **Cost structure**

In total, a yearly investment of \$89M is needed to fund school connectivity in Honduras. This contains \$37M in the central states and \$51M in the western and eastern states

An additional \$52 will have to be spent per unconnected student on an annual basis to fund school connectivity.

For an average school, \$5,986 is required on an annualized basis



For Honduras, five different funding models are considered to fund school connectivity:

- Coverage as a service revenue sharing model
- USF financing
- Community contribution
- Spectrum Auction
- Electricity as a business model



In terms of operating model, the following is advised:

- Private company/ consortium for coverage as a service (revenuesharing) and electricity as a business model
- Turnkey (+ Lease) for one-off gov't subsidies
- Cooperative and
   Voluntary set-ups for
   community contribution



### Funding models support operating models spanning commercial, government and community - thus involving different stakeholders in improving connectivity

Funding model		Explanation		Operating model	
А	Coverage as a service – revenue-sharing	The revenue-sharing model falls within the commercial-provided archetype. It is guided by the private company/consortium operating model. Government intervention is necessary, however, to promote local revenue-sharing projects, as currently most projects on the national level		Private company/ consortium	
В	One-off government subsidy	Spectrum auctions and USF financing are (implicit) one-off subsidies. USF financing is gov't- driven. The spectrum auction is an implicit PPP model given the need for agreement from both the gov't and commercial parties. Given Tigo and Claro's strong market position, a Turnkey model is advised, with the potential to shift to a lease model at a later stage		Turnkey (+ Lease)	
С	Community contribution	The community contribution model builds on the community-based archetype. The higher- density central states are commercially attractive – there, a cooperative model is advised. The Western and Eastern states have higher poverty rates, lower GDP and lower population density – there, a voluntary model is more appropriate		Cooperative and Voluntary	
D	Electricity as a business model	Electricity as a business model should accompany a private company/consortium operating model - a commercial-provided archetype. Given the high number of sun hours in Honduras there is an interesting business proposition for this model, but gov't support is needed for initial investments and/or to build a scalable model	$\diamond$	Private company/ consortium	



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#### Country & school overview

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Honduras is a country with several challenges. There are three main hurdles to overcome to connect all schools to the internet

Deep-dives on next pages

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Two thirds of households live in **extreme poverty** 

Although many schools fall in 3G or 4G coverage area, very few schools are connected

44% of schools are **not** connected to electricity

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## Two thirds of Honduran households live in extreme poverty, with highest poverty rates in the southwestern departments



1. Many undocumented activities in Gracias a Dios makes poverty rate less reliable; 2. (Extreme) poverty as shown on the map is an estimate and should therefore be used for comparison purposes between states predominantly; According to World Bank, before the impact of COVID-19 and hurricanes Eta & lota, ~15% of the Honduran population lived on less than US\$1.90 per day. In addition, almost half of the population lived on less than US\$5.50 per day, the second highest poverty rate in Latin America. Another third of the population was near-poor and vulnerable to falling back into poverty, while the size of Honduras' middle class (18 percent) was among the smallest in the region (compared to an average middle class of 41 percent); Source: National Center for Social Sector Information (CENISS). Poverty estimated by the Honduran government in 2018-19 www.gigaconnect.org | info@gigaconnect.org

2.3 m total households 298 cities & towns

1 city with pop. >1m

10 m inhabitants



26,516 U\$ m 2021 GDP 2021-24 +3.5% CAGR

11 cities with pop. > 50k



112,492 km<sup>2</sup>

# Although 85% of schools are covered by some form of internet, only 6% of schools are connected<sup>1</sup>, which can partly be explained by socioeconomic factors

### School coverage map



## Socioeconomic factors closely correlated with school connectivity

- 19.1% of urban schools are connected vs 3.9% of rural schools, which can partly be explained by different coverage levels but also by higher educated parents and more exposure to technology in urban areas
- Connectivity penetration in schools is highest in regions with lower extreme poverty rates, suggesting that parents' purchasing power is an important factor for school connectivity
- Honduras experiences low levels of ICT skills on teachers and administrative staff, hindering school connectivity
- Previous attempts to connect more schools were dependent on political attention and therefore not sustainable see deep-dive in Chapter 3

For Honduras, online classes are not a viable option because the country has one of the lowest coverage of internet services in the world. It is useless to have a sender of technological messages if the target population cannot be reached - Former Deputy Minister of Education

1. According to expert interviews, another 10-15% of schools is connected but not mapped as the school pays for connectivity out of pocket Source: Giga; BCG analysis; Forbes Sept 2020 www.gigaconnect.org | info@gigaconnect.org



# 85% of households in Honduras have electricity, but only half of the schools do – posing an extra hurdle for the use of electric devices at school

85% of the houses in Honduras are connected to electricity - high connectivity rates in the north and close to the main highway





- Coordinator of Digital Education in Honduras

Source: Desempeño Del Sector De Telecomunicaciones En Honduras Informe Trimestral Cuarto Trimestre 2020; El Heraldo Sept 2020 www.gigaconnect.org | info@gigaconnect.org

# Covering all schools will be difficult, but not connecting schools leads to an increase in drop out rate as many students cannot be reached

Honduras has 17,000 schools throughout the country, mostly located in western and central areas



As number of schools is the main cost driver in rolling out connectivity, costs of roll-out are **relatively high** in Honduras

Source: BCG analysis; El Heraldo Sept 2020 www.gigaconnect.org | info@gigaconnect.org Almost half of students didn't finish secondary education pre-pandemic, and drop-out rates are expected to rise as many students cannot be reached



Since the start of the pandemic, a part of the population has not advanced their education since they have no internet, even in the capital. The Ministry of Education is afraid the drop out rate will rise because they are not able to reach those students

- Coordinator of Digital Education in Honduras



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# Only pockets of higher population density in the west have access to connectivity, leaving the east relatively unconnected

Different topographical challenges ...



The country has three major topographical regions with hills or lowlands. When providing connectivity to schools, these differences provide for different opportunities regarding fiber, 4G connectivity or WISP

Source: World Atlas; ITU Broadband maps; BCG analysis www.gigaconnect.org | info@gigaconnect.org

... and a variety in population density per department ...



... lead to differences in existing connectivity



As the eastern side of Honduras is full of rainforest (this part is also called "little Amazon") there are very few larger villages there, making it hard to document population and schools in that area Fiber cables and 4G towers are easiest to build next to existing infrastructure. Therefore, it can be hard to expand connectivity to rural areas as there are very few larger roads or other infrastructure there.



## Penetration levels of both fixed and mobile have a lot of headroom left, with total number of mobile subscriptions being stagnant for the last 5 years

Although more people use new technologies each year, total number of MBB subscriptions shows no growth



Note that many people have multiple SIM cards and therefore penetration levels will be significantly lower than number of subscriptions per 100 citizens

## Fixed broadband subscribers increased between 2013-2018 but stagnated since then



Note that each household will have at most 1 fixed subscription and therefore penetration levels will be higher than number of subscriptions per 100 citizens

For MBB, regulator data shows a jump from 2.7 M subscribers in Q3 2019 to 5.0 M subscribers in Q4 2019. We therefore excluded this source here. Source: OMDIA; ITU; BCG analysis

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# Although 4G adoption almost doubled in 2 years, internet speed and reliability is still low compared to neighboring countries

Strong 4G uptake in last two years now reaching half of mobile subscribers ...



... however, compared to neighboring countries, Honduras gets relatively low speed and reliability



# Price of both mobile and fixed broadband is far above ITU recommendation at 8% and 14% of GNIpc respectively

8.2% of GNIpc spent on 1.5 GB mobile broadband data basket, which is far above ITU recommendation for affordable internet ...

Spent on data-only mobile-broadband (1.5GB) as % of gross national income per capita-2020



for the wealthiest citizens Spent on fixed broadband (5GB) as % of gross national income per capita-2020



... and fixed broadband is even more expensive, reaching

14.1% of GNIpc; making fixed broadband accessible only

### To achieve higher school connectivity, main focus should be on decreasing the usage gap by increasing affordability and electrifying schools



1. Note data differs from Connect-the-dots report because of different sources and the fact that 3G does not provide meaningful school connection 2. See Chapter 2 Source: Honduran government Q1 2021(coverage rates); OMDIA (subscriptions); GIGA; BCG analysis www.gigaconnect.org | info@gigaconnect.org

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## Summary | Honduran telco market faces several difficulties, but upcoming changes could provide meaningful connectivity for schools

### Several issues to overcome in Honduran telco market to connect all schools



Honduran market lacks competition, with Tigo and Claro as the only two players in the mobile market and also the two largest players in the fixed market



Market grew until 2018 but has stagnated since – lack of competition could be reason behind low innovation and growth rates



Used technology needs to be modernized to meet GIGA's 20 Mbps target by updating network to 4G or fiber optics



Major hurricanes, higher risk of diversion and industryspecific taxes do not provide ideal circumstances for investment

Millicom announced a \$500 m investment to develop high speed networks, which can be used to connect schools in the selected areas

Deep dives on next pages

## However, upcoming changes might provide new possibilities for school connectivity



The National Broadband Program (which will be published soon) will bring connectivity to schools and public locations, partly funded by USF budget



The Inter-American Development Bank approved 3 projects to expand coverage, reduce costs and expand digital economy – partly focusing at accelerating the use of technology in education



The regulatory framework will be updated to promote connectivity, expanding the range of possible funding strategies



## **Deep dive on telco landscape** | Honduran market is held back by old regulation and has difficulty overcoming divide between rural and urban areas

<b>Characteristics</b>	Description
Current status of fiber and 4G, WISP, and of satellite coverage in country	<ul> <li>Since 1995, with the promulgation of the Framework Law of the Telecommunications Sector, Honduras has been trying to develop and modernize the telecommunications sector by capitalizing public operator Hondutel. It monopolized the fixed segment until 2005 and the mobile segment until 2003 when Celtel and Megatel (Claro) entered</li> <li>Currently, it is still an emerging market with important opportunities of growth. Until 2018, mobile and fixed</li> <li>However, after this expansion, the growth in the number of broadband subscribers decreased. Even more, in 2020, the absolute number of users of mobile broadband networks decreased in comparison with the previous year.</li> <li>The persistence of inequalities, in the social and economic sphere, also results in a persistent digital divide. The inequality in access between urban and rural areas is significant</li> <li>The country still needs to allocate new mobile spectrum. Also, in 2018, it was planning to shut down analogue services. However, this was postponed until 2020 and, due to the pandemic, it was suspended again</li> </ul>
Unfavorable natural developments	<ul> <li>Honduras is one of the countries in Central America most impacted by major hurricanes in the last decades. In 2010, hurricane Matthew hit Honduras, causing a negative impact of 15.7 % on per capita labor income. A similar event happened in 2020 with Eta and lota storms caused U\$10 billion in damages. In the telecommunications sector these events left the country uncommunicated for 8 hours, caused \$11 m lempiras in damages and \$22 m lempiras in losses</li> </ul>
Industry specific taxes	<ul> <li>The telecommunication industry contributes with specific taxes such as the mobile security tax and the FITT contribution limit the adoption of telecommunications services, in particular mobile services. The sector faces obstacles to increase its investments affecting the development of infrastructure and consolidating the digital divide</li> </ul>



# **Deep dive on upcoming changes that can be leveraged | Several funds and investments could be used to upgrade school connectivity**

🔊 Major changes	Description
National Broadband Plan	<ul> <li>Plans are made for a National Broadband Program, which will be published soon. Part of the program is to connect about 1000 schools to the fixed network, using local and national fixed wireless providers</li> <li>The budget of the programme is 62 M dollars – 57% will be funded through USF and the rest through private investors</li> </ul>
IDB funds the development of the digital economy	<ul> <li>In December 2019, the Inter-American Development Bank approved 3 projects to expand the coverage and use of connectivity, reduce transaction costs for citizens, companies and public organizations through the development of digital government and will encourage the development of the digital economy in the country</li> <li>One of the initiatives will connect more than 700 public educational and health sites, will support the updating of the regulatory framework to promote connectivity, and will equip a broadband network operation centre through a public-private co-financing model</li> <li>Other initiatives are the roll-out of an educative platform "Educatrachos" and distribution of 200.000 tablets to high school students</li> </ul>
Millicom announced investments in mobile networks	<ul> <li>Millicom, Honduras's mobile incumbent, inaugurated its first datacenter in the country in October 2019. It also announced a U\$500 m investments in the next 5 years to development high-speed networks in the country. Connecting schools in the selected areas to this high-speed network would mean a significant improvement in school coverage</li> </ul>
Broadband auctions	<ul> <li>When analogue TV service are completely switched off (due April 2020 but postponed indefinitely due to Covid), 3.3-3.7GHz band will be auctioned for mobile use, and 3.7-3.8 GHz band for fixed wireless access use</li> </ul>
Telecom Debt Relief	<ul> <li>In January 2021, an initiative was approved stateing that all legal and natural institutions are urged to pay the debts they have with Hondutel, without surcharges, interest and penalties. Hondutel seeks to collect some 1,000 million lempiras (around 42 M USD), which will improve its financial situation and might be used to connect rural areas</li> </ul>



# Millicom and América Móvil are the largest players in both the mobile and fixed internet market, leaving previous state-player Hondutel behind



Millicom use the commercial brand Tigo; América Móvil operates as Claro Source: OMDIA; Honduras Government; BCG analysis www.gigaconnect.org | info@gigaconnect.org 159 😯 gig

Backup



2019 2020

## Millicom (Tigo) | Key facts & figures

### Key figures



## 21,000



Headquarters

Ownership

Publicly listed

Employees

- Publicly its
   Top 10
  - shareholders own less than 20%

#### Key financials (USD m) Honduran market



#### Overview

- Millicom is the mobile market leader and the longest established mobile operator in Honduras. Latin America represents approximately 90% of Millicom's business
- Millicom was the was the exclusive provider of mobile voice and data services in Honduras from 1996 until late 2003, when América Móvil entered

#### **Recent news**

- In Q4 2020, when hurricanes hit the island the impact on its infrastructure was relatively modest, but it still caused the disconnection of 8,000 HH.
- The company has been focusing on upgrading its mobile customers and expanding its networks. In Q4 2018 the share of mobile subscribers connected to 4G was 27% and in Q4 2019 it grew up to 38%.
- Millicom is also making efforts to improve the penetration of its network and cross-sell its products to its existing customers.

#### Strategic Partnerships

- Millicom partnered with Amazon Web Services (AWS) to expand and integrate its managed and professional services into its cloud solutions portfolio.
- They also launched its partnership with Amazon Prime Video for its mobile customers which helped with ARPUs figures.

Source: Company website, annual reports, Press research www.gigaconnect.org | info@gigaconnect.org

### Fixed customers (k)

2017

2016



2018



Mobile customers (m) 4,848 4,821 4,678 4,639 4,620 Backup



## América Móvil (Claro) | Key facts & figures

#### Key figures



## H

Headquarters

Employees

10,647



OwnershipPublic company





#### Overview

- América Móvil is the second largest mobile company in Honduras
- They were originally called Megatel.
- América Móvil's Claro units in the Caribbean returned to growth since Q4 2020 following recent COVID impacted quarterly falls.

#### Mobile customers (m), Central America



#### Strategic plans

- Mexican telecom group América Móvil plans to invest to boost its network infrastructure and acquire additional 5G spectrum in new markets. It also approved a plan to spin-off the towers from América Móvil in Latin América.
- In 2011, América Móvil bought the fourth mobile operator in Honduras, Digicel, a Jamaica-headquartered private company. After the merge, the Mexican group committed to an investment of U \$150 m.

#### Infrastructure challenge

• By the end of 2020 América Móvil covered 89% of the population with GSM technologies, 82% with UMTS and only 58% with LTE. This is the lowest among the Group's operations. The share of population with access to LTE grew only 6 percentage points since 2018.

1. Financials include Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panamá Source: Company website, annual reports, Press research. www.gigaconnect.org | info@gigaconnect.org

61 🕂 giga

Backup



## **Hondutel | Key facts & figures**

### Key figures



Headquarters



Ownership

Public company



#### Overview

• Hondutel lost the monopoly of the international and fixed services in 2005. Since then, the company has been losing market share against its private competitors, mostly Tigo (Millicom) to whom it has lost its leadership in fixed, mobile and B2B markets.





#### Strategic plans

 In the last years, the company has tried and failed in different occasions to secure a partner and as a result the government appointed a new management team to run the company, with the aim of expanding and modernising its networks.





#### Financial challenges

- Declining revenues have obliged the government to intervene and pay company wages. At the same time, the company is trying to reduce personnel expenses by reducing the number of FTE. In 2020 it decreased the FTEs by 5%.
- Its dire financial situation has prevented Hondutel from investing in the modernization of its networks and the increased competition from private companies creates obstacles for Hondutel's chances of increasing ARPUs.

Source: Company website; Annual reports; Press research www.gigaconnect.org | info@gigaconnect.org

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# **Deep dive on financials** | Current telco economics of Honduras make (foreign) investment unattractive, as poor return on investments over last decade



No clear information found on why current investments are not effective, however our hypothesis is this is linked to the current tax, legislative and administrative systems. Note: This figure is based on revenues & investments by Telcos active in the market. Changes in the telco market and exits may therefore lead to a different picture vs. looking at successful telcos only. Source: ITU, BCG analysis www.gigaconnect.org | info@gigaconnect.org |



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Country & school overview Connectivity status & developments

Telco landscape



#### Recommendations

Funding models Financial impact of funding models Short-term next steps





# To provide meaningful connectivity to all schools in Honduras, the following four prerequisites need to be met

### Complications in previous attempts

- Termination due to stop of donation/political attention
- SLAs not delivered without consequences from regulator
- Outdated regulation frameworks and rigid tax system limit potential
- Lack of devices and staff IT skills
- Long timeline due to multiple iterations in planning phase
- "
- The government has tried several times to connect more schools, but all tries have failed. International insurance is needed to ensure stability and predictability, which is crucial for a sustainable solution
  - ITU Head Area Office in Honduras

### Requirements for new projects



Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

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Recommendations



#### Funding models

Financial impact of funding models Short-term next steps





## The following five funding models would be sustainable in Honduras



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### revenue sharing

- Currently large players deliver bad/no service to rural schools
- Many local players could connect schools but weren't considered by govt
- Model lets local players tag onto network of large players for small share of revenue
  - Urban/rural



## Electricity as a business model

- 44% of schools and 15% of households in Honduras have no electricity
- Place solar panels next to schools and sell power to community
- Profit can be used to fund school connectivity

### Rural/remote



## USF financing/tax exemptions

- Existing USF fund can be used to fund school connectivity
- 1% of revenue of all internet providers is put in this fund
- Tax exemptions can be given to (local) players who connect schools effectively – although proven difficult in the past
  - All regions



Community

contributions

network

Community builds

and maintains own

Initial funding could

come from NGO

• OpEx covered by key

clinics in the area

clients likes doctors.

expats and medical



## Spectrum auctions

- Upcoming spectrum auctions can be used to establish effective and efficient use of the network
- School connectivity can be a prerequisite
- Works best in urban areas as large players will compete in auction

#### Urban



# **Overview of selected funding models** | Each model brings opportunities, depending on area and local circumstances

Funding model	Considered circumstances	Possible constraints	Would work best in	share
Coverage as a service – revenue sharing model	<ul> <li>Companies that win the school connectivity bids are often from capital, and do not provide timely maintenance in rural areas</li> <li>There are local players that could provide better and more affordable service</li> </ul>	<ul> <li>Success is dependent on willingness of major internet providers</li> <li>Regional approach needs more initial research and administration to set up</li> </ul>	<ul> <li>Rural areas with larger villages, to provide a positive business case</li> </ul>	
Electricity as a business model	<ul> <li>44% of schools currently has no electricity</li> <li>Although 85% of households has electricity, there are still many (smaller) communities that are not connected to the grid</li> </ul>	<ul> <li>Honduran electricity system and regulation is outdated, which can complicate setting up an entity to sell electricity through</li> <li>Need large upfront investment</li> </ul>	• Rural and remote areas where there's no power yet or current power is too expensive	•
USF financing/tax exemptions	<ul> <li>There is a USF in place, funded by tax revenues – providers connecting schools could be exempted</li> <li>School connectivity satisfies all requirements for financing from USF</li> </ul>	<ul> <li>Government decision processes could delay school connection</li> <li>Unsure if this would provide enough money for full funding – can be used as safety net</li> </ul>	<ul> <li>All projects, can be combined with other funding models</li> </ul>	
Community contribution	<ul> <li>Would be most feasible option for hard-to- reach areas like Gracias a Dios</li> <li>No need for buy-in from private parties</li> </ul>	<ul> <li>High CapEx required, could be funded through NGO's or one-off donations</li> </ul>	<ul> <li>Remote areas: few local players and strong communities</li> </ul>	
Spectrum auction	<ul> <li>Auction coming up for previous analogue TV frequencies (3.3-3.7 GHz)</li> <li>Routers could be attached to low (450MHz) frequency networks for local connectivity</li> </ul>	<ul> <li>High frequencies mostly used for 5G network, consider affordability for schools</li> <li>Proven unreliable in the past for rural areas as system would not be maintained</li> </ul>	<ul> <li>Urban areas where connecting schools is relatively easy and cheap to maintain</li> </ul>	

Note that although the government is not directly involved in most funding models, buy-in will be needed to ensure success

**Expected** 



# **Backup** | Of the 10 funding models considered, 5 were selected whereas the other 5 were discarded for several reasons

Coverage as a service – revenue sharing model Government increases school funding	Discarded models	Considerations
Lax exemptions/discounts for ISPs Community pays for connectivity Electricity as a business model	Tax-revenue linked financing	Governments should exhibit transparency and trustworthiness to attract investors
Community contribution Advertising model Spectrum auction	Government increases school funding	School funding is already quite high but efficiency of spend needs to be improved
USF financing	Community pays for connectivity	Unconnected areas are those with highest extreme poverty rates (>70%) so no purchasing power
	Tax exemptions/discounts for ISPs connecting schools	Current telco tax system is too rigid and requires much admin, but once tax system is improved tax discounts could be used as a funding model
	Advertising model	Likely not enough demand to use this as a full funding model due to low purchasing power, but could be considered for additional funding
Coverage as a service – revenue sharing model	/e on D	iscarded models
Community contribution • preferred m	nodels in	ossible models for future projects
Spectrum Auction next sli	des P	referred models for current project
Source: World Bank, expert interviews, BCG analysis		1

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### **Deep dive on coverage as a service - revenue sharing | Local providers** could offer school connectivity at a fair price and provide better service

	Explanation of role	Financial consequences	Considered players
7 blayer	<ul> <li>Large player provides general network, along main infrastructure and cities</li> <li>Allows local player to add onto their network and provides access</li> <li>Large player does not have to provide maintenance, which is a bottleneck in the current system</li> </ul>	<ul> <li>In return for opening the network, large player gets a share of the revenue obtained by local player from connecting the community</li> </ul>	<ul> <li>Main mobile players are Millicom and América Móvil, who both have 4G coverage in most urban areas</li> <li>Most of the fiber is owned by Hondutel and Ufinet, a neutral fiber optic operator that works with international and local ISPs throughout Latin America</li> </ul>
blayer	<ul> <li>Local player provides local network, connecting schools, households and other important community buildings</li> <li>Can add onto general network from larger player, thereby reducing costs</li> <li>Local player is responsible for maintenance and upgrades of network</li> </ul>	<ul> <li>Local player obtains revenue from providing connectivity to schools and community</li> <li>Local player shares part of revenue with large player in return for network use</li> </ul>	<ul> <li>There are currently local players that have a wireless network in place but cannot compete for school connectivity because government usually offers nation-wide projects to firms</li> </ul>
	<ul> <li>The schools and community get reliable connectivity through a player that knows local needs and restrictions</li> <li>Optional: local player trains community members to provide maintenance and training to community (community collaboration model)</li> </ul>	<ul> <li>Schools and community pay a fair price for connectivity</li> <li>When community members provide training and maintenance, internet use will go up and maintenance cost will go down, leading to a more competitive price for connectivity</li> </ul>	<ul> <li>This model would be most effective in rural areas with larger villages that are relatively close to 4G/fiber nodes and where there's already an active local player in the neighbourhood</li> </ul>
vnert interv	view with Secretary of Education: BCG analysis		1

Source: Expert interview with Secretary of Education; BCG analysis www.gigaconnect.org | info@gigaconnect.org

Large

Local

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# **Deep dive on electricity as a business model |** Connecting communities to electricity can fund school connectivity, depending on area and regulations

# Many schools without electricity fall in departments with lower electricity penetration ...



## ... and current Honduran power system needs upgrading ...



Until 2013, the National Electric Power Company had a monopoly position on electricity production and distribution and is still a major player

In May 2014, a new law was approved, opening the market up for small players. Some towns are now providing their own electricity on small scale – although a license is needed to distribute electricity<sup>1</sup>



Because of the large player's oldschool approach, power off the grid is quite expensive in Honduras, making it inaccessible for many households

#### ... providing an opportunity for electricity as a business model in those regions



By installing solar panels next to the internet provider, the school can generate electricity and internet simultaneously, and sell electricity to the community



As solar power is cheaper than electricity of the grid<sup>2</sup> and Honduras has 1500 sun hours per year on average, the school can charge a price slightly above cost price while still being competitive



This additional revenue can be used to fund school connectivity while also connecting communities to electricity – note that legal set-up needs to be checked

1. A license needs to be obtained from the ENEE to generate and distribute electricity – with certain exceptions for low amounts 2. The average price of grid electricity provided to residential and commercial areas was \$0.21 per kWh in 2020, whereas solar panel electricity costs between \$0.08-\$0.15 per kWh in Honduras. Source: El Heraldo 2020; Forbes 2020; Press search; BCG analysis

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## **Deep dive on USF financing** | universal service fund (FITT)

Fondo de inversiones en telecomunicaciones y las tecnologías de la información y las comunicaciones



### Regulations regarding USF

All operators of Public telecommunication services have to contribute **1% of their monthly income** from provision of telco services

Other sources of income are returns of investments made with their own resources or donations

Administration costs are covered with resources in the fund All operators and providers of public telco services are obliged to provide CONATEL with **updated maps of their actual coverage** 

## What requirements need to be met for USF spend?

E B € C

Purpose of the fund is to **finance plans**, **programs and projects to facilitate universal access** and telco service for all inhabitants of Honduras. This can be done through:

1. Subsidizing/financing projects to **install new networks** and services or increase coverage in underserved areas

2. Subsidizing/financing activities to **ensure potential users** of projects **benefit** from connection

- 3. Reduce digital inequality
- 4. **Promote access** to telco services

## Who decides on budget spending?

**CONATEL** is responsible for defining and monitoring access and universal service projects, and to guarantee efficient and transparent spending

**Previous projects** financed by the USF are

- "Internet de Pueblo" this project connected public spaces in specific towns, about 500 schools were connected
- About 400 schools were involved in another project, where equipment and infrastructure was improved and teachers were trained



## How can we use USF to connect schools?

Connecting schools in underserved areas fulfill all four requirements of USF spending, as through instalment of new networks and training of staff and students, digital inequality will be reduced and access to telco services will be promoted.

The USF can be used for specific schools where other funding models are not viable, or for schools where other business models can only cover part of the costs

Moreover, the fund can be used as a collateral to provide loans for projects with high CapEx



## **Deep-dive on community contribution |** Combining the structure of a professionally-run non-profit with a community approach to connect schools

## Local ownership of community-based ISP at the micro level



The local community sets up and maintains the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses.



Setup consists of a WiFi internet backhaul, a Wifi mesh and hotspot, and is powered by a solar panel with a backup battery. Excessive power can be used to charge phones at a cheap price.



Most of the OpEx is covered by a few anchor clients, like doctors, hospitals, expats and local businesses who can afford to pay a regular fee



Community members can buy vouchers for access or set up a dedicated line at home and pay depending on their monthly financial status and schools would be connected free of charge



However, initial investments are quite large and need to be provided through an NGO or one-off donation

### Multi-stakeholder non-profit organization at the meso level



Serves as the bridge between the macro players (telecom providers, the government, technical partners) and obtains funding to:

- Seed and establish the micro level ISP business
- Train and develop capacity to ensure sustainability
- Continuous support on legal, regulatory and technical topics
- Develop and maintain the backhaul infrastructure



**The Zenzeleni Cooperative** pioneered a community network in South Africa. The keys to its success are the professional NPO structure, job creation in the community and smart financing

The project grew from 12 to 75 hotspots, from 2 to 21 anchor clients and from a negative margin to a 51% margin in between 2017 and 2020 – showing impressive progress



# **Deep-dive on spectrum auctions** | Upcoming spectrum auctions could provide new possibilities for school connectivity in urban areas

## Spectrum auctions can be used to sustainably connect schools, if regulator has enough mandate



When new spectrum auctions come up, include in the bidding process that winning party must connect a certain number of schools in certain regions



A fine system needs to be put in place to ensure that parties provide agreed service levels and maintenance



Auction revenues will likely be lower using this method, but it creates incentives to connect schools in a reliable and sustainable way – given that there is an effective regulator checking SLAs are satisfied

This method has been used before in Honduras, but many schools and communities got connected for only a short time. Often the network inreliablity would be blamed on weather conditions and only be repared after checks from the regulator. It is therefore crucial that this process is executed by local providers in areas where the connection can be checked and maintained properly

- Network expert of Secretary of Education

## Upcoming spectrum auction for 3.3-3.7 GHZ (mobile) and 3.7-3.8 GHz for fixed wireless

- Will be auctioned once analogue TV is released (planned for 2020 but postponed due to Covid)
- Frequencies are suitable for 5G networks and therefore attractive for major commercial parties

### Low frequency networks (450-700 MHz) that are currently empty can be used for school connectivity

- Although these frequencies cannot be received by handsets, the frequency can be received by routers, which can then provide Wi-Fi connection for 20 Mbps on selected locations
- This frequency can be received from 100 km, making it ideal for remote locations

**Net1** currently operates through a combination of low(450 MHz) and high (3.5 GHz) frequency networks



They offer end to end connectivity for local government units in the **Philippines**, connecting schools through a turn-key solution

# Tailoring the funding models to the local circumstances can resolve many of the current issues in connecting schools

## From a bureaucracy heavy, nationally focused connectivity program ...

Large players used to win bids for school connectivity as government took a national approach

Maintenance takes multiple weeks while schools keep paying without consequence due to lack of mandate of regulator

Local players can offer more reliable networks in rural areas but could previously not compete for school connectivity

Many schools buy network from a local provider out of pocket, enlarging digital inequalities

44% of schools are currently not connected to electricity and can therefore not be connected in current programs



## ... to a locally tailored and sustainable project in which the community is involved



Large players connect local players to network to jointly provide school connectivity while sharing revenue



Maintenance will be done through local players/community and checked properly by regulator, ensuring fast solutions



Upcoming auctions and projects can be used to give large players extra incentive to collaborate with local players



USF partially covers costs for less profitable areas and can give local players (FITT) tax exemptions depending on service



Electricity as a business model can be used to connect remote communities – solving two issues at once



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# Regional focus will be needed when rolling out connectivity as economic and geographic differences between regions are large

Proposed division for analysis of funding models<sup>1</sup>





### Central states

- Tend to have higher coverage rates, lower poverty rates, higher GDP per capita, higher (school) electricity rates and more urban areas
- Because of geographic & infrastructure circumstances (e.g., lowlands, close to main highways), schools in these regions are easier to connect using mainstream models

### Western & eastern states

- Tend to have lower coverage rates, higher poverty rates, lower GDP per capita, lower (school) electricity rates and more rural area
- Because of geographic circumstances (e.g., elevated topography & vegetation), schools in these regions are harder to connect using mainstream models and will probably rely more on innovative funding models



1. Model allows for easy switch of states between groups Source: expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org

# **P&L of an avg. school<sup>1</sup> in central states** | No model sufficient by itself to cover costs, though clear differences in potential arise



#### Model 1: Coverage as a service (revenue sharing)

### Model 3: One-off government subsidy



#### 1. Using as example a school that does not have electricity access; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs Note: Excludes profit margin for commercial parties. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



Model 2: Electricity as a business model

78 **••••** giga

### P&L of an avg. school<sup>1</sup> in western and eastern states | No model sufficient by itself to cover costs, though clear differences in potential arise



### Model 3: One-off government subsidy







#### Model 4: Community contribution



1. Using as example a school that does not have electricity access; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs Note: Excludes profit margin for commercial parties. Source: BCG analysis

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## **P&L of total area of central states |** No model sufficient by itself to cover all schools of central states, though clear differences in potential arise



#### Model 1: Coverage as a service (millions)

#### Model 3: One-off government subsidy (millions)



#### \$42 \$3 \$7 \$20 \$7 \$11

Electricity as a

business model

Model 2: Electricity as a business model (millions)



Costs

 Assumed, based on external academic sources on telecommunications sector, at 30% of total costs Note: Excludes profit margin for commercial parties.
 Source: BCG analysis
 www.gigaconnect.org | info@gigaconnect.org



Gap

#### P&L of total area of western and eastern states | No model sufficient by itself to cover all schools, though clear differences in potential arise



#### Model 3: One-off government subsidy (millions)



Note: Excludes profit margin for commercial parties.

Source: BCG analysis

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#### Model 2: Electricity as a business model (millions) \$59



#### Model 4: Community contribution (millions)



Indirect costs<sup>1</sup>

## P&L of Honduras | Funding models can lead to school connectivity if assumptions turn out positive



1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; 2. Brazil's current value is 1.4 (ITU); Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: ITU, BCG analysis

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# **P&L of Honduras | Combining funding models leads to school connectivity in theory, however many hurdles need to be overcome**

Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved...



1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

### ...however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter 'short-term next steps')
- In addition, the current model does not account for potential profit margins that commercial parties demand. These numbers have not been included to allow for flexibility in operating model choice (e.g., infrastructure may be provided on non-profit basis due to CSR efforts)
- Even though the full potential of these models may not be realized in practice, this exercise still provides us with useful insights. It shows:
  - Which models have the largest potential payoff in covering capex & opex
  - What prerequisites "need to hold" for the funding models to work
  - The potential upside of overcoming the hurdles that require solving



#### Backup

## **Detailed assumptions |** These are the "what you need to believe" for these P&Ls to hold true and what targets must be met for theory to meet practice

#### Model 1: Coverage as a service (revenue sharing)

- The basic underlying premise of this funding model is that gov't input is needed to 'close the gap' Assuming efficient markets, these areas would have already been covered by commercial parties if financially attractive. As such, this model cannot stand on its own
- The funding model for open access network operators is assumed to be equal to that of the community contribution model (see model 4)
- This model also allows for a cost-reduction, assuming that local players are more efficient on a small-scale operation or in the particular region. As such, a cut of 5% on capex and 10% on opex has been assumed vs. the usual cost assumptions
- In return for opening the network, large player gets a share of the revenue obtained by local player from connecting the community

#### Model 3: One-off government subsidy

- A one-off subsidy from the government is provided to cover initial capex expenditures and accompanying indirect costs<sup>1</sup>, which could be financed by the following methods, provided assumptions hold true:
- Spectrum auctions: The reduction in the spectrum price paid by commercial parties is equal to the price of initial capex and the indirect costs attributed to the addition of the new last-mile connectivity
- USF financing: The USF has enough funds and is willing to attribute enough financing to cover one-off capex and attributed indirect costs
- Tax exemptions: The government is willing to provide tax exemptions that equal the one-off capex and attributed indirect costs

#### Model 2: Electricity as a business model

- Around ~600 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~80 people can be served by a 100 m2 solar roof, given:
  - ~37,000 kWh annual output
  - 80% utilization
  - 288 kWh average annual consumption per person, which is the country's current value
  - ~6,000 kWh consumed by school
- Customers will pay \$0.11 per kWh (60% of country's grid price)

#### Model 4: Community contribution

- Around ~600 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~16 are willing to use school connectivity in year 1, ramping up to ~60 people in year 10. This is based on the growth behavior seen in other countries with similar penetration rate, but with an assumed growth cap at 10% of population living around each school
- These 16 (Y1) to 60 (Y10) people are willing to contribute 2% of their Gross National Income (GNI) per capita, following ITU's recommendation for affordable internet. GNIpc is assumed to increase 4% per year, in line with the historic 5year average compounded annual growth rate

1. This implies a one-off government subsidy that will cover 4 years of 4G, WISP, and satellite connection (assumed depreciation period), and 20 years for fiber Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF). Source: BCG analysis

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Short-term next steps





#### Recommendations for short-term next steps



Install a workgroup with members of several institutions, like CONATEL, Secretary of Education, ENEE and other parties to increase transparency and data sharing

Roll out three pilots



Use electricity as a business model in remote areas to connect 10 schools and communities

- Use the revenue sharing funding model with the local players offering fixed wireless broadband in rural areas to connect 25 schools
- Set up 10 community networks in remote areas that have strong communities (and lower risk of vandalism) in collaboration with research centers following the Zenzeleni model



Conduct a competition analysis to see if current lack of competition could result in low innovation levels



Examine the regulatory network to see if operators distributing electricity to communities and operators running a community network receive the appropriate protection



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187 **giga** 

## Indonesia case study





#### **Country profile | Indonesia**

<b>S</b> Key figures	<ul> <li>Population: 270 m</li> <li>GDP: \$1139 B</li> <li>GDP per capita: \$4,221</li> <li>GDP growth: 7.6%</li> <li>Investments/GDP: 31.3%</li> <li>Urban population: 57%</li> <li>Total population under 18 years: 31.1%</li> <li>Secondary completion rate: 87.9%</li> <li>Adult literacy rate: 95.7%</li> <li>% of schools connected: 76.3%</li> <li>Connectivity starting point: 76.84%</li> <li>Electricity penetration: 98.9%</li> </ul>
Demography of schools	<ul> <li># of schools in country: 218k</li> <li>Average no. of students per school: 198</li> <li>Current % of schools with internet connectivity: 81%</li> <li>The proportion of unconnected school is much higher in the sparsely populated islands, like Papua (lowest population density). The Ministry estimates 71% of schools in Papua are not connected to the internet</li> </ul>
Government involvement	<ul> <li>% GDP spent on education</li> <li>6.1</li> <li>6.3</li> <li>3.1</li> <li>3.6</li> <li>0.4</li> <li>Nigeria Rwanda Indonesia Honduras Brazil</li> <li>SL</li> <li>7.7</li> <li>6.1</li> <li>7.7</li> <li>6.3</li> <li>7.7</li> <li>6.1</li> <li>6.3</li> <li>6.3</li> <li>7.7</li> <li>6.1</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>7.7</li> <li>6.5</li> <li>9.6</li> <li>9.7</li> <li>9.6</li> <li>9.6</li> <li>9.6</li> <li>9.7</li> <li>9.6</li> <li>9.6</li> <li>9.6</li> <li>9.6</li> <li>9.7</li> <li>9.6</li> <li>9.7</li> <li>9.7&lt;</li></ul>

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## Indonesia's geography forms a barrier to be able to connect all schools, different funding models apply for the less developed regions

Context: The mobile segment in Indonesia plays a major role. Mobile internet is widespread and penetration is over 130%. However, only 14% of households are subscribed to the fixed segment, with the many islands being a major obstacle. ~19% of schools in Indonesia are not connected to the internet. 70% of these unconnected schools covered by a base transceiver station, while 12,600 (30%) schools are not, meaning the schools are completely removed from connectivity. Additionally, the unconnected school proportion is much higher in sparsely populated areas. A five-year plan made in 2019 aims to provide 20 Mbps service to 30% of the population, including 71% of urban households. Still, 13M people across 12,500 remote villages have no internet access



To connect schools in Indonesia, funding is required on the four technologies. Given low penetration of fixed broadband in the country, WISP, 4G and satellite are expected to hold higher relevance. The share of funding is determined as follows:

- Fiber: 30%
- WISP: 30%
- 4G: 38%
- Satellite: 2%

#### **Cost structure**

A total annualized investment of \$168M is needed to fund school connectivity in Indonesia.

An additional \$20 will have to be spent per unconnected student on an annual basis to fund school connectivity.

For an average school that is not connected to electricity, \$4,450 is required on an annualized basis



Different funding models are considered for the well-developed versus less developed. For the well-developed regions the following models are considered:

- Demand-side subsidy
- Prerequisite in upcoming 5G spectrum auction
- Build, Operate and Transfer
   by BAKTI
- Revenue-sharing

For the less developed regions:

- Demand-side subsidy
- USO financing
- Regulated advertising model
- Community contribution
- Govt co-invest alongside SPs



In terms of operating model, the following is advised:

- Private company/consortium for coverage as a service (revenue-sharing)
- State/gov't driven for the gov't budget increase
- Turnkey (+ Lease) for one-off gov't subsidies
- Cooperative and Voluntary set-ups for community contribution



#### Multiple funding models (private, PPP, state and community) can be used, thereby involving different stakeholders in the process of improving connectivity

Funding model		Explanation		Operating model
Α	Coverage as a service – revenue-sharing	The revenue-sharing model falls within the commercial-provided archetype. It is guided by the private company/consortium operating model. This model is more relevant for well-developed regions e.g., Java, Bali and Sumatra. Private individuals have already set up their own networks covering ~20 households – a formal model connection local businesses and main operators must be established	$\diamond$	Private company/ consortium
В	Government increases school funding	Falls within the government-contributed archetype and therefore the state/government driven operating model is advised. As no new infrastructure would be needed in this model, the operating model would be focused on optimal use of funding, rather than infrastructure development.		State/government
С	One-off government subsidy	Spectrum auctions and USF financing are (implicit) one-off subsidies. USF financing is gov't- driven, however can be conducted in a wide variety of methods (e.g., BAKTI owns infrastructure, or outsources to commercial parties). The spectrum auction is an implicit PPP model given the need for agreement both the gov't as well as commercial parties. Another subsidization model is Build-Operate-Transfer (BOT) where BAKTI licenses rights to operate in an auction, which includes a mandate subsidization of school connectivity	$\diamond$	Turnkey (+ Lease)
D	Community contribution	The community contribution model builds on the community-based archetype. It is more appropriate for less-developed regions e.g., Kalimantan, Sulawesi, Nusa Tenggara and Papua. Local ownership is based on supporting community-based micro-enterprises. Village ownership may be more successful, as the NPO or local gov't provides continuous guidance and training in addition to initial funding	$\diamond$	Cooperative and Voluntary

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Deep-dives on next pages There are large socioeconomic differences between islands

Meaning that several districts have weak or no mobile broadband signals

With an estimated 19% of schools that are not connected to the internet yet







3 5. 2.

## Large populations separated by islands with significant socio-demographic differences



Kalimantan	
Population (%)	6.1
GDP (%)	7.9
Pop. density (people/km2)	30

Sumatera	
Population (%)	22.0
GDP (%)	21.4
Pop. density (people/km2)	123

7.3
6.7
105

Java	
Population (%)	56.2
GDP (%)	58.7
Pop. density (people/km2)	1,172

Papua & Maluku	
Population (%)	2.8
GDP (%)	2.3
Pop. density (people/km2)	15

Bali & Nusa Tenggara	
Population (%)	5.6
GDP (%)	2.9
Pop. density (people/km2)	207

501-1.500

>1,500

101-500

People/KM<sup>2</sup> 0-100





#### 1,139 U\$ Bn 2021 GDP 2021-24 + 3.2% y-o-y



1,916,907 km<sup>2</sup>

Source: Statistics Indonesia, EIU, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

## Indonesia is the world's largest island country, with significant variances in connectivity set up

### The world's largest island country, it consists over 17 thousand islands, with 4 distinct topographical regions...

One of the main challenges to developing ICT Infrastructure in Indonesia is its geography. This includes the number of islands, size of the territory to cover, the numerous remote and difficult to reach areas, and the number of low-income and uneducated inhabitants



## ... and significant variances in connectivity set up, with the East being less connected

Due to the limited funding capability of both the government and the private sector, infrastructure development cannot fully meet the demand in Indonesia. Thus, isolated and impoverished parts of the country are unconnected



Sources: World Atlas, ITU Broadband maps, ITU digital regulation platform, GSMA www.gigaconnect.org | info@gigaconnect.org

## Different economic set-ups of regions must be taken into consideration in rolling out school connectivity

#### High labor force has made Java to be the epicenter of manufacturing and economic development ...

Labor force (m), split formal/informal labor (%), labor force/total population (%)



## ... which leads to higher GDP & spending per capita ...

GDP per capita (IDR m) and spending per capita (IDR m)



#### ... and lower poverty rates...

Poor people to total population (%) and split urban/rural(%)



196 **;;;; gig** 

Source: Statistics Indonesia, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

#### Differences in population density leads to variances in school set up

Population is concentrated in two islands, with one island having an extremely high population density Total population (m), split urban/rural (%), and population density (people/km2)



### ...leads to higher number of schools in the two islands despite little variability in students per school

No. of schools per region ('000), split primary/secondary/high school (%) and students per school



Source: Statistics Indonesia, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

# Many students still have limited or no internet access, making it difficult to give online education

## Although Indonesia has relatively smaller proportion of schools without connectivity ...

School connectivity distribution (%)



## ... studying from home is difficult for many students across country ...

More than a third of Indonesian students has limited or no internet access [including at home]

Ministry of Education, Culture, Research, and Technology

<sup>CO</sup> There are 42,159 or ~19% of schools in Indonesia still without access to internet, even though 70% of these schools under BTS coverage

Ministry of Education, Culture, Research, and Technology



Putri Salsabila – Student in Kenalan Village, Central Java





#### Indonesia has a 99% electrification rate with almost equal access for both urban & rural, however ~9,500 schools still operating with no electricity



Source: Giga school data, Worldbank, MECRT, Press search, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

199 🤸 gig

# Java, Bali & Sumatra also have the best 4G coverage in schools, and are relatively closer to nodes which would allow them to connect more easily

## The three well-developed islands have relatively better 4G coverage

3G/4G coverage in schools

www.gigaconnect.org | info@gigaconnect.org

100% Java 85% 100% Bali 76% 70% National 54% 56% Sumatra 35% 51% Kalimantan 31% 35% Sulawesi 28% To achieve meaningful connectivity, a 4G 26% Nusa Tenggara 9% connection is required Papua 6% Maluku 6% Strong 3G Signal Strong 4G Signal Source: Giga school data; BCG Analysis

And in Java and Bali nearly all schools are within 25 km of a node, thus within easier connection reach



Percentage of schools withing x distance to node

# Increasing the school connectivity might face major structural challenges in the sparsely populated islands

School connectivity varies between islands, it's estimated that ~19% schools across Indonesia are not connected to internet ...



MECRT- Ministry of Education, Culture, Research and Technology Schools - Include primary, secondary and high school Source: Unicef, Press search, BCG Analysis www.gigaconnect.org | info@gigaconnect.org ... while no connectivity is more intense in the sparsely populated islands ...

- According to MECRT, there are ~42,000 or 19% schools across Indonesia that are not connected to internet
- 70% of these unconnected schools covered by a base transceiver station, while the 12,600 (30%) schools are not, which means the schools are completely removed from connectivity
- The unconnected school proportion is much higher in the sparsely populated islands, like Papua where it has the lowest population density, the Ministry estimates 71% of schools in Papua are not connected to the internet
- Moreover, in the sparsely populated islands, where overall connectivity coverage is low, schools have more structural challenges to connect and higher cost to serve



## Example | Inside Java, the most connected island, connectivity gap still exist in rural areas, with limited device available to connect



Source: Press news, BCG Analysis www.gigaconnect.org | info@gigaconnect.org



# The multilayer administration structure with its own autonomy might bring more complexity for project coordination and funding set up



- Since the early 2000s, Indonesia has implemented a decentralization policy by giving regional govt more power in determining the uses of budget and agenda
- However, the administration and fiscal viability of decentralized governance are restricted by its social capacity, resource base, investment and infrastructure
- More autonomy also brings more complexity to align the strategic national agenda and its implementation
- Minister of Education stated that, only 15% of IDR ~550 Tn education budget is managed under the ministry, while the rest is managed by local government and other ministry

Central govt non-tax and tax revenues – VAT, income tax, luxury tax, share profits from SOE, oil & gas, etc. Provincial govt non-tax and tax revenues – Vehicle tax, fuel tax, share profits from regionally-owned ENT., etc. City/district govt non-tax and tax revenue – Hotel, restaurant, entertainment taxes, other retribution, etc.

Source: Ministry of Finance, Press search, BCG Analysis www.gigaconnect.org | info@gigaconnect.org



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# Costs of a mobile broadband data basket are below affordable level, yet income spent on fixed broadband is still considerably high

## 1.3% of GNIpc spent on 1.5 GB mobile broadband data basket, which is below ITU recommendation for affordable internet ...

Spent on data-only mobile-broadband (1.5GB) as % of gross national income per capita-2020



... on the other hand, fixed broadband costs are still considerably high, with 10.9% of GNIpc spent on a 5 GB FBB data basket

Spent on fixed broadband (5GB) as % of gross national income per capita-2020



5 🔨 giga

# Many districts still have weak or no mobile broadband signal, while fixed broadband penetration is considerably low at 0% for some provinces

Despite mobile broadband costs being below affordable level, many districts still have weak or no signals ...

Villages with weak or no signal (%)



... while fixed broadband penetration only reaches 15% of HH, with 13 provinces having a 0% rate

Fixed broadband access to total households (%)



of 🕂 gig

# Solutions are required to improve coverage quality to reach better (school) connectivity



Note: Strong signals split 4G/3G/2G using BTS types proportion from the top 3 telco operators; Telkom, XL, Indosat Source: Statistics Indonesia, Company Data, MECRT, BCG Analysis www.gigaconnect.org | info@gigaconnect.org



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#### **Overview of telco landscape in Indonesia**

Characteristics	Description
Current status of fiber and 4G, WISP, and of satellite coverage in country	<ul> <li>Despite the high penetration of mobile services in Indonesia, there is still a connectivity gap between sparsely populated island and densely populated island in Indonesia, mainly outside Java</li> <li>In 2019, Statistics Indonesia reports that only 41.8% out of ~84,000 districts in Indonesia have BTSs, and ~30% of districts in Indonesia having weak/no signal</li> <li>Significant improvement in connectivity has been shown in the last 3 years after the Indonesian government initiated the Palapa Ring project under national strategic agenda in 2016. The goal was to lay 36,000 km of fibre optic cable connecting from the west to the east part of Indonesia to provide high-speed internet</li> <li>The number of fixed broadband connections remains relatively low, with penetration only ~18% of households. The country's geography, consisting of 17,000 islands, is an obstacle for operators' deployments that have focused on fiber</li> <li>The regulator launched different initiatives to improve the capacity and reach of fixed-broadband services. The five-year plan, publicized in 2019, aimed at providing a 20 Mbps service to 30% of the population, including 71% of urban households</li> </ul>
Competitive landscape	<ul> <li>Indonesian telecommunication sector has been increasingly competitive after the removal of monopoly regimes in the early 2000s and increase of the 49% foreign ownership cap to 95%</li> <li>Currently there are 5 major players in mobile services, with Telkom as market leader covering almost 50% of total ~355m mobile subscription in 2020</li> <li>In fixed broadband, where there is even lower penetration, market share concentration is more pronounced with Indihome (part of Telkom) accounting ~85% of total ~ 11.8m fixed broadband subscriptions in 2020</li> </ul>
Spectrum auction for 5G won by 2 players	<ul> <li>3 blocks of 2.3GHz frequency auction that will be used for 5G networks has been conducted this year and won by 2 telco player, Telkomsel (2 blocks) and Smartfren (1 block)</li> <li>The 2.3GHz frequency auction was divided into three blocks in the range 2360-2390 MHz with a capacity width of 10MHz each</li> </ul>





💭 Major changes	Description
Joint Service Operation (JSO) to provide 4G mobile services in remote areas	<ul> <li>In June 2021, the Telecommunication and Information Accessibility Agency (BAKTI KemKominfo) opened a joint service operation (JSO) for telco operators to participate in providing 4G mobile services in remote/underdeveloped regions across Indonesia, to alleviate some of the financial burdens.</li> <li>Under this JSO, BAKTI will be responsible to provide base transceiver station (BTS) and other supporting infrastructure including the land site for the BTS that can be used by telecom providers to provide 4G cellular services.</li> <li>This arrangement will incentivize telco operators to penetrate the low economic scale regions with lower capex. As a result, there will be wider network coverage to the regions and more schools will be connected</li> </ul>
IDR 17 Tn of 2021 state budget to improve internet connectivity	<ul> <li>Ministry of Finance Indonesia stated that Indonesian government allocates IDR 17 Tn (\$ 1.2 Bn) of 2021 state budget to improve connectivity across Indonesia mainly for ~9,000 remote / underdeveloped villages</li> <li>This budget is a part of government 5 year agenda to improve Indonesia's connectivity inclusion especially in Indonesia's outermost, frontier, and underdeveloped areas (3T)</li> <li>Together with improving the connectivity, it will allow more equalization of internet access to schools and the community</li> </ul>
Next frequency auction to increase available spectrum for 5G	<ul> <li>Another frequency auction to be set in 2022 for mmWave (26 – 28 GHz) and 700 MHz after the expiry from the current band usage in TV services</li> <li>KemKominfo also plans to offer 3.3 GHz and 3.5 GHz in 2023, and possibly 2.6 GHz in 2025</li> <li>These additional frequencies will help telco providers roll out 5G services as currently there is limited spectrum for it</li> </ul>
2020 Omnibus Law to increase telco sector efficiency	<ul> <li>The Omnibus Law allows telecommunications operators to share and transfer spectrum with prior approval from the central government. This flexibility could potentially pave the way for mobile industry consolidation</li> <li>Sharing passive infrastructure with other telecommunications operators became mandatory under the new law. This potentially will allow smaller players in the industry to expand networks at slightly lower capex</li> </ul>



Indonesia

## Penetration levels of fixed broadband has room for improvement, whilst increasing uptake in fixed broadband subscribers

#### Mobile broadband (MBB) declined post identity registration requirement; fixed broadband (FBB) needs wider infrastructure deployment

Mobile broadband penetration to population (%) and Fixed broadband penetration to households (%)



Increasing fixed broadband subscribers driven by the rollout of infrastructure by Telkom, which currently has ~85% FBB market share

Fixed broadband subscriptions (in m)



Source: Omdia, BCG analysis www.gigaconnect.org | info@gigaconnect.org

211 🔨 🥳 g

## 60% mobile broadband subscribers have access to 4G, with three telco players controlling 80% of market share

#### ~97% internet subscription using mobile broadband, while nearly ~40% MBB Telco industry has consolidated from ten subscribers still cannot access 4G operators in 2013 to five operators in 2020 2020 internet subscribers (in m) Mobile broadband subscriptions (in m), split by market share (%) Mobile subscriptions declined in 2018 after the government # of 7% of "Others" market operators share in 2013 consists of 5 imposed the 367.3 367.3 355.5 439.0 operators 3 2% 3% requirement that 12.8% 4 387.5 15% 342.6 prepaid SIM card users 3% 329.1 324.1 355.5 341.0 7% need to register their 7% 13% 323.3 18% 8% 3% 12% SIM with their national 26.5% 4% 11% 9% 3% 19% 10% identity 12% $\left(\right)$ 11% >17% 16% Telco industry has 25% 17% 12% 18% 18% undergone 22% 96.8% 17% 17% 18% 20% consolidation process in 20% 18% the last ten years; from 60.6% ten operators to now 45% 45% five key players, with 50% 48% 50% 45% 45% 42% 5 three players controlling ~80% of market share Internet Internet type Mobile 2013 2014 2015 2016 2017 2018 2019 2020 subscribers broadband Mobile broadband Indosat 📃 XL Axiata 📕 3 Indonesia 📕 Smartfren Fixed broadband 2G 3G Telkom Others

Source: Omdia, BCG analysis www.gigaconnect.org | info@gigaconnect.org 12 😯 giga

# Significant difference in 4G download speeds observed across operators despite similar 4G availability



4G Download speed – This metric shows the average download speed for each operator on LTE connections as measured by users

4G Availability – The proportion of time users have an LTE connection available to them on each operator's network. It's measure of how often users can access the 4G network

Source: Open Signal, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

Smaller players continue increasing their network

# Telkom leads in terms of size and as a result of its scale advantage manages to have higher profitability levels

Telkom leads by controlling the largest market share both in MBB and FBB, followed by Indosat and XL whose revenues are mainly driven by mobile broadband services; Telkom managed the scale, yielding higher EBITDA margin compared to peers

Revenue and EBITDA (IDR Bn), EBITDA margin (%)



214 🥆 gi

## Telkom capex has remained constant, with smaller players investing slightly more to expand their 4G network

Telco players aggressively increased their capex in 2019 to expand 4G base stations nationwide; Capex/revenue intensity higher in the smaller players as they are trying to increase network coverage & quality Capex (IDR Bn) • XL and Indosat to



- XL and Indosat to continue 4G network expansion, especially outside Java and increase the network quality
- While Telkom has an established mobile network outside Java already, its CapEx remain constant to expand its fixed broadband network
- Passive infrastructure sharing requirement in new Omnibus Law provides long-term positive for the industry capex efficiency

Source: Company Data, BCG Analysis www.gigaconnect.org | info@gigaconnect.org
# Several interesting partners exist in Indonesia to reach school connectivity, either in terms of funding potential, or in terms of operating model



## IdREN

A dedicated network infrastructure that connects research and dedication institutions, IdREN could be an operational partner for connecting schools





## **Universal Service Obligation Fund**

Indonesian USF to fund network coverage in the outermost, frontier, and under-developed areas. USO is likely to be the main source of fund to help govt co-invest alongside service providers in remote areas





A MCIT's arm to bring digital infrastructure and ecosystems in areas that are not commercially viable, BAKTI is a good candidate to work with as operational partner for connecting school



#### Deep-dives on next pages

Note: BAKTI is the sole government agency that manages the USO. There is however a case in which the ministry of education could indirectly get support from the USO fund (for connecting schools). BAKTI is working with the MoE to connect schools using the USO fund. Therefore, contacting only BAKTI is the most logical route. However, as theoretically another option does exist, both have been highlighted here www.gigaconnect.org | info@gigaconnect.org



# IdREN brings better connectivity for education and research, providing potential operating model for wider coverage

IdREN initiated close collaboration between stakeholders for better connectivity in education and research ...



... and provides potential operating model to reach wider coverage into primary and secondary schools across country ...

- Founded in 2017, IdREN is a dedicated network infrastructure that connects research and education institutions and community in Indonesia through national closed network that could bring faster and more reliable connectivity
- In this collaboration, telco providers help to provide network and communication services, colocation data center, and network backbone interconnected with Global Research & Education Network
- Although this infrastructure still limited to universities and research institutions, it provides potential operating model to connect basic education like primary/secondary schools. There is also no indication that IdREN would not be open to it, therefore it has a potential to open for discussions
- Working together with IdREN in connecting schools would allow for:
  - Reliable connectivity, through national closed network that currently in place
  - Access to funding & expertise, as IdREN has connected many institutions across country together with its partners from telco industry

🤊 🤨 giga

# USO, Indonesian USF to fund network coverage in the outermost, frontier, and underdeveloped areas

Funded by telco operators' contributions to fund coverage in underserved areas ...

- A non-tax govt revenue (PNBP)
- 1.25% of gross revenues contributions from telco operators, paid quarterly
- IDR ~3.3 Tn (\$ ~227,6m) annually



- Main uses to fund network infrastructure and OpEx subsidy in underserved areas
   Using regulated user tariff
  - Managed by TIAA under MCIT
- Criteria in utilizing USO is the region has no connection or the connection is less than 50% coverage



- Palapa Ring is a 36,000 km fiber optic backbones project connecting the west, central and east Indonesia funded by USO
- In 2019, government has completed ~12,000 km with estimated cost of IDR ~7.7 tn. Another ~13,000 km is estimated to start the construction in 2022 - 2023
- From the ~12,000 km completed, 6,300 km is established in the east region, connecting the highly unconnected regions such as Papua, Maluku, and Nusa Tenggara
- As a result, remote regions like Papua saw a significant improvement of more than 80% in download speed in 2020 compared to 2018.
- ~7,900 BTS in the outermost, frontier, and underdeveloped regions to be built Previously, government has built ~ 1,200 BTS in 2020 funded by govt budget and USO

... and connecting schools and increasing digital literacy ...

- In cooperation between MECRT and MCIT, government has connected ~1,500 schools in remotes area from 2015 – 2018, funded by USO. The program including funding the device acquisition for the usage of internet
- Besides physical infrastructure, government is expanding the agenda into digital literacy through seminar and other socialization methods
- Whether the government will allocate USO to fund local start-ups is under discussion, but the decision is not clear yet
- USO money is spent via BAKTI (see next page)

**TIAA** – Telecommunication and Information Accessibility Agency (BAKTI KemKominfo) **MCIT** – Ministry of Communication and Technology

MECRT – Ministry of Education, Culture, Research and Technology

Source: ITU, respective websites, BCG analysis www.gigaconnect.org | info@gigaconnect.org



# Bridging the connectivity gap and building digital ecosystems in not commercially viable areas through BAKTI



## Vision

• Bridging the digital divide for Indonesia's better future



• BAKTI (TIAA) is an MCIT's arm on connectivity program, with main function to build digital infrastructure and ecosystems in areas that are not commercially viable



- Mainly funded by USO, with budget of IDR ~3.3 Tn annually
- Direct allocation from state budget (size unknown)

... with priority programs to build both the infrastructure and the ecosystem needed to better utilize the digital connectivity

### **Building digital infrastructure:**

- Villages' connectivity using 4G BTS, building or upgrading 2G/3G site to 4G. Its focus mainly in the outermost, frontier and underdeveloped (3T) regions
- Internet access for public services including in school, public health center, etc.
- Provision of satellite capacity rental and high-throughput satellite to support providing internet access in public services, using Satellite of Republic Indonesia (Satria). BAKTI targets there will be 10,000 points that will be supported by Satria services in 2023
- Palapa Ring, connecting the outermost regions with fiber optic to provide high-speed and reliable internet connectivity

#### **Building digital ecosystem:**

- Building ICT ecosystem to develop human resources capabilities and expand the penetration of digital-based public services in unfeasible areas
- Working together with the Ministry of Villages, Disadvantaged Regions, and Transmigration to strengthen the digital economy ecosystem and grow economic potential in villages
- As a facilitator to develop digital literacy of the community

**TIAA** – Telecommunication and Information Accessibility Agency (BAKTI KemKominfo) **MCIT** – Ministry of Communication and Technology

Source: Expert interview, MCIT, Press news, BCG Analysis www.gigaconnect.org | info@gigaconnect.org



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The key issue to be resolved in Indonesia, besides funding, is regional differences



Extreme regional differences exist between islands in Indonesia that lead to large discrepancies in educational standards between regions



While mobile broadband costs in GNI per capita is below the 2% recommendation, taking into consideration the regional differences, being online is unaffordable for many on the poorer islands because income levels are lower



These differences lead to the regions being less attractive to commercial parties, which exacerbates the problem. Low-hanging fruit, or the projects that have slightly positive NPV, have already been invested in, leaving only the areas with the worst prospects



Besides the relatively high costs in poor regions, digital literacy is likely to be low because of low connectivity, meaning that demand would for connectivity would be low even if coverage was expanded by telco operators. Thus, telco operators are again less likely to invest in these regions, as revenues will be low



For example, after the completion of the Palapa ring near Papua, the least densely populated island of Indonesia, mobile operators were still reluctant to broach the island because of low commercial viability

Innovative funding models will help address these regional differences, but in order to become fully sustainable in the long run, these issues need addressing



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# Digitalization and school connectivity being top of mind of Indonesia leaders ...

# "

I hope that the 2021 Digital Connectivity program will become an important momentum that can connect Indonesian people with new technologies, new mindsets, new global business opportunities, and a new future towards advanced Indonesia.

Joko Widodo, (current) President of Indonesia Launching of 2021 Digital Connectivity program February 2021

# "

Those (in the outermost, frontier and undeveloped regions) who really need equal distribution of internet access (in schools) like we have in the cities. This equalization continues to be pursued by the government..

Nadiem Makarim, (current) Minister of Education, Culture, Research, and Technology Bringing digitalization to schools February 2021

- Under his administration, Indonesia's President Joko Widodo, has launched several initiatives in bringing new era of digital disruption to citizens
- One of the main agenda points is bringing digital inclusive revolution, with three principles of access, affordability, and ability
- He emphasizes the importance of equal distribution for connectivity especially on the outermost, frontier, and underdeveloped regions
- By entering his second (last) period, the upcoming election in 2024 would again determine whether this strategic agenda still in place with the new elected leader



# ... However, school connectivity gaps remain, especially in islands with lower population density, thereby requiring different funding solutions per region

Well-developed islands of Java & Sumatra with high population density that are generally easier to connect or have already been connected



Less developed islands of Kalimantan, Sulawesi, Nusa Tenggara & Papua with low population density and that are harder to connect



## Regional focus: Java, Bali & Sumatra

Well-developed islands with good connectivity for general population and higher school connectivity levels



# Most of schools are connected already, despite Sumatra still needing more equalization of internet access

# High concentration of population in Java ...

## Population (m)





Spending per capita (IDR thousands)



# ... and more schools are connected, although connectivity gap still exist in Sumatra



Schools per region map

## For the well-developed regions, we believe four funding methods would be especially suitable to reach 100% school connectivity of a meaningful standard

Funding method			Reason for suitability	
	Demand-side subsidy	Overlaps with region 1	<ul> <li>Suitable because: Government of Indonesia has shown high willingness to work with service providers to connect unconnected regions. In addition, government has shown willingness to invest in education</li> <li>Reason for concern: Government funding on education already very high vis-à-vis neighboring countries. Therefore, sustainability of solution in long-term likely not high. A combination of money from different, relevant ministries could work, so long as the total amount funded is a small increase</li> </ul>	
☑ A ☑ B ☑ C	Prerequisite in upcoming 5G spectrum auction		<ul> <li>Suitable because: Commercial sector is most efficient in rolling-out connectivity</li> <li>Reason for concern: Commercial parties may have misaligned interests and provide lower quality service vs. intended government/project outcomes. In addition, making school connectivity for all of Indonesia a prerequisite may lead to undesired responses to the RFP. Therefore, we would suggest to only include slightly negative, break-even, and positive cases, but exclude those that are too hard-to-connect</li> </ul>	
	Build, Operate & Transfer by BAKTI		<ul> <li>Suitable because: BOT where BAKTI is the procuring partner setting up the networks. Right to operate is licensed through an auction, which then includes a mandate subsidization of school connectivity.</li> <li>Reason for concern: Same as for '5G spectrum auction'</li> </ul>	
	Revenue-sharing		<ul> <li>Suitable because: Private individuals are currently setting up their own networks that cover about 20 households. As this is technically illegal, a formal version of this is a revenue-sharing model where local businesses set up their own network by connecting to the main operators. These entrepreneurs are more flexible than operators, thus can cover areas where it is unviable for large players.</li> <li>Reason for concern: Licensing and upfront CapEx needs to remain affordable and not too complicated for local businesses.</li> </ul>	

Note: USO funding was removed from consideration for well-developed regions due to the maximum 50% coverage requirement Source: BCG analysis

www.gigaconnect.org | info@gigaconnect.org

# Demand-subsidy | Government's allocation to school funding is already high, making an increase from moe unlikely to be sustainable

## Education spending allocation has been maintained at ~20% from total spending in the last 6 years ...

Government education spending (IDR Tn) and the allocation to total government spending (%)



# ... which is considerably higher allocation than neighbor countries ...

Govt education spending allocation to total government budget (%)



# ... but a 1% increase can already make a large difference

- In 2021, government allocates IDR ~7.4 Tn (1.3%) to support digitalization and building connectivity infrastructure for public education services
- Only 15% of education budget is managed by MECRT, while a huge portion (54%) is directly managed by local governments (including the IDR ~7.4 Tn budget), bringing more complexity in aligning the government strategic agenda
- However, a 1% in education budget would already mean an IDR 5.5 Th increase, which could be directly used to pay

for connectivity



MECRT- Ministry of Education, Culture, Research and Technology

Source: Ministry of Finance, Press news, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

## **Prerequisite in upcoming 5G spectrum auctions : Upcoming** spectrum auctions could provide new possibilities for school connectivity in

**urban areas** Spectrum auctions can be used to sustainably connect schools, if regulator has enough mandate



When new spectrum auctions come up, include in the bidding process that winning party must connect a certain number of schools in certain regions



A fine system needs to be put in place to ensure that parties provide agreed service levels and maintenance



Auction revenues will likely be lower using this method, but it creates incentives to connect schools in a reliable and sustainable way - given that there is an effective regulator.



This is an urban, rather than rural solution, as 5G-enabled devices are more expensive and higher connectivity speeds are usually rolled out there first. Subsequently, funds from these auctions can be used in rural areas through cross-subsidization

## Upcoming spectrum auctions in 2022 (26-28 GHz and 700 MHz), 2023 (3.3-3.5 GHz), and 2025 (2.6 GHz)

Frequencies are suitable for 5G networks and therefore attractive • for major commercial parties

## Low frequency networks (e.g., 450 MHz) that are currently empty can be used for school connectivity

- Although these frequencies cannot be received by handsets, the frequency can be received by routers, which can then provide Wi-Fi connection for 20 Mbps on selected locations
- This frequency can be received from 100 km, making it ideal for remote locations and Indonesia's scattered geography.

Net1 currently operates through a combination of low(450 MHz) and high (3.5 GHz) frequency networks

They collaborate with a local partner in Indonesia to provide a 4G network in remote areas (incl highlands and offshore areas)

Net1 Indonesia's network is currently available in 31 provinces, of which 70% is located in remote and rural villages. The company is planning to provide 4G LTE-450MHz network access on 14,000 islands to more than 260 million Indonesians

They offer end to end connectivity for local government units throughout the Philippines, connecting schools through a turn-key solution

# Build, Operate & Transfer by BAKTI | Selling infrastructure for expanding services into underserviced areas rather than money



# BAKTI has been investing in backbone infrastructure project such as the Palapa Ring

- Upon completion, the Palapa Ring project will span 36,000 km in on- and off-shore fiber optic network. BAKTI has invested in this project and MCIT owns the infrastructure
- BAKTI also built BTS, which is then also owned by MCIT<sup>1</sup>

<sup>1</sup> MCIT – Ministry of Communication and Technology

BAKTI can make negative NPV areas more attractive by selling infrastructure for payment in-kind

- The backbone infrastructure that is built through BAKTI often operates in underserviced areas, where large telco players have not expanded to yet due to large CapEx, Opex and lower demand.
- By offering to sell their infrastructure, BAKTI and MCIT provide these players with an opportunity to expand into these areas.
- Instead of asking monetary returns for the use of the fiber backbone of the Palapa ring, BAKTI can ask telco players to expand into negative Net Present Value (NPV) project areas and mandate school connectivity (payment in-kind). This gives telco players the opportunity to expand into areas at low CapEx and practically have a monopoly, as they are the first to service it.





## Coverage as a service - revenue sharing (I/II) | Though Indonesia is used to sharing infra, formalized revenue-sharing provides opportunity for funding

Current situation exists in which informal players provide internet to other households

In Indonesia, there are already many small informal players operating by setting up their own connectivity access point. This is not in line with legal guidelines as they do not have the proper licenses or formal permission from large operators to commercialize

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An individual can procure a stand-alone package and franchise it to 20 households or so, then they collect fees. This private procurement does not sit well with permits and regulations

Sr. Advisor, ITU

Formalized revenue-sharing in cooperation with official telco companies would allow for a potential solutions

- In the formalized revenuesharing method, the mobile operator owns backbone infrastructure but is not nimble enough to expand into rural areas or the pay-off is not large enough. They will earn a percentage of the rural operator's revenue.
- The rural operator builds on the backbone to provide last mile connectivity. They market the mobile operator's brand in their local area

### For the formalized revenuesharing model to work, certain prerequisites must be met

- Mobile operator must have backbone infrastructure on the island in question
- Mobile operator must be willing to share their infrastructure with smaller, local/regional players
- One of the following must be true:
  - Rural operator has lower CapEx than mobile operator in the rural/difficult to connect areas
  - Rural operator has lower OpEx than the mobile operator in the rural/difficult to connect areas

Subscribers, number plans, end-users remain in ownership of mobile operator; rural player owns last-mile infra

- Rural operators do not have their own spectrum, numbering plans or end users
- Mobile operators must use the assets of the rural operator in case they want to expand to these areas



Source: Expert interviews, GSMA, BCG analysis

# **Coverage as a service - revenue sharing (II/II)** | There are many local providers that could offer school connectivity at a fair price

	Explanation of role	Financial consequences	Considered players
arge player	<ul> <li>Large player provides general network, along main infrastructure and cities</li> <li>Allows local player to add onto their network and provides access</li> <li>Large player does not have to provide maintenance, which is a bottleneck in the current system</li> </ul>	<ul> <li>In return for opening the network, large player gets a share of the revenue obtained by local player from connecting the community</li> </ul>	<ul> <li>Main mobile players are Telkom Indonesia, XL Axiata, and Indosat who have 4G coverage in most urban areas</li> <li>Most of the fiber is owned by Telkom Indonesia, the market leader in Indonesia.</li> </ul>
ocal player	<ul> <li>Local player provides local network, connecting schools, households and other important community buildings</li> <li>Can add onto general network from larger player, thereby reducing costs</li> <li>Local player is responsible for maintenance and upgrades of network</li> </ul>	<ul> <li>Local player obtains revenue from providing connectivity to schools and community</li> <li>Local player shares part of revenue with large player in return for network use</li> </ul>	<ul> <li>There are currently many (informal) local players that have a network in place but cannot compete for school connectivity because government usually offers nation-wide projects to firms</li> </ul>
School	<ul> <li>The schools and community get reliable connectivity through a player that knows local needs and restrictions</li> <li>Optional: local player trains community members to provide maintenance and training to community (community collaboration model)</li> </ul>	<ul> <li>Schools and community pay a fair price for connectivity</li> <li>When community members provide training and maintenance, internet use will go up and maintenance cost will go down, leading to a more competitive price for connectivity</li> </ul>	<ul> <li>This model would be most effective in rural areas with larger villages and relatively close to 4G/fiber nodes</li> </ul>

232 **• giga** 

## Regional focus: Kalimantan, Sulawesi, Nusa Tenggara & Papua

Less developed islands with poorer connectivity for general population and lower school connectivity levels





# Majority schools have limited or no connectivity in the sparsely populated islands

# Smaller size of population across the islands ...

#### Population (m)





Spending per capita (IDR' thousands)

8.9



# ... while schools are highly unconnected, with lower schools per region due to smaller population

Schools per region map



Source: Statistics Indonesia, Uniced, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

## For the less-developed regions, we believe five funding methods would be needed in order to reach meaningful connectivity in the long-term

Funding method		Reason for suitability		
	Demand-side subsidy	<ul> <li>Suitable because: Government of Indonesia has shown high willingness to work with service providers to connect unconnected regions. In addition, government has shown willingness to invest in education</li> <li>Reason for concern: Government funding on education already very high vis-à-vis neighboring countries. Therefore, sustainability of solution in long-term likely not high. A combination of money from different, relevant ministries could work, so long as the total amount funded is a small increase</li> </ul>		
	USO financing	<ul> <li>Suitable because: BAKTI's mission, vision, and existing priorities are well-aligned with Giga's mission to connect schools to the internet globally. BAKTI has proven to be efficient and successful in rolling out connectivity</li> <li>Reason for concern: Likely not enough funds available to cover schools in all unconnected areas, especially those that are 'hard to connect</li> </ul>		
	Regulated advertising model	<ul> <li>Suitable because: Using cross-subsidization, income could be generated using ad revenue from Java, Bali &amp; Sumatra mostly. This revenue would then lead to a cost-contribution in hard-to-connect, high-cost areas</li> <li>Reason for concern: A lot of ethical considerations need to be worked out (e.g., what types of ads would kids be allowed to see, how many a day, and who would approve them?)</li> </ul>		
	Community contribution	<ul> <li>Suitable because: Exists in two variations: the traditional type and the village model. Can help in covering the costs and leads to higher appreciation for service (large number of projects where connectivity was provided for free did not yield good results).</li> <li>Reason for concern: Likely relatively little &amp; unstable source of cost-sharing as population in many of these islands has little disposable income</li> </ul>		
	Govt co-invest alongside SPs	<ul> <li>Suitable because: Government has shown high willingness to connect the unconnected areas</li> <li>Reason for concern: Difficult as most "low hanging fruit" has been picked already; very few positive NPV projects left, potentially even with the availability of government contribution</li> </ul>		

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# USO financing | A trustworthy USO can be leveraged as a financial mechanism





#### Traditional USO spending

Current mechanism of spending the fund as income comes in.
 This function is currently being used by BAKTI

#### Using the fund to raise more capital

- The USO can leverage the upcoming revenue streams to move cashflows forward. Over a 5-year period, instead of raising IDR 1 tn a year, it would be able to invest 5 tn in first the year whilst paying off the investment in the subsequent year.
- To the best of our knowledge, the USO is not being leveraged as a financial mechanism yet

#### Using the USO as a guarantor

- The USO can act as guarantor for new investments. This would take some of the risk off the telco companies undertaking new projects.
- The service provider occurs the upfront cost and can be compensated retrospectively for unfair net costs.
- Safeguards against any misappropriation of funds, especially if the USO fixes a maximum compensation percentage in advance.
- It is probable that BAKTI has used this function for the Palapa ring

# Most important prerequisite to reach that is a clear regulatory framework

- To be able to leverage a USO as a financial mechanism, it needs to be trustworthy enough for banks and companies. This requires a clear regulatory framework.
- Thankfully, the USO has set up clear rules and criteria for its use and is under overseen by the Ministry of Communication and Technology
- BAKTI serves as an additional independent body to make sure that funds are not misappropriated.
- Larger upfront investments can be made if the Indonesian government decides to use USO as a financial mechanism.

There is definitely not enough government funding. BAKTI pulls from the USO, and we need to look at alternative sources of funding. — BCG expert on Indonesia



# **Regulated advertising model** | Advertisement seen as potentially viable option for funding method, however rules & guidelines surrounding ethics needed

# With curated advertisements that adhere to clear standards of what can and cannot be shown ...



- Currently, advertisement in school is widely used, especially on school's event like art festival or other educational activities
- The company and advertisement content should be subject to filtering by the national Ministry of Education



# ... this could be a viable option as one of funding methods for school connectivity

- There is no specific government ruling<sup>1</sup> found on the limitation of using advertisements in school, however many schools have their own policy for it
- A maximum no. of ads per day should be agreed upon to avoid any type of decrease in the quality of education
- Cross-subsidization can fund hard-to-connect areas by using ad revenue generated in Java, Bali & Sumatra
- As there are no insurmountable upfront barriers identified, advertisement could be further investigated as a viable option as one of funding method for school connectivity
- Further research required into stance of students, parents, and teachers' community



# Community contribution | A community contribution model is driven by local ownership leading to lower costs

# Local ownership of the community would lead to affordable, high-quality connectivity

The goal of community networks is to set up affordable, quality connectivity

In the successful example of Zenzeleni Networks (see right side), community networks work as follows:



The local community sets up and maintains the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses



The technical set-up consists of a Wi-Fi internet backhaul, a Wi-Fi mesh and hotspot, and is powered by a solar panel with a backup battery. Excessive power can be used to charge phones at a cheap price



OpEx financing comes from the community. People can buy vouchers for access or set up a dedicated line at home. Additionally, there some anchor clients in the form of NGOs and local businesses who can afford to pay a fixed fee. Schools can be connected for free



**The Zenzeleni Cooperative** pioneered a community network in South Africa. The keys to its success are the professional Not-For-Profit (NPO) structure, job creation in the community and smart financing

Financials	2017	2018	2019	2020
Hotspots	12	35	55	75
Anchor clients	2	5	8	21
Data Usage (TB/Mth)	0.5	6.0	13.5	23.0
Net (USD)	-203	-521	758	7,184
Gross margin	0%	-8%	21%	51%

1. Excluding USD338.000 grant by University of Western Cape for R&D and CapEx

Source: Include a source for every chart that you use. Separate sources with a semicolon; BCG-related sources go at the end www.gigaconnect.org | info@gigaconnect.org

# Community contribution #1 – local ownership | Zenzeleni's model is successful due to professional organization steering local communities

# Meso

Zenzeleni not-for-profit company

### **Obtains funding to:**

- Seed & establish the micro level ISP business
- Train & develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc.



## Zenzeleni model based on meso & micro level organizations

- Model is based on inception & support of community-based micro-enterprises
- Two entities (meso & micro) work together to stimulate the digital ecosystem, e.g., health, entrepreneurship, etc.
- Government too has a role to create an enabling policy & regulatory environment and subsequently use the ecosystem to deliver its programs to stimulate growth in impoverished areas





# Community contribution #2 – village ownership | The Indonesian village model variant of the Zenzeleni model would look as follows

# Meso

## Not-for-profit Company or local Ministry/government

## **Obtains funding to:**

- Seed & establish the micro level ISP business
- Train & develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc.



# The village model has a few advantages

This version is more robust than the Zenzeleni model as it keeps it strengths

- The overarching NPO, local Ministry or government provides continuous guidance and training. It also helps with initial funding
- At the town level, villagers are taught and paid to keep the network running, leading to better engagement and long-term sustainability

## And overcomes the weaknesses of the Zenzeleni model

- New laws allow villages to invest budget in connectivity, thus CapEx requirements are more easily met because the villages can contribute to funding as well
- This also allows for better scalability across villages

## Similar pilots have been proven successful in Indonesia

• The Common Room has done come pilot studies that empowers communities to maintain their own networks. ISP Awinet provides infrastructure and training, and connectivity is sold through vouchers

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# Government invests alongside ISPs | The Indonesian government can help ISPs to expand into new areas by co-investing

## The Indonesian government has made steps to help ISPs expand into new areas

- A big hurdle for service providers towards providing connectivity in underdeveloped regions is the negative NPV of new projects
- Operators need an incentive to expand into these regions
- Through several Indonesian initiatives such as the joint service operation launched in June 2021, the Telecommunication and Information Accessibility Agency can help relieve some of the costs and risk that comes with operating in these areas

## Deep-dive on example of funding model – Joint Service **Operation launched in June 2021**



- The JSO allows selected partners the right to use the 4G Base Transceiver Station Infrastructure and its supporting infrastructure built by BAKTI to provide 4G Mobile Services and receive revenue
- BAKTI is responsible for providing the BTS infrastructure, including loaning land from the local governments

## Government invests alongside ISPs is especially relevant to connect schools in most rural areas



Providing connectivity across all islands is a nightmare. The government is already doing this, but for some it just doesn't make business sense, even with government help. That's why BAKTI was started. I think NPV-positive is impossible, especially if we talk about the most remote population. This isn't even an NPV case, but a humanitarian need.

-BCG expert on Indonesia

# • Plans such as the JSO are great opportunities for



- school connectivity, because a school connectivity mandate can be included in the right to use BAKTI infrastructure
- Plans for new infrastructure developed by telco players that rely on government subsidies should also include provisions to connect schools



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## P&L of an avg. school<sup>1</sup> in Java, Bali & Sumatra | No model sufficient by itself to cover costs, though clear differences in potential arise



Model 1: Coverage as a service (revenue sharing)



Model 2: Government increases school funding

## Model 3: One-off government subsidy



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## P&L of total area in Java, Bali & Sumatra | No model sufficient by itself to cover all schools of central states, though clear differences in potential arise

Model 1: Coverage as a service (revenue sharing)



## Model 3: One-off government subsidy



#### Model 2: Government increases school funding



<sup>14 57</sup> 

#### Backup

## **Detailed assumptions** | These are the "what you need to believe" for these P&Ls to hold true and what targets must be met for theory to meet practice

## Model 1: Coverage as a service (revenue sharing)

- The basic underlying premise of this funding model is that gov't input is needed to 'close the gap' Assuming efficient markets, these areas would have already been covered by commercial parties if financially attractive.
- Around ~1400 people on average live around each school (based on total population area and no. of schools in region). Of those, around ~41 are willing to use school connectivity in year 1, ramping up to ~140 people in year 10 (based on the growth behavior seen in other countries with similar penetration rate, but with an assumed growth cap at 10% of population around each school). They are willing to contribute 0.5% of their Gross National Income (GNI) per capita.
- This model also allows for a cost-reduction, assuming that local players are more efficient on a small-scale operation or in the particular region. As such, a cut of 5% on capex and 10% on opex has been assumed vs. the usual cost assumptions

## Model 3: One-off government subsidy

• A one-off subsidy from the government is provided to cover initial capex expenditures and accompanying indirect costs<sup>1</sup>, which could be financed by various methods, such as spectrum auctions (assuming the reduction in the spectrum price paid by commercial parties is equal to the price of initial capex and the indirect costs attributed to the addition of the new last-mile connectivity)

## Model 2: Government increases school funding

- The government is willing to increase the average spend per student from 3.58% of GDP to 3.59%, which is equal to a 0.2% increase in government budget spent on education
- This additional budget will be divided by the unconnected schools equally, to be used exclusively to connectivity
- In addition, the implicit assumption is that the government will continue with the financial support, regardless of potential shifts in political priorities

1. This implies a one-off government subsidy that will cover 4 years of 4G, WISP, and satellite connection (assumed depreciation period), and 20 years for fiber Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF). Source: BCG analysis

245 7

## P&L o total area in Java, Bali & Sumatra | Funding models can lead to school connectivity if assumptions turn out positive



1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; 2. Indonesia's current value is 1.3% (ITU); Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: ITU, BCG analysis

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# **P&L of total area in Java, Bali & Sumatra | Combining funding models leads to school connectivity in theory, however many hurdles need to be overcome**

Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved ...



# ... however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter 'short-term next steps')
- In addition, the current model does not account for potential profit margins that commercial parties demand. These numbers have not been included to allow for flexibility in operating model choice (e.g., infrastructure may be provided on non-profit basis due to CSR efforts)
- Even though the full potential of these models may not be realized in practice, this exercise still provides us with useful insights. It shows:
  - Which models have the largest potential pay-off in covering capex & opex
  - What prerequisites "need to hold" for the funding models to work
  - The potential upside of overcoming the hurdles that require solving

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org |



# P&L of an avg. school<sup>1</sup> in Kalimantan, Sulawesi, Nusa Tenggara & Papua | N model sufficient by itself to cover costs, though clear differences in potential

## arise



## Model 1: Regulated advertising model

## Model 3: One-off government subsidy



1. Using as example a school that does not have electricity access; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs Note: Excludes profit margin for commercial parties. Source: BCG analysis

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### Model 2: Government increases school funding



\$1,998

Gap

#### Model 4: Community contribution

## P&L of total area in Kalimantan, Sulawesi, Nusa Tenggara & Papua | No model sufficient by itself to cover all schools, though clear differences in potential arise

Model 1: Regulated advertising model (millions)



Model 2: Government increases school funding (millions)



\$22

Gap

## Model 3: One-off government subsidy (millions)



Note: Excludes profit margin for commercial parties. Source: BCG analysis

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## Model 4: Community contribution (millions)

#### Backup

## **Detailed assumptions** | These are the "what you need to believe" for these P&Ls to hold true and what targets must be met for theory to meet practice

## Model 1: Regulated advertising model

- ~9.4 M students eligible to view advertisements (all students except for students at private schools)
- 100% of them will view one advertisement everyday (180 school days)
- CPM is \$4.0 (source: Magna average of online display and online video for Indonesia)

## Model 2: Government increases school funding

- The government is willing to increase the average spend per student from 3.58% of GDP to 3.60%, which is equal to a 0.5% increase in government budget spent on education
- This additional budget will be divided by the unconnected schools equally, to be used exclusively to connectivity
- In addition, the implicit assumption is that the government will continue with the financial support, regardless of potential shifts in political priorities

## Model 3: One-off government subsidy

• A one-off subsidy from the government is provided to cover initial capex expenditures and accompanying indirect costs<sup>1</sup>, which could be financed by various methods, such as USO financing (assuming the USF has enough funds and is willing to attribute enough financing to cover one-off capex and attributed indirect costs)

## Model 4: Community contribution

- Around ~880 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~22 are willing to use school connectivity in year 1, ramping up to ~88 people in year 10. This is based on the growth behavior seen in other countries with similar penetration rate, but with an assumed growth cap at 10% of population around each school.
- These 22 (Y1) to 88 (Y10) people are willing to contribute 1% of their Gross National Income (GNI) per capita
- GNIpc is assumed to increase 2% per year, in line with the historic 5-year average compounded annual growth rate

1. This implies a one-off government subsidy that will cover 4 years of 4G, WISP, and satellite connection (assumed depreciation period), and 20 years for fiber Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF). Source: BCG analysis

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**giga** 

## P&L of total area in Kalimantan, Sulawesi, Nusa Tenggara & Papua | Funding models can lead to school connectivity if assumptions turn out positive



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Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved ...



## ... however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter 'short-term next steps')
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  - Which models have the largest potential pay-off in covering capex & opex
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  - The potential upside of overcoming the hurdles that require solving

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Short-term next steps





### Recommendations for short-term next steps



Set up working teams to support the operations of BAKTI, the government and the USO to discuss sustainable funding models

#### Roll out four pilots

- Use the demand-side subsidy to connect 10 schools in Jakarta
  - A small subsidy is likely to suffice in Jakarta to connect the remaining schools to the internet, therefore roll out pilots to test effectiveness
  - Additionally, these schools cannot count on BAKTI funds, thus it is important to try this model
- Use the revenue-sharing model in Sumatra to connect 10 schools in low connectivity areas
  - In Sumatra, there is a great variance in school connectivity. Test two versions of this pilot
  - Connect 5 schools in a better-connectivity area (>50% of schools) in partnership with the main mobile operator in the area. Identify small entrepreneurs to maintain local network
  - Similarly, connect 5 schools in a low-connectivity area (<50% of schools). It is important to refine the model in this kind of area, so it can be extended to less-developed islands as well
- Use the revenue-sharing model on one of the less-developed islands to connect 10 schools
  - Connect 10 schools in one of the less-developed islands where there is a suitable mobile/rural operator partnership. Use refinements learned in Sumatra before extending.
- Set up 10 community contribution models on the less-developed islands that have strong communities (and lower risk of vandalism) in collaboration with research centers following the village/Zenzeleni model
  - Roll out a pilot for 5 schools in Papua and 5 in Kalimantan. The difference in GDPpc in these areas allows for refining the model for different environments before extending implementation



Research whether the regulatory framework offers enough possibilities for telco providers and ISPs to implement the sustainable funding models



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## Rwanda case study

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### **Country profile** | Rwanda

<b>Key figures</b>	<ul> <li>Population: 12.6 m</li> <li>GDP: \$10.4 B</li> <li>GDP per capita: \$820</li> <li>GDP growth: 7.4%</li> <li>Investments/GDP: 24%</li> <li>Urban population: 17%</li> <li>Total population under 18 years: 45%</li> <li>Secondary completion rate: 23%</li> <li>Adult literacy rate: 73%</li> <li>% of schools connected: 45%</li> <li>Connectivity starting point: 22%</li> <li>Electricity penetration: 35%</li> </ul>
Demography of schools	<ul> <li># of schools in country: 4,744</li> <li>Average no. of students per school: 652</li> <li>Current % of schools with internet connectivity: 57%</li> <li>Current no. of schools with internet &gt;5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt;5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools that are connected</li> <li>Current % of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with internet &gt; 5 Mbps (%): 23% of schools with interne</li></ul>
Government involvement	<ul> <li>% GDP spent on education</li> <li>6.1</li> <li>6.3</li> <li>3.1</li> <li>3.6</li> <li>0.4</li> <li>Nigeria</li> <li>Rwanda</li> <li>Indonesia Honduras</li> <li>Brazil</li> <li>SL</li> <li>Government debt: 61% of GDP</li> <li>Government's education budget on a per-student basis: \$103</li> <li>Broadband a universal service: Yes</li> <li>Operational USF available: Yes</li> <li>Total amount allocated: \$5.9m</li> </ul>

1. As estimated in the ACTUAL model (Giga) for last-mile connectivity Source: Giga, UNICEF, ITU, government, World Bank, press search, BCG analysis www.gigaconnect.org | info@gigaconnect.org

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## Financing of school connectivity in Rwanda relatively cheap given higher existing connection levels and large schools vis-à-vis other focus countries

Context: About 6 out of 10 people in Rwanda have access to the internet. Even though usage is low, coverage is quite high: ~98% of the nation is covered by 4G 35% of primary schools, and 61% of secondary schools are connected to the internet. Schools that are not connected in Rwanda do not have internet access for several reasons, despite a close to 100% coverage level: 1) lack of electricity, 2) lack of affordability and 3) lack of digital literacy. Improving infrastructure is key in Rwanda for several reasons: Affordability can be improved by adding cheaper alternatives to the existing 4G coverage. In

addition, lack of electricity can be tackled concurrently with an increase in fiber backhaul, which is most suitable for school connectivity



Given the high existing 4G coverage in Rwanda, technology would need to focus mostly on extending the fiber network, therefore the following cost split is expected:

- Fiber: 50%
- WISP: 47%
- 4G: 2%

### **Cost structure**

An increase of \$12 per unconnected student is required to fund school connectivity. This excludes the cost of adding a grid network or decentral electricity, which is required for many regions.

For an average Rwandan village of ~700 inhabitants and 1 school, \$7,900 is required on an annualized basis

For an average Rwandan city of ~140k inhabitants, a total of \$69k annually is required to reach school connectivity



For Rwanda four funding models will be able to together close the currently existing funding gap:

- Government increases school funding
- Community pays for connectivity
- Electricity as a business model
- Tax revenue-linked financing



In terms of operating model, the following is advised:

- State/gov't driven for the gov't budget increase
- Cooperative and Voluntary set-ups for community contribution
- Private company/consortium set-up for electricity as a business model
- Turnkey (+ Lease) for tax revenue-linked financing



# Funding models support operating models spanning commercial, government and community - involving different stakeholders in improving connectivity

Fu	nding model	Explanation		Operating model
A	Ongoing government budget increase	Falls within the government-contributed archetype. Therefore, the state/government-driven operating model is advised		State/government
В	Community contribution	The community contribution model builds on the community-based archetype. For the higher-density, higher-GDP urban areas, funding could be commercially attractive – there, a cooperative model is advised. For rural areas with higher poverty rates, lower GDP and lower population density, a voluntary model is advised		Cooperative and Voluntary
С	Electricity as a business model	Electricity as a business model should accompany a private company/consortium operating model - a commercial-provided archetype. However, there are some barriers - 1) an operator would need the assistance of the state-owned utility company, or some of its some Independent Power Producers (IPPs) and 2) an on-grid electricity connection is a pre- condition for computers to be distributed to schools	>	Private company/ consortium
D	Tax revenue-linked financing	In the tax revenue-linked financing model, investors provide upfront financing in return for repayment of tax revenues. This is classified as a PPP model where the government can decide to either outsource the infrastructure building and operations or do it themselves. For the Rwandan government, given the relatively low market competition, the Turnkey model would be advised, with a potential shift to Lease, if it becomes commercially attractive for companies	>	Turnkey (+ Lease)

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### Large difference in poverty, income and connection to electricity between urban and rural areas

#### Northern

Pop. Size (% Rwanda) <sup>1</sup>	16%
Est. Pop. Density per km2	633
Consumption per adult (x1000 RWF per year)	230
Poverty rate	42%
Electricity from grid/solar <sup>2</sup>	25%

#### Vestern

Pop. Size (% Rwanda) <sup>1</sup>	23%
Est. Pop. Density per km2	505
Consumption per adult (x1000 RWF per year)	219
Poverty rate	47%
Electricity from grid/solar <sup>2</sup>	35%

boathern	
Pop. Size (% Rwanda) <sup>1</sup>	25%
Est. Pop. Density per km2	522
Consumption per adult (x1000 RWF per year)	230
Poverty rate	41%
Electricity from grid/solar <sup>2</sup>	25%



	Est. Pop. Densit	y per km2	
	Consumption pe (x1000 RWF per	er adult year)	
	Poverty rate		
	Electricity from	grid/solar <sup>2</sup>	
	Total	Urban	
			Ì

Kigal

Pop.

	TOLAI	Ulban	Nulai
Pop. Size (% Rwanda)	100%	17%	83%
Consumption per adult (x1000 RWF per year)	279	570	216
Poverty rate	38%	16%	43%
Electricity from grid/solar <sup>1</sup>	35%	76%	27%

#### People/KM<sup>2</sup> 0-500 501-1.000

1. Latest size per province numbers from 2012, 2. 2017 numbers;

Source: Government website, National Institute of Statistics Rwanda (NISR), Macrotrends, BCG analysis www.gigaconnect.org | info@gigaconnect.org

Eastern	
Pop. Size (% Rwanda) <sup>1</sup>	25%
Est. Pop. Density per km2	330
Consumption per adult (x1000 RWF per year)	242
Poverty rate	37%
Electricity from grid/solar <sup>2</sup>	30%

City	
Size (% Rwanda) <sup>1</sup>	11%
op. Density per km2	1,864
umption per adult 0 RWF per year)	597
rty rate	14%
ricity from grid/solar <sup>2</sup>	80%

>1.000

FRW 9



## 12.6m inhabitants

### 3m total households

### c. 2.3m urban inhabitants

(Strong urbanization between '91-'02 from ~5% to ~17% urban population, a ~11% y-o-y growth)

Rwanda



### 9,746 billion GDP 20~8.2% y-o-y





## Number of schools with internet connectivity growing fast, 55% at primary schools and 25% at secondary schools



The number of **primary schools** with internet connectivity grew from 278 to 1029 at 55% p.a. between 2016 and 2020...

Number of primary schools



# of schools

# of schools connected to grid

# of schools with internet connectivity



... while internet connectivity at secondary schools grew around 25% p.a. coming from a higher base of 558 schools in 2016 Number of secondary schools



53 🔨 gig

Rwanda

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## Rwanda—case study | Only ~700k out of ~8m internet users (~9%) make use of 4G internet, though uptake is growing rapidly



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Rwanda

## **Rwanda—case study** | Cost of mobile broadband substantially above average affordable internet levels, making school connectivity attractive alternative

Rwandan affordability of mobile broadband worse vs. average and >3 times above ITU suggested 2% for affordable internet

Spent on data-only mobile-broadband (1.5GB) as % of gross national income per capita - 2019



## Several advantages to using school connectivity over 4G network in place

- School connectivity would be cheaper by a factor of >3x vs. 4G (2% of GNIpc using school connectivity vs. 7% of GNIpc for 4G)
  - Fiber/microwave allows for more trustworthy connection with faster speed for both download & upload
- By funding school network, child has access to digital education
- Optional: Access to school devices
- More constraint in terms of location (use close to school, rather than in-home)
- May be limits on timing of use (e.g., not during school hours)

Note: To be conservative, even though there are many advantages to using school connectivity, the laid-out analysis did not assume any individuals switching from their current connectivity choice to school connectivity. Rather, the analysis assumes the gap has been bridged for those currently unconnected



## **Rwanda—case study |** Solution required to address electrification, affordability and digital literacy gap to reach (school) connectivity



1. On-grid electricity is a government pre-condition for computers to be distributed to schools Source: Connect-the-Dots report, BCG analysis www.gigaconnect.org | info@gigaconnect.org

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### **Overview of telco landscape in Rwanda**

Characteristics	Description
Current status of fiber & 4G, WISP, and of satellite coverage in country	<ul> <li>&gt;95% of Rwanda's land area is covered by 4G network, nonetheless, only 9 per cent of the population uses this network</li> <li>High cost of use of the network, with e.g., spend on data-only mobile-broadband (1.5GB) in Rwanda as percentage of Gross National Income (GNI) per capita being ~7% in 2019. The average spend per capita as a percentage of GNI is ~3.4%, while the ITU recommendation for affordable internet lies at 2% of GNI per capita &amp; the country is in the top-30 least affordable countries for internet access.</li> <li>Only ~22% of the population use the internet on a regular basis. This gap is driven by, amongst others, digital literacy, electrification, affordability, and outdated devices.</li> <li>In addition to 4G, Rwanda has invested in expanding its fiber network by 45% since 2015, spanning 6,100km of backbone in 2019, nearly all schools being within 30km of the fiber network &amp; covered by mobile broadband</li> </ul>
2 dominant mobile network operators, 18 ISPs with active subscribers	<ul> <li>There are only companies with a mobile network license, MTN &amp; Airtel, who together dominate the mobile network market. MTN &amp; Airtel are the only companies providing the 7,363k EDGE &amp; 3G subscriptions, somewhat more than half, 54%, in hands of MTN</li> <li>The 4G market is dominated by MTN, responsible for 66% of the 587k subscriptions, Airtel is responsible for 21% of the subscriptions. There are 24 ISPs with a license, 18 of them covering the final 13% of 4G subscriptions</li> </ul>
Mixed success of single 4G whole seller and network provider KTRN	<ul> <li>KT Rwanda Networks (KTRN) is Rwanda's only 4G LTE infrastructure company. The company is responsible for the wholesale provision of mobile broadband network built on 4G LTE technology</li> <li>All 4G network is resold via KTRN, which is the only 4G whole seller and network provider</li> <li>Although almost all land area is covered with the 4G network, usage is very low due to the unfavorable price point and therefore the expected shift to 4G is not yet happening, while the world is already moving to 5G in the meantime</li> </ul>



## Overview of major upcoming changes in telco landscape and resulting school connectivity expected

Major changes	Description
MTN renews licence in Rwanda	<ul> <li>MTN Group, a South African multinational mobile telecommunications company, concluded its licence renewal process with Rwanda Utilities Regulatory Authority (RURA) with effect from 1 July 2021. The company paid 70% of the \$75.7 million renewal fee, equivalent to around \$53 million, with the remaining 30% due by July 2022. The new concession is valid for ten years.</li> </ul>
National Strategy for Transformation (NST)	• In 2017, following the Presidential Election, the country set targets for the next 7 years (2017-2024). The implementation instrument for this is the National Strategy for Transformation (NST1) which embraces the Sustainable Development Goals (SDGs) and consists of 17 goals with more than 170 targets and indicators. In relation with telecommunications, Rwanda plans to increase internet connectivity from 10% (in 2016) to 100% by 2024. At the same time, it intends to expand mobile broadband subscription from 28% (in 2016) to 47% by 2023/24. The government bets on the roll out of the 4G network, promoting internet of things, increasing smart devices penetration and leveraging Kigali Innovation City as a mechanism to spur ICT services.
Liquid Telecom launches fibre products in Rwanda	<ul> <li>In February 2020, Liquid Intelligent Technologies Rwanda, part of the leading pan-African telecoms group Liquid Intelligent Technologies, launched a new range of fibre broadband products. It is offering customers, in selected areas of Kigali, connectivity at speeds from 5Mbps to 150Mbps.</li> </ul>

## Mobile network operators are substantially more dominant vs. ISPs in mobile broadband subscriptions



1. As per March 2020; Note: Given low importance of fixed internet (0.2% penetration), no deep-dive has been provided on players Source: Rwanda Utilities Regulatory Authority, BCG analysis www.gigaconnect.org | info@gigaconnect.org Only two companies in Rwanda have mobile network licenses:

- MTN
- Airtel

In addition, 24 internet service provider licenses have been provided, of which 18 have active subscribers in the mobile market. These ISPs only provide 4G networks (no EDGE/3G)

All 4G network is resold via KTRN, which is the only 4G whole seller and network provider



## Rwanda allows for only one 4G whole seller and network provider, KT Rwanda Networks, which has shown mixed success



## KTRN is a JV between the Rwandan government and KT to provide wholesale provision of 4G to ISPs ...

- KT Rwanda Networks (KTRN) is Rwanda's only 4G LTE infrastructure company. The company is responsible for the wholesale provision of mobile broadband network built on 4G LTE technology
- KTRN is a joint venture between KT and the Rwandan government, launched in November 2014
- The nationwide 4G coverage (~95% of the population) has been completed 3.5 years later
- KT Rwanda aims to promote healthy competition by reselling to ISPs (18 active internet service providers are currently reselling 4G internet bundles), however, prices have remained high until now

(~95% of the Nyagatare National National

4G coverage map

### ... However, the success of the program has received mixed reviews

Feb-2020: A couple of years down the road, many Rwandans are still stuck to the 3G networks despite the available infrastructure. The internet and telecom operators that are supposed to vend the 4G are shying away from the product due to the unfavorable price points. And now, the world is moving on to the even higher 5G network putting the country at risk of not meeting its technology advancement goals. New Times

Nov-19: Korea Telecommunication Rwanda Networks has announced a nationwide 4G LTE network upgrade for better connectivity after several complaints of network failure attributed to a growing demand for 4G internet. KT Press

Oct-18: Retailers are still charging more than double the retail price of 4G internet. For example, ISPs buy 4G internet at a wholesale price of Rwf21.000 and sell at Rwf24, 000 and others double the price. KT Press



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## The following four funding models are considered to be sustainable in Rwanda



## Government funding

 Additional 1% spend on education by the government, increasing government spend on education from ~3% to ~4% of GDP



## Community contribution

- Community builds and maintains own network
- Initial funding could come from NGO
- OpEx covered by key clients liks doctors, expats and medical clinics in the area



## Electricity as a business model

- 43% of schools in Rwanda have no connection to the grid, 45% in rural & 33% in urban areas
- Place solar panels next to schools and sell power to community
- Profit can be used to fund school connectivity



## Tax revenue-linked financing

- Investors provide upfront financing in return for longer term repayment out of tax revenues
- Increased internet connectivity boosts economic activity which leads to increased tax revenues







## Government spend on Education is relatively low1, with a consistent decrease after 2013...



## ... but increase in spend is expected shaping the learning environment

- The absolute government spend has been growing slightly in the past years, but grew slower than the growth of the economy, hence the decline in % of GDP
- A large budget increase for the 2021 is announced, increase government spend with more than 50% up to \$480-490 million. The recent budget increase is attributed to the Government of Rwanda's strong commitment to construct around 20,000 classrooms and hire more teachers both in primary and secondary schools. However, there is no indication that this will be used for connectivity
- The Ministry of ICT plan to have 90% of public institutions connected to Broadband Internet by 2024

1. This includes only national government spend, unclear if local authorities (e.g., municipalities) also help fund education; 2. Data unknown for 2006 and 2015 Source: MINICT (2018), World Bank (2019), UNICEF (2020); www.gigaconnect.org | info@gigaconnect.org



## **Community contribution | A community contribution model is driven by local ownership leading to lower costs**

## Local ownership of the community would lead to affordable, high-quality connectivity

The goal of community networks is to set up affordable, quality connectivity.

In the successful example of Zenzeleni Networks (see right side), community networks work as follows



The local community sets up and maintains the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses



The technical set-up consists of a Wi-Fi internet backhaul, a Wi-Fi mesh and hotspot, and is powered by a solar panel with a backup battery. Excessive power can be used to charge phones at a cheap price



OpEx financing comes from the community. People can buy vouchers for access or set up a dedicated line at home. Additionally, there some anchor clients in the form of NGOs and local businesses who can afford to pay a fixed fee. Schools can be connected for free



The Zenzeleni Cooperative pioneered a community network in South Africa. The keys to its success are the professional Not-For-Profit (NPO) structure, job creation in the community and smart financing

Financials	2017	2018	2019	2020
Hotspots	12	35	55	75
Anchor clients	2	5	8	21
Data Usage (TB/Mth)	0.5	6.0	13.5	23.0
Net (USD)	-203	-521	758	7,184
Gross margin	0%	-8%	21%	51%

1. Excluding USD338.000 grant by University of Western Cape for R&D and CapEx

Source: Include a source for every chart that you use. Separate sources with a semicolon; BCG-related sources go at the end www.gigaconnect.org | info@gigaconnect.org





## Community contribution | Zenzeleni's model is successful due to professional organization steering local communities

### Meso

Zenzeleni not-for-profit company

#### **Obtains funding to:**

- Seed and establish the micro level ISP business
- Train and develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc



#### Zenzeleni model based on meso and micro level organizations

- Model is based on inception and support of community-based micro-enterprises
- Two entities (meso and micro) work together to stimulate the digital ecosystem, e.g., health, entrepreneurship, etc.
- Government too has a role to create an enabling policy and regulatory environment and subsequently use the ecosystem to deliver its programs to stimulate growth in impoverished areas



## **Community contribution** | In Rwanda's model villages, the range of school Wi-Fi would lead to a maximum walk of ~3 minutes to get connected



### Range of Wi-Fi sufficient

- The government envisaged rural settlements to facilitate people to be well settled, while accessing economic and social services easily. To be able to reach this objective, the government introduced the concept of 'model village'
- The primary or secondary school in model villages is placed in the communal infrastructure
- The range of a Wi-Fi point on top of the school allows for a ~100m range. Given the size of the average Rwandan model village, the villagers would have Wi-Fi access in all the communal buildings (in the entire yellow area surrounded by residential houses). As a result, residents would have to walk less far to get to wi-Fi access, than to get to a water point



## Tax revenue-linked financing | Growth in tax revenues as a result of GDP boost driven by connectivity could be used to repay investors

### Overview



Investors provide upfront financing in return for longer term repayment out of tax revenues



Investors provide upfront financing in return for longer term repayment out of tax revenues



Investors provide upfront financing in return for longer term repayment out of tax revenues

### Key benefits and considerations



Private investors take revenue risk. Only incremental tax revenues are used to service the instrument



Private investors take revenue risk. Only incremental tax revenues are used to service the instrument



Private investors take revenue risk. Only incremental tax revenues are used to service the instrument



## **Energy as a business model |** Selecting key partners in Rwanda, the prevalent electrification barrier could be made a principal decision consideration



One of the potential business models to provide Rwandan schools with energy AND electricity is: Energy as a business model for connectivity

#### Overview .....

- Model addresses connectivity as well as power supply. Initial progress in Giga project in Rwanda has shown that a large part of schools, struggle with not having a (reliable) connection
- Renewable energy in combination with lithium batteries is likely to be the main deployment solution. The mobile operator can function at the same time as an ESCO, providing both connectivity, as well as energy support. One important note is that on-grid electricity connection is a pre-condition by the government for computers to be distributed to schools
- This would increase revenues, as revenue streams would come from both energy, as well as from connectivity

#### Key benefits and considerations

- Commercial impact could be significant; however, an operator would need the assistance of the national state-owned utility company, or some of its some Independent Power Producers (IPPs) <sup>12</sup>
- Model could be scaled up & implemented in many rural villages and could be replicable in all of Rwanda's rural areas
- Government policy adjustment of only distributing computers to schools that are connected on-grid, rather than off-grid, would aid tremendously in connecting schools via micro/mini-grids<sup>2</sup>
- Example project is Nokia Fusion Grid in Namibia<sup>2</sup>. The pilot can deliver coverage up to an estimated 3-5 KM and has the scope to handle 600 consumers for a cost of \$16,000 for the initial grid and \$13,500 to develop the grid system in the village

1. In 2019, Rwanda had 31 licensed IPPs, and 71 accredited electrical practitioners; 2. On-grid electricity is a government pre-condition for computers to be distributed to schools. Example shown here is an off-grid solution and would therefore have to be adjusted accordingly. 2. According to the World Bank, the private sector has become a strategic partner for Rwanda's power sector through its investments in power generation and off-grid access; Source: Rwanda Utilities Regulatory Authority (RURA), EUCL-REG, GSMA, World Bank, BCG analysis www.gigaconnect.org | info@gigaconnect.org | info@g

## **Energy as a business model |** Besides rural areas, cities (~15% of population) could benefit from energy business model

#### Energy as a BM for connectivity through PPP with gov't seems sustainable solution for cities ...

- Electricity access is a problem in cities, similar to in rural areas. For example, capital Kigali's electricity access is only ~6% higher vs. that of rural areas<sup>1</sup>
- Using a PPP model in which the government would subsidize a percentage of the electricity roll-out (potentially subsidized by REG1), would allow for sustainable coverage in cities



#### ... especially given Rwanda's gov't has set ambitious goals to roll-out energy access ...

- The Energy Sector Strategic Plan (ESSP) high-level target objectives includes 100% access to electricity for households
- Rwanda has signed a wide range of new electricity contracts, which are expected to come on board in 2020 and could more than double capacity (512 megawatts)
- Currently, electricity is funded only ~3% by foreign direct investments, providing an opportunity to significantly increase this number vis-à-vis other sectors, such as information and communication technology, incl. connectivity
- Rwanda has limited low-cost energy resources, and it does not have a large enough market to benefit from scale economies. Adding additional competition and ability to group connectivity and electricity together could lead to scale advantages and subsequent drop in costs closer to comparable countries

#### ... due to high cost of electricity in Rwanda and relatively less direct foreign investments

Cost of electricity in Rwanda and other Sub-Saharan African countries, 2016



Stock of foreign direct investment in Rwanda by sector, 2015

Sector	<b>\$ (m)</b>	Share (%)
Information & communication	592	28
Financial & insurance	477	22
Manufacturing	329	15
Tourism	219	10
Agriculture	104	5
Mining	90	4
Wholesale & retail trade	89	4
Electricity, gas, steam	70	3
Other	61	3
Transport & storage	46	2

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## Set-up of case funding study starts with how to fund rural areas (~85% of population) followed by urban areas (~15% of population)

#### **Rural areas**



- Several options considered for sustainable funding to connect schools
  - Community contribution
  - Government funding
  - Energy as a business model
  - Tax revenue-linked financing
- Community contribution and electricity as a business model are most attractive options to fund average village in Rwanda, but a combination of multiple funding models will likely be needed

#### Urban areas



- Several options considered for sustainable funding to connect schools
  - Community contribution
  - Government funding
  - Energy as a business model
  - Tax revenue-linked financing
- Community contribution and electricity as a business model are most attractive options to fund average city in Rwanda, but a combination of multiple funding models will likely be needed



## **Rural areas** | Several sustainable funding models can be considered for rolling out connectivity in average Rwandan rural school



Model 1: Government increases school funding

### Model 3: Electricity as a business model



#### Model 2: Community pays for connectivity



### Model 4: Tax revenue-linked financing



1. Increase in school budget calculated to achieve break even, considering all other 3 funding models in place; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

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### **Rural areas** | A 0.6% increase in education budget would be needed on top of all other models combined

### Model 1: Government increases school funding



### Disadvantages

- Risk for sustainability of solution in long-term if commitment of • government decreases (e.g., if government switches)
- Governments tend to generally be slower and less efficient in rolling out connectivity
- No community payment needed in this model, which could potentially lead to the following & more misaligned incentives:
  - Community consistency in using internet may be lower
  - Less incentive for parents/community to use school's Wi-Fi

### Description

- Government increases education budget by 1%, which would be divided by unconnected schools
- Government can work together with commercial party to roll-out actual infrastructure
- No community or commercial involvement on a funding level would be used

### Advantages

- Simplicity of payment structure, having only 1 payer
- Ouick roll-out possible as little negotiations between parties are required (relatively straightforward RFP to commercial parties would suffice)
- No schools being left out due to little community revenues or costsharing possible



Annualized connectivity capex costs 🚺 Annual connectivity opex costs 🚺 Annualized electricity opex & capex costs 🚺 Indirect costs





## **Rural areas |** For average Rwandan school, community contribution won't suffice to cover connectivity costs

### Description

- Minority of costs covered by community contribution to connectivity
- Government subsidy used to bridge remaining gap
- Could be combined with 'minimum subsidy' funding model to make attractive to commercial parties (increasing gov't funding)

### Advantages

- Community directly responsible for paying for internet connectivity, thereby having an incentive to optimally use internet connection
- Long-term sustainability of solution increases with community contribution (like all developed nations working with commercial-parties only)



### Model 2: Community pays for connectivity



### Disadvantages

- Community contribution not sufficient to meet total revenue requirements to cover direct costs
- Community revenue will likely take a while to ramp-up, and therefore government subsidy would have to be higher in first 2-4 years
- Long time required to repay initial capex investment
- More annual government subsidy required in order to make offer attractive to commercial parties, as 'total revenue required for breakeven' refers to capex, opex, and overhead only, but does not include profit margins for commercial parties

ectivity capex costs 📃 Annual connectivity opex costs 📃 Annualized electricity opex & capex costs 📃 Indirect costs

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



## **Rural areas | Electricity as a business model not sufficient to cover costs to connect school**

### Disadvantages

- Would only work in villages where there's currently no electricity access; other villages would have to be funded in an alternative manner
- Commercial party needs to work together/partner-up with ESCO, or alternatively, provide electricity themselves. The former will take time to implement, the latter may lead to inefficiencies due to a lack of relevant experience
- Payback period may take some time, as surplus is somewhat limited annually. As graph only considers direct cost and overhead, and ignores profit margins, this model may not be attractive to many commercials without some additional government subsidy

### Model 3: Electricity as a business model

#### Government subsidy required likely limited \$10,196 \$909 \$3,578 \$3,803 Suitability of model for Archetype: connecting schools: Commercial \$2,425 \$6,618 Commercial \$3,059 (Gov't only if shortage) Costs Electricity as a Gap business model Annualized connectivity capex costs Annual connectivity opex costs Annualized electricity opex & capex costs Indirect costs Source: BCG analysis

#### www.gigaconnect.org | info@gigaconnect.org

#### Description

- Model addresses connectivity as well as power supply
- Renewable energy in combination with lithium batteries is likely to be the main deployment solution. The mobile operator can function at the same time as an ESCO, providing both connectivity, as well as energy support. This would increase revenues, as revenue streams would come from both energy, as well as from connectivity

### Advantages

- Community directly responsible for paying for internet connectivity, thereby having an incentive to optimally use internet connection
- Two birds with one stone: Addressing both electrification, as well as connectivity at the same time
# **Rural areas | Tax revenue-linked financing won't suffice to cover costs to connect average school**

#### Description

• Investors provide upfront financing in return for longer term repayment out of tax revenues. Increased internet connectivity boosts economic activity which leads to increased tax revenues. Portion of the increased tax revenue is passed back to investors until CAPEX is paid.

#### Advantages

- Community directly responsible for paying for internet connectivity, thereby having an incentive to optimally use internet connection
- Government indirectly pays for connectivity; however, government budget does not decrease in absolute terms vis-à-vis the previous year (rather, the increase is contributed)
- Model incentivizes providers to involve community optimally in order to realize maximum GDP growth possible



#### Disadvantages

- Must be conducted on a pilot-scale first, to determine whether model is feasible in practice
- Legislation must allow for model (research needed)
- Large time & resource commitment upfront to project potential GDP increase per village
- Long expected negotiations regarding terms/calculation of tax revenue-linked financing
- Government/donor funding required to bridge phase until GDP growth materializes

#### Model 4: Tax revenue-linked financing



Annualized connectivity capex costs 🗾 Annual connectivity opex costs 🔄 Annualized electricity opex & capex costs 🔄 Indirect costs

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



## **Rural areas** | Funding models can lead to rural school connectivity if assumptions turn out positive



 Assumed, based on external academic sources on telecommunications sector, at 30% of total costs;
 Rwanda's current grid electricity price is \$0.26 (Global Petrol Prices);
 Assuming 99% of the increase would be applied in rural areas Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: ITU, BCG analysis

# **Rural areas | Combining funding models leads to rural school connectivity in theory, however many hurdles need to be overcome**

Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved...



### ...however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter 'short-term next steps')
- In addition, the current model does not account for potential profit margins that commercial parties demand. These numbers have not been included to allow for flexibility in operating model choice (e.g., infrastructure may be provided on non-profit basis due to CSR efforts or by NREN cooperation)
- Even though the full potential of these models may not be realized in practice, this exercise still provides us with useful insights. It shows:
  - Which models have the largest potential payoff in covering capex & opex
  - What prerequisites "need to hold" for the funding models to work
  - The potential upside of overcoming the hurdles that require solving

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

290 😯 🙀 giga

#### Backup



# **Detailed assumptions |** These are the "what you need to believe" for these P&Ls to hold true and what targets must be met for theory to meet practice

#### Model 1: Government increases school funding

- The government is willing to increase the education budget from 3.07% of GDP to 3.09%, which is equal to a 0.6% increase
- 99% of the additional budget would be used in rural schools
- In addition, the implicit assumption is that the government will continue with the financial support, regardless of potential shifts in political priorities

#### Model 3: Electricity as a business model

- Around ~ 3200 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~1000 people can be served by a 100 m2 solar roof, given
  - ~37,000 kWh annual output
  - ~6,000 kWh consumed by school
  - 80% utilization
  - 26 kWh average annual consumption per person, which is the country's current value
- Customers will pay \$0.15 per kWh (60% of country's grid price)

#### Model 2: Community pays for connectivity

- Around ~3200 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~60 are willing to use school connectivity in year 1, ramping up to ~320 people in year 10. This is based on the growth behavior seen in other countries with similar penetration rate, but with an assumed growth cap at 10% of population living around each school
- These 60 (Y1) to 320 (Y10) people are willing to contribute 2% of their Gross National Income (GNI) per capita, following ITU's recommendation for affordable internet. GNIpc is assumed to increase 3.1% per year, in line with the historic 5-year average compounded annual growth rate

#### Model 4: Tax revenue-linked financing

- The GDP of rural Rwanda is ~\$6.7 B (estimate based on country's GDP and average consumption per adult in rural/urban areas)
- GDP will grow 0.12% for every 1% increase in broadband penetration (according with estimates by ITU)
- Tax revenue is ~15% of GDP (World Bank)
- 80% of the additional tax revenue will be shared with operator, until upfront CAPEX is paid

Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF). Source: BCG analysis

# Set-up of case funding study starts with how to fund rural areas (~85% of population) followed by urban areas (~15% of population)

#### **Rural areas**



- Several options considered for sustainable funding to connect schools
  - Community contribution
  - Government funding
  - Energy as a business model
  - Tax revenue-linked financing
- Community contribution and electricity as a business model are most attractive options to fund average village in Rwanda, but a combination of multiple funding models will likely be needed

Urban areas



- Several options considered for sustainable funding to connect schools
  - Community contribution
  - Government funding
  - Energy as a business model
  - Tax revenue-linked financing
- Community contribution and electricity as a business model are most attractive options to fund average city in Rwanda, but a combination of multiple funding models will likely be needed

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## Urban areas | Several sustainable funding models can be considered for rolling out connectivity in average Rwandan urban school



#### Model 1: Government increases school funding

#### Model 3: Electricity as a business model



#### Model 2: Community pays for connectivity



#### Model 4: Tax revenue-linked financing



1. Increase in school budget calculated to achieve break even, considering all other 3 funding models in place; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties. Average profit margin of 17%; Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

## **Urban areas** | Funding models can lead to urban school connectivity if assumptions turn out positive



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www.gigaconnect.org | info@gigaconnect.org

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  - 26 kWh average annual consumption per person, which is the country's current value
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Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF). Source: BCG analysis

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### Rwanda case study | Table of contents

Country & school overview Connectivity status & developments Telco landscape

Recommendations Funding models Financial impact of funding models



Short-term next steps



# Several practical considerations need to be worked out in more detail to ensure models works in real-life

#### Enough demand needs to be created from villages to increase penetration levels of connectivity

- More research needs to be conducted into the willingness of Rwandans to travel to the Wi-Fi hotspot<sup>1</sup> in order to gain access to (cheaper) internet. In In Rwanda, only 57 per cent of the population access safe drinking water that is within 30 minutes of their home. Therefore, it is expected that the willingness to walk to get internet access is high, but less than that to get water
- Additional research is needed in the practicalities around gaining internet access. An important question to answer is whether there is an ability to have a (weatherproof) working spot around school, e.g., a roofed park table & bench or a more extensive work center
- Several other methods to increase demand for the school's Wi-Fi could be considered, including close-proximity individuals, companies & organizations that have a demand for internet that's currently unmet, e.g., mayor's office, health care clinic, etc.
- On a village-per-village basis, the ability to borrow computer devices from the school could be considered (although difficult in practice) to further stimulate demand for the school's Wi-Fi system

#### Practical considerations on how payments can be monetized need to be considered

- Set up of a scratch card system that could be sold by local villagers. Upon scratching the card, a new Wi-Fi log-in code would be revealed that could be used for one, or multiple session. Allows for direct increase in GDP of villagers selling scratch cards. A disadvantage could be a potential conflict with the MNO, who experiences additional competition
- Pay with mobile device directly to the school or ISP to gain Wi-Fi access via online portal (using mobile money). Only works in villages where there is enough access to mobile devices and digital literacy
- A combination of the scratch card system with the mobile money option paying directly to the school or ISP is also possible
- Cooperation with Irembo–a Government to Citizen e-Service portal, which facilitates the citizen to submit the application and make the payment for various services. Login & password system can be sent to phone to access school's Wi-Fi after payment that month. Only works in villages where there is enough access to mobile devices and digital literacy. Research needs to be conducted into potential roll-out time of using this platform

#### Sharing of the school's Wi-Fi needs to be set-up in a way to ensure meaningful connectivity

- Several models can be used to ensure that schools have access to meaningful connectivity, even with the village using it (at the same time):
  - The village is allowed to use the internet at the same time as the school (during school hours), however priority is given to students. The router can be adjusted to ensure this right-of-way access in an easy manner. Unless the school would watch several movie streams at the same time, the village would still have decent internet access (better than 3G)
  - A challenge remains device affordability and device compatibility. In order for the village to be able to use the school's Wi-Fi, a device that can access Wi-Fi is required
  - A model can be created in which the village could make use of the internet during nonschool hours (weekends, breaks, and evening hours). However, this model is less acceptable given a lower expected demand uptake

1. The hotspot range can be relatively large to ~100 meters around the school; Source: UNICEF, BCG analysis www.gigaconnect.org | info@gigaconnect.org



# We recommend 3 short-term actions for the Giga team in its journey towards realizing 100% school connectivity

Deep-dives on pages following



Several legal questions are currently outstanding before pilot projects could commence that require proper diligence



Government should be engaged to test appetite for various models suggested and to provide advice on 4G set-up



Several pilot projects can be started (after legal diligence has been conducted) to test feasibility



### Suggested short-term next steps for Giga

Several legal questions are currently outstanding before pilot projects could commence that require proper diligence

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

#### Government increases school funding

 Although Rwanda has some of the lowest corruption scores in Sub-Sahara Africa, some research would be required into the optimal 'wallet' of the government to ensure the best potential return. For example, would supplementary school funding for connectivity best come from the Ministry of Education, or the Ministry of ICT, Innovation?

#### Community contribution

• The primary constraint in community contribution models is the lack of conducive regulatory environments in most countries. License fees and reporting requirements are usually too onerous for small networks. Research is required into the regulatory framework in Rwanda

#### • Electricity as a business model

- On-grid electricity may be a government pre-condition for computers to be distributed to schools. Further research is required into whether subsidies couldn't be provided to schools connected using solar power.
- Further legal research is required into government legislation regarding the large-scale development of decentralized energy. In addition, is there any supportive legislation that could be put in place to spur investments in decentralized energy combined with connectivity?

#### Tax-revenue linked financing

- Legal diligence is required into how the tax structure would look like and how potential terms & conditions would allow for a fair distribution between the government and a potential investor
- Further research can be conducted into what the role of Giga could be in this model. E.g., would Giga be allowed to be the investor and therefore the receiver of taxes to recoup its initial investment?



### Suggested short-term next steps for Giga

Government should be engaged to test appetite for various models suggested and to provide advice on 4G set-up

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

#### Government increases school funding

 Giga teams can test the government's appetite for increasing school funding. As the spend on education as a % of GDP is relatively low in Rwanda vs. in other Sub-Saharan countries, this argument could be used in engaging the government

Gov't spend on education (% GDP)



#### • Tax revenue-linked financing

- The tax revenue-linked financing model cannot be conducted without full buyin from the government, as it's directly linked to the taxes that the government charges
- As the tax revenue-linked financing has not been tested before in real-life, it requires proper due diligence. It is suggested to include the relevant Ministries and explain the model, its risks, its potential trade-offs, and show a detailed overview of how a pilot would work

#### • 4G pricing model

 ITU's expertise could be leveraged to provide advice and/or open a dialogue with the government regarding the current 4G set-up. Whilst the 4G network in Rwanda has some of the highest Sub-Saharan coverage rates, there are some barriers that don't allow for universal adoption. By providing ITU's recommendations, analyses & experience, it may serve as a sparring partner to the government in their next steps

### Suggested short-term next steps for Giga

Several pilot projects can be started (after legal diligence has been conducted) to test feasibility

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

#### Community contribution

 Testing the community contribution model should ideally focus on rural regions. The suggestion here is to focus on regions with different GNI pc to test the effect this has on the success of the pilot and how to adjust for this accordingly. It would be suggested to start with ~5 pilots, one for each quintile of the bottom 50% of GNI pc in rural areas

#### • Electricity as a business model

- The government has an ambitious electrification plan, including vast reliance on grid extension, microgrids, and solar home systems. Especially the latter two are interesting for this funding model. In line with that, the suggestion is to focus pilots on 5 areas throughout the country where solar home systems and microgrids are within the governments intentions.
- Examples could include (1) Nshili in Nyaraguru; (2) Regions around Birambo in Karongi; (3) Colline Nyamirembe in Gatsibo, etc.

#### • Tax-revenue linked financing

- Any pilot within this model must be conducted in close collaboration with the government. We would suggest to start with only 1 pilot as a lot of work will be required in working out the terms & conditions (however, the model is very scalable thereafter).
- The suggestion is to test this model in a village where currently only low internet penetration exists. We wouldn't recommend an area without any penetration as digital literacy will consequently be low and there's no one in the village to help explain to inhabitants how to use the internet. Contrarily, we wouldn't recommend a region with high penetration as the further uplift of this model will be limited



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## Sierra Leone case study

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Source: BCG Analysis www.gigaconnect.org | info@gigaconnect.org



### **Country profile | Sierra Leone**

Key figures	<ul> <li>Population: 7.8 M</li> <li>GDP: \$4.4 B</li> <li>GDP per capita: \$542</li> <li>GDP growth: 3.0%</li> <li>Investments/GDP: 18.7%</li> <li>Urban population: 42%</li> <li>Total population under 18 years: 10.9%</li> <li>Secondary completion rate: 33.3%</li> <li>Adult literacy rate: 48%</li> <li>% of schools connected: 1.83%</li> <li>Connectivity starting point: 13.24%</li> <li>Electricity penetration: 23%</li> </ul>
Demographics of schools and country	<ul> <li># of schools in country: 11,200</li> <li>Average no. of students per school: 238</li> <li>Current # of schools with internet connectivity: 169</li> <li>Opex: Fiber (\$3,567), 4G (1,331), WISP (2,410), satellite (4,168)</li> <li>Division: 30%, 18%, 22%, 30%</li> </ul>
Government involvement	<ul> <li>% GDP spent on education</li> <li>6.1</li> <li>6.3</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.3</li> <li>6.4</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.4</li> <li>6.5</li> <li>6.5</li> <li>6.6</li> <li>6.7</li> <li>6.7</li> <li>6.7</li> <li>6.8</li> <li>6.9</li> <li>6.1</li> <li>6.9</li> <li>6.1</li> <li>6.1</li> <li>6.3</li> <li>6.3</li> <li>6.4</li> <li>6.4</li> <li>6.5</li> <li>7.5</li> <li>7.5</li> <li>7.5</li> <li>8.5</li> <li>7.5</li> <li>8.6</li> <li>9.6</li> <li>9</li></ul>

# It is relatively expensive to finance school connectivity in Sierra Leone given the low fiber and 4G coverage, electrification and (digital) literacy

Context: Sierra Leone's mobile internet coverage is 86%, yet internet use remains low at 17%. The low use is driven by 1) low access to electricity, ~23%, and 2) high relative cost, ~16% of GNI per capita has to be spent on data-only 1.5GB mobile broadband. 86% of schools are within 3G coverage, but only 2% of schools are connected to the internet. Additionally, 4G connection would be needed for a meaningful connectivity (>5 Mbps). The main topics to be addressed are: 1) internet coverage, 2) electrification, 3) affordability and 4) (digital) literacy. Only 1% of the population is covered by a fiber network. Currently, the government is undertaking a \$28M project to roll out 660km of fiber optic cables across the country



Since fiber coverage is very low, it is not always the best option for Sierra Leone. Investments in all options should be leverage to improve school connectivity:

- Fiber: 30%
- WISP: 22%
- 4G: 18%
- Satellite: 30%

### S Cost structure

In total, a yearly investment of ~\$66M is needed to fund school connectivity.

An additional \$27 will have to be spent per unconnected student on an annual basis to fund school connectivity.

For an average Sierra Leonean school that is not connected to electricity, \$6,699 is required on an annualized basis



Different funding models are considered for urban and rural areas. For both areas:

- Electricity as business model
- Government-subsidized PPP
- One-off subsidy by the gov't (USF financing)

For urban areas:

- One-off subsidy by the gov't (tax exemptions, fine system)
- Advertising model
- Gov't increases school funding

For rural areas:

- Community contribution
- Community collaboration



In terms of operating model, the following is advised:

- Private company/consortium or contract (if gov't is involved) for electricity as a business model
- Turnkey (+ Lease) for one-off gov't subsidies
- State/gov't driven for the gov't budget increase
- Cooperative and Voluntary set-ups for community contribution



06 5.

### All operating models (private, PPP, state and community) are used, thereby involving all different stakeholders in the process of improving connectivity

Funding model		Explanation		Operating model
A	Electricity as a business model	Electricity as a business model should accompany a private company/consortium operating model - a commercial-provided archetype. As most of the pop. is without electricity, the potential synergy between electricity and connectivity is an attractive business proposition. However, this requires expert knowledge from both industries and should be large-scale to attract investment		Private company/ consortium or Contract (if gov't is involved) <sup>1</sup>
В	One-off government subsidy	Includes gov't-subsidized PPP and USF financing - an (implicit) one-off subsidy. USF financing is gov't-driven - however USF funds are often spent via commercial parties (more efficient at building infrastructure vs. gov't). Gov't subsidized PPP entails an RFP to commercial parties for e.g., police stations, hospitals, and include a mandate for school connectivity. PPP is, therefore, more relevant in urban areas. Tax exemptions for ISPs would be another (implicit) subsidization model, relevant for both urban and rural areas.	$\diamond$	Turnkey (+ Lease)
С	Government increases school funding	Falls within the government-contributed archetype and therefore the state/government driven operating model is advised.		State/government
D	Community contribution	The community contribution model builds on the community-based archetype. Funding model is more appropriate for rural regions. Local ownership is based on supporting community-based micro-enterprises. Village ownership may be more successful, as the NPO or local gov't provides continuous guidance and training in addition to initial funding	$\diamond$	Cooperative and Voluntary
1. Can	also be cooperative / voluntary model	, however we would urge to involve a commercial party given the complexity of execution. In essence, more	del	

1. Can also be cooperative / voluntary model, however we would urge to involve a commercial party given the complexity of execution. In essence, model A is operating-model agnostic (see Kenya deep-dive for more information); Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org

### Case study Sierra Leone table of contents

Country and school overview

Connectivity status and developments

Telco landscape

Recommendations Funding models Financial impact of funding models Short-term next steps Sierra Leone is a country with several challenges. There are three main hurdles to overcome to connect all schools to the internet

Deep-dives on next pages

#### Two thirds of households live in extreme poverty

A third of schools is covered by 4G, yet very few are connected

78% of schools are not connected to electricity







# Sierra Leone consists of 16 districts with high poverty rates in all regions besides the west



n nd Urban population 43% - 2020



71,740 km<sup>2</sup>

4,420 U\$ m 2021 GDP

2021-25 + 4.1% y-o-y

Sierra Leone

7.8 M inhabitants

### Sierra Leone is facing significant development challenges ...

## Sierra Leone exhibits post-conflict characteristics ...



#### High youth unemployment

9% vs. 4% over total population

#### Corruption

- Ranked 117th out of 180 on Corruption
   Perception Index
- Highly corrupt score but improving

#### Weak Governance

- Ranked 24th out of 54 on African
   Governance Index
- Exhibits increasing improvement

Source: Corruption Perception Index, Ibrahim African Governance Index, World Bank www.gigaconnect.org | info@gigaconnect.org

## ... and suffered from negative GDP growth due to two disease outbreaks in one decade



311 •••• gig

# ... leading to fewer opportunities and low education levels, with few students completing education past primary school



#### Sustained low literacy rates ...

#### ... because of low school attendance



School attendance rates

### In line with poor country connectivity, schools in Sierra Leone have worse connectivity vs. several other comparable countries

### Only 1.5% of schools has internet in Sierra Leone, and none of them have meaningful connectivity >5 Mbps



### Only 34% of unconnected schools are in a 4G coverage area, which is required for >5 Mbps



Coverage status of unconnected schools (percent)

Source: Annual School Census, Giga Data, BCG Analysis www.gigaconnect.org | info@gigaconnect.org

Data unavailable	No connectivity
------------------	-----------------

Good

 Moderate connection (<5 Mbps) is not good enough for meaningful connectivity

Moderate

• Good connection (>5 Mbps) is the minimum requirement



#### Key statistics:

- 169 schools (2%), albeit connected, are currently not in line with Giga's suggested minimum for meaningful connectivity
- 6,843 (61%) schools don't have internet due to digital illiteracy or due to affordability
- 8,679 (78%) schools require an increase in electrification, and potentially require more interventions

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# Economic growth in Sierra Leone is impeded by the fact that a majority of Sierra Leoneans does not have access to electricity ...

Only 23% of the population has access to electricity, with especially rural areas lacking ...





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# ... and partially as a result of this electricity access issues, there is poor internet connectivity for the population at large

Less than 1% of the population is connected through fiber ...

... but a large part of the country is already covered by 3G/4G



1. The ECOWAN fiber cable is an economic community of West African states project funded by the Islamic Development Bank Source: Project connect, Giga data, BCG analysis

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# The problem of low electrification persists when looking at schools, especially in the more rural districts



Freetown, located in Western Area Urban, has by far the best electrification rates

#### Percentage and total number of schools with electricity





And better access to the grid correlated with higher electrification, whilst rural schools rely more on solar

#### Type of electricity in schools





15.6% of GNIpc spent on 1.5 GB mobile broadband data basket, which is far above ITU recommendation for affordable internet ...

Spent on data-only mobile-broadband (1.5GB) as (%) of gross national income per capita-2020



... meaning mobile connectivity has expanded from 2013, but internet usage remains low at 17%

Broadband coverage, and internet penetration, (%) of population



19 **•••••** giga

# Sierra Leoneans desire better connectivity, but there are structural and cultural hurdles towards achieving this

### Although communities want better connection, several hurdles exist

- Sierra Leone faces a comprehensive infrastructure problem, worsening as you get further from the capital. This includes but is not limited to electricity, water, roads, and connectivity. As such, many villages do not have access to electricity or the internet.
- According to experts, village communities are interested in better connectivity and would be willing to travel for to access points.
- Big issues are the presence of a generator and sustainable maintenance, which requires community ownership and oversight. Including the community in tackling these issues is generally seen as key in providing a solution

66

Community-support is incredibly important. Otherwise, you risk equipment not being used for its intended purpose or even being stolen and resold —BCG Consultant and previous resident of SL The rainy season, which runs from May to November, leads to several practical challenging, e.g., it's difficult to bury underground fiber cables



320 5. 8

## All in all, lack of connectivity in Sierra Leone is a consequence of a coverage gap, as well as an affordability, electrification, and literacy issue



1. 3G/4G division based on data on Rwanda, expectation is that it will be similar for Sierra Leone Source: Giga data, GSMA, RURA, BCG analysis www.gigaconnect.org | info@gigaconnect.org

# Although 16% of Sierra Leoneans have access to mobile internet, a large share is connected to 3G, which is not sufficient for meaningful connection in schools

### 4G coverage is limited to the largest cities ...

#### Map of 3G/4G coverage



... which is required to reach meaningful connectivity ... Enables Connection Speed <10 2G or 3G • Not sufficient to Mbps reach meaningful connectivity in schools • Opening 10-20 Requires 4G Defined as Mbps documents • "meaningful • Taking connectivity" assessments Giga's Giving feedback minimum and questions Watching online internet speed videos >20 Requires 4G Video-enabled Giga's target school Mbps • speed environments Cloud-based apps

### ... as such, the real coverage gap is closer to 65%



Source: ITU, BCG analysis www.gigaconnect.org | info@gigaconnect.org



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# Summary | SL's telco market is facing significant challenges, but the arrival of international players provides hope in the expansion of school connectivity

### The Sierra Leonean telecom market is facing several difficulties



Sierra Leone's electricity and telecom backbone infrastructure is severely underdeveloped



Mobile internet subscriber numbers are slowly growing, with affordability remaining a large issue



The regulator (NATCOM) has failed to clarify the regulatory environment, limiting operator willingness to upgrade the networks



Corruption, mismanagement and potential political instability create a complicated business environment

### However, upcoming changes might provide new possibilities



Orange's arrival on the Sierra Leonean market has spurred new investment activity and increased competition



Completion of the ACE submarine cable connects Sierra Leone to low—cost, high—speed international bandwidth



Number of directors were purged from NATCOM and the audit service Sierra Leone outlined necessary regulatory reforms



Big growth opportunities are still to be found in basic services, especially in rural areas

### Deep—dives on next pages



### **Overview of telco landscape in Sierra Leone**

Characteristics	Description
Current status of fiber and 4G, WISP, and of satellite coverage in country	<ul> <li>In Sierra Leone, 86% of the population has access to a mobile subscription. However, access to mobile broadband is limited, with a penetration of 15% as of 2019</li> <li>4G coverage has been slowly expanding in the country, despite low 4G penetration. The mobile market saw an 18.5% y-o-y growth rate in 2020, reaching a total of 6.2M mobile subscribers. This growth can mostly be attributed through aggressive price promotions, meaning that many new subscriptions could become inactive as the promotions pass</li> <li>The country has 250,000 fixed lines, most of which are in the capital Freetown and regional capitals of Bo and Kenema. Fixed broadband penetration in Sierra Leone is less than 1%. However, the government is investing in a \$28M fiber optic project to roll out 660km of fiber optic across the country.</li> </ul>
Two large players and two small ones	<ul> <li>Orange, Africell, QCell and Sierratel are the major players in Sierra Leone, the former two being the largest. all four players offer 3G and 4G services</li> <li>Orange has been quickly developing in the country by acquiring Airtel in 2016 and emerged as the market leader in 2020. Orange had a total of 3.2 million subscribers by the end of 2020 while Africell had 2.68 million by 20191</li> </ul>
Instability and years of Civil War have devastated the infrastructure and requires large investments to rebuild	<ul> <li>Sierra Leone went through a decade-long Civil War which ravaged the country and destroyed much of its infrastructure. After the war, the country has been slowly investing and rebuilding its infrastructure</li> <li>Since the liberalization of the market in 2000, investments in network infrastructure have been increasing from telco players and international organizations such as the IFC</li> </ul>

1. Multiple SIM ownership and reluctance to deactivate inactive SIM cards might overinflate subscriber numbers. Source: Buddecomm, Fitch Solutions www.gigaconnect.org | info@gigaconnect.org



## Overview of major upcoming changes in telco landscape and resulting school connectivity expected

<b>I</b> Major changes	Description
Africell announces multi-million-dollar agreement	<ul> <li>In April 2021, Africell signed a deal with US-based Aviat Networks to provide a 5G-ready, end-to-end disaggregated transmission network</li> <li>Such high-speed networks can be beneficial for school connectivity, especially if they also cover previously unconnected areas. A downside to 5G networks is that they also require more expensive equipment</li> </ul>
End of Sierratel's monopoly on fixed broadband	<ul> <li>In 2012, Sierra Leone was connected to the Africa Coast to Europe submarine cable, which provides high-speed, low-latency connectivity and could be used to connect schools in the vicinity of the cable</li> <li>The cable was fully operated by Sierratel. However, plagued by corruption and mismanagement, Sierratel has been unable to expand fixed broadband despite significant investments</li> <li>Half of the access to the cable was privatized and in 2020, Orange started delivering fixed broadband. As one of the largest operators in Sub-Saharan Africa, it is expected to push the development of fiber and address the bad backbone infrastructure and last-mile connectivity problems. Expanding the existing fixed broadband base would likely enable lower last-mile connectivity costs for schools, and potentially higher-quality connections, leading to more for meaningful connectivity</li> </ul>
One area network initiative	<ul> <li>In April 2019, the National Telecom Commission (NATCOM) announces the signing of a MoU with telecom agencies of Liberia, Guinea, and Côte d'Ivoire to implement the One Area Network. This agreement allows customers to use their mobile services in all the mentioned countries without any extra roaming fees or tariffs</li> <li>The elimination of extra fees and tariffs enhances profitability of MNOs and could turn once negative NPV projects more positive, thus potentially generating further investment interest, lower prices, and allowing for better services for schools as well</li> </ul>
Government plans	<ul> <li>Expand broadband coverage to 30% and mobile internet to 80% by 2024</li> <li>National Curriculum Framework and Guidelines For Basic Education expanded to include ICT literacy and technology in basic education. This addresses digital literacy in children, who can relay knowledge to their community</li> <li>Government announces \$30M loan to finance the deployment of fiber network across the various districts, with an emphasis on hospitals and schools. This increases affordability and addresses the coverage gap and usage gap</li> </ul>



## Sierra Leone remains a difficult environment to operate in, with a below-average risk/reward profile



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Orange has emerged as market leader in 2020, despite failure on the regulator's side to provide a stable business environment

### Despite NATCOM's regulatory shortcomings

- NATCOM is responsible for implementing government policies relating to ICT through regulations, licensing, and monitoring the performance of the industry players
- After reports of corruption and mismanagement, a number of directors were fired in 2020
- In 2019, the Audit Service Sierra Leone reported that NATCOM needs to reform to carry out its duties. There are currently insufficient regulations in areas such as quality of service, licensing, tariffs, universal services to oversee and guarantee the quality and development of the sector
- NATCOM has been ineffective at claiming outstanding license fees, totaling USD 2.93 from Africell, 1.3m from QCell, and 5.2M from Sierratel
- NATCOM has not yet licensed the full 900-1800MHz bands, thus the mobile market is not yet at its full potential

### • ... Orange gained market share at Africell's expense



Source: Fitch Solutions, Press research, BCG Analysis

### **Orange Sierra Leone (Sonatel) | Key facts & figures**

### Key figures



#### Employees ~4500



### Headquarters

### OwnershipPublic company

- Subsidiary of Orange
  - (42% controlling stake)

#### Key financials (US Dollars m<sup>1</sup>) Sonatel



#### Overview

• Orange is a key player in telecommunications in Sub-Saharan Africa. In Sierra Leone, it operates through its subsidiary Sonatel. Sonatel acquired the Sierra Leonean company Airtel in 2016, which got renamed Orange Sierra Leone. In 2020, Orange SL emerged as the market leader with a 52% market share Subscriber numbers and 2019/2020 growth rate



### Strategic plans

- Orange SL is the most recent player to expand its network to 4G in 2019, allowing it to offer more advanced solutions and applications
- The mobile money service Orange Money reached 1m subscribers in Sierra Leone in 2020. They also launched the "Lajor" loan service, revolutionizing easy access to credit for Sierra Leoneans
- Commitment to further expanding coverage areas, especially in rural areas, by an 10.3% y-o-y increase in Capex (XOF22.9m)<sup>2</sup>
- Gained access to the ACE fiber cable, effectively ending Sierratel's monopoly on fixed broadband

### Corporate social responsibility practices

- Launch of Orange Energy, a solar energy package that generates enough power for 3 utility bulbs, a radio, fan, and a television set, with a flexible payment method.
- Free access to E-Learning portal for all students and free internet access to some university and all Ministry of Education websites.

1. Conversion rate 1 FCFA = 0.0018 USD 2. 1 SLL = 0.000098 USD Source: Company website, annual reports, Fitch Solutions, Press research. www.gigaconnect.org | info@gigaconnect.org

orande

### **Africell | Key facts and figures**



### Key figures



#### Employees ~1000



### Headquarters

#### Ownership

- Private company
- Backed by international investors

#### Key financials (US Dollars m<sup>1</sup>)



#### Overview

- Africell operates in several sub-Saharan African countries including Gambia, Uganda, and DRC
- Entered the Sierra Leone market in 2005 and acquired rival Millicom's business in the country. The company was the market leader for years but was surpassed by Orange in 2020

### Strategic plans

- Africell was the first player to launch 4G services in Sierra Leone in 2018 and has signed a deal with the USbased Aviat Networks in 2021 to provide a 5G-ready, end-to-end disaggregated transmission network
- Received a USD 105 million loan to support its growth plans in 2021 from the US-based Overseas Private Investment Corporation
- Launched its mobile money service in 2014 and a mobile insurance scheme in 2017

### Corporate social responsibility practices

- Conducts awareness-raising campaigns on health topics and provides donations for regions impacted by epidemics such as Ebola
- Sponsors clinics in rural areas to promote access to healthcare
- Provides funding for sports teams

Source: Company website, annual reports, Fitch Solutions, Press research. www.gigaconnect.org | info@gigaconnect.org

#### Subscriber numbers Africell





### Despite new regulations, mobile players are struggling to advance their service quality



The regulator has set forth new regulations to protect consumers and promote better services ...

- NATCOM established the Telecommunications Act 2006 to oversee the development of the sector
- The agency holds 'Consumer Parliament' sessions to enable customers to discuss issues with telco players
- NATCOM agreed with the telco regulators of the ECOWAS countries (Senegal, Burkina Faso, Mali, Côte d'Ivoire, & Guinea) to provide free roaming between the countries
- The agency reduced the price floor for voice calls from SSL 650 to SSL 590 in 2020, after a World Bank report showed that Sierra Leone had the most expensive tariffs in sub-Saharan Africa



... And telecoms have been fined for not adhering to these ...

- Orange was fined US 390,000 for tampering with network frequency in 2 regions which caused disruptions to their competitors, and also USD 700,000 for poor service delivery, as per NATCOM's guidelines
- Sierratel was fined USD 200,000 for poor service delivery. Furthermore, it has USD 5.2m in outstanding license fee payments to NATCOM
- Airtel was fined USD 450,000 in 2012 for poor network services and a further USD 1.2 million in 2016 due to poor service and failure to meet KPIs



### ... This matters to school connectivity due to coverage and quality

- As 4G coverage in rural areas is still very low, the telco sector needs to be in good shape to further expand into rural areas where schools are not connected yet
- NATCOM's service quality requirements are important to ensure the stable connections.
- In order to reach meaningful connectivity, not only is 10 Mbps a minimum requirement, but connections also need to be stable and trustworthy



Sierra Leone's Universal Service Fund is unaccounted for, making it inaccessible for school connectivity funding

### -• The effect of Sierra Leone's Universal Service Fund (USF) is unknown

- A Universal Service Fund can be used to reallocate funds to stimulate ICT investments in areas with a coverage gap, based on principles of universal availability, affordability and accessibility.
- Along with the other ECOWAS countries, Sierra Leone adopted a USF in 2007. However, Sierra Leone does not report any data on the usage of its USF. Thus, it is unknown whether the funds have been utilized at all.
- Press reports have indicated that the African Organisation of English-speaking Supreme Audit Institutions found that NATCOM had misappropriated the Universal Access Development Fund (UADF, Sierra Leone's USF). USD 800k was used to cover salaries and administrative expenses instead of using investing it in its intended purpose of improving infrastructure to enable universal access to telecom services
- GSMA recommends discontinuation of USF funds, as they have generally been unsuccessful, and funds have not been deployed. Instead, nations should transition to a Universal Service Obligation, which allows consumers to demand a minimal quality standard. If providers incur unfair costs, they can retrospectively be compensated
- Consequently, the USF is unlikely to be accessible for school connectivity funding, as the UADF's strategic plan from 2019-2023 is mostly focused on identifying different types of access gaps, which they have categorized as a 'true access gap' that needs sustained funding, the 'smart subsidy gap' which needs a small subsidy to jumpstart, and the 'efficient market gap' which mostly needs better regulations and private investments

The primary role of the Universal Access Development Agency is to identify the different access and service frontiers, and to determine the specific policies and interventions needed to extend access and service to reach universal access targets

-Universal Access Development Agency

Source: GSMA, Universal Access Development Agency, Press research, BCG Analysis



### Sierra Leone's new NREN could be an interesting avenue for expanding connectivity in schools



Sierra Leone's nascent SLREN could be further expanded to include connections to schools

Sierra Leone established Sierra Leone Research and Education Network (SLREN) in 2016. SLREN provides advanced ICT services to the education and research communities in Sierra Leone

During the pandemic, SLREN helped with the implementation of e-learning platforms in universities and provided access to free Zoom licenses

Although SLREN's reach appears to be limited to universities in Freetown, its scope could be expanded to primary and secondary schools

## Best practices can be found in Brazil, where schools already have connectivity through NREN

The Brazilian NREN (RNP) provides connectivity through its own network to an estimated 4M users across 1,500 sites in Brazil

Funding comes from the Brazilian government through ministries of education, science, technology, health, defense and citizenship



RNP has launched a project to roll out and connect not only universities and research institutes, but also schools, governments, hospitals and businesses to optic fiber

### Working with SLREN in connecting schools would allow for scale benefits and access to funding and expertise

Scale benefits when there are universities and research institutions in the area

Access to funding and expertise, as SLREN can rely on guidance from the West and Central African Research and Education Network

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## Several key issues need to be tackled to achieve meaningful school connectivity, of which funding models is one



#### Electricity availability

- A large share of the population in Sierra Leone does not have access to electricity
- In urban areas this amounts to 50%
- In rural areas, less than 5% of the population has electricity access
- For schools, electricity levels amount to 22%
- As electricity is a prerequisite for school connectivity, this is a major hurdle to be overcome



#### Regulatory framework

- Whilst Sierra Leone has made great steps in adjusting regulatory frameworks in the telecom sector, it still struggles to police regulations and to issue and collect fines when needed. The process can also sometimes come across as arbitrary
- Difficulties in delivering on new initiatives can also be seen in the USF and NREN, which have been established years ago but have failed to make any significant progress



#### nework Corruption

- A big issue is the reported corruption in the government, state-owned businesses and in companies
   For example, mismanagement of funds has wasted significant investments made by
  - across Sierrratel in the fiber cables, which still remain largely g on unused
    - Another example is the firing of directors at NATCOM, which is supposed to oversee the telecom sector at large in a transparent manner



### Demand needs to be stimulated

- Besides the large coverage gap, there is a large usage gap in areas covered by mobile internet. This is largely due to affordability of mobile internet (far above the 2% of GNIpc recommendation) and devices.
- This is likely part of the reason that telco operators have not been able to expand into rural areas yet, as demand is still too low
- (Digital) literacy needs improving, because a large share of the population of SL cannot read or use a device



### Funding models need to be identified

- Several funding models need to be identified that would lead to sustainable connectivity of schools
- As tackling the aforementioned points may lead to changes in the underlying economics of the different regions, these funding models may have to be revisited over time
- A separate section has been provided on what funding models are deemed suitable to close the gap in school connectivity

#### Deep-dive provided



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### As large differences exist between rural & urban population, we believe splitting the country as such is required when looking at funding models

An increasing share of the population is living in urban areas...

Population living in urban and rural areas



#### 🗾 Urban population 📃 Rural Population

Source: United Nations; BCG Analysis www.gigaconnect.org | info@gigaconnect.org



### ...with currently already ~10% of the population living in Freetown

## Connecting schools in urban areas will have a good chance of success with the following funding models

Funding m	ethod	Reason for suitability							
4	Electricity as a business-model <sup>1</sup>	<ul> <li>Suitable because: Most of the population have no access to electricity yet; connectivity requires electricity. Synergies between electricity and connectivity providers can lead to significant advantages and profits can be used to fund school connectivity</li> <li>Reason for concern: Requires expert knowledge crossovers from both fields. Also needs to be a large-scale project to be attractive for investors</li> </ul>							
Å	USF financing <sup>1</sup>	<ul> <li>Suitable because: Reforming the USF opens doors to multiple financing opportunities. It can be used in the traditional way to invest in universal according or used as a financial mechanism</li> <li>Reason for concern: During the USF's decade of existence, Sierra Leone has failed to enact transparent regulations. Clear definitions need to be set around how funds are collected and how it is spent</li> </ul>							
	Government- Subsidized PPP <sup>1</sup>	<ul> <li>Suitable because: RFP bidding for packages including several institutions such as police stations and hospitals, including a mandate for free connectivity in schools, would ensure revenues for telecom providers</li> <li>Reason for concern: The regulator needs to police quality provided to schools by the telcos. The institutions in the package also need to be able to pa for prolonged connectivity</li> </ul>							
	Tax exemption for ISPs	<ul> <li>Suitable because: Corporate tax rate of 30% and other telco specific taxes and licensing fees make this an attractive model to stimulate school connectivity</li> <li>Reason for concern: Need clear oversight to see if telco players deliver on their agreements to get the tax exemptions</li> </ul>							
	Advertising model	<ul> <li>Suitable because: Targeted ads outside of schools are already being used; by showing ads in the entire country, earnings could be used to cross-subsidize the poorer parts</li> <li>Reason for concern: Ads will need to adhere to government requirements/limitations, and checked with schools and parents</li> </ul>							
\$	Gov't increases school funding	<ul> <li>Suitable because: Investing in the network roll-out is also an indirect investment into upgrading other facilities in schools across the country, e.g., clean water, for which additional funding is needed</li> <li>Reason for concern: SL's current spend on education is already relatively high; but additional funds might be allocated to Opex</li> </ul>							
	Fine system	<ul> <li>Suitable because: NATCOM has set up a quality and consumer protection framework and hands out fines when providers ignore these. Instead of paying the fine, telcos could opt to invest in negative NPV projects</li> <li>Reason for concern: Risk of long litigations if telcos do not wish to pay the fine. Would require a clearer framework than the current to speed the process up</li> </ul>							
1. Xxx Source: BCG an	alysis	Most likely to succeed Neutral Least likely to succeed							

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Backup



### Back-up | Several funding methods considered for Sierra Leone

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# Deep-dive: Electricity as a business model | Connectivity requires electricity and could be a useful source of funding

### Only 22% of schools is connected to electricity...



1. Estimated based on a model created by so simple solar Source: Giga data; BCG Analysis www.gigaconnect.org | info@gigaconnect.org

#### ...providing an opportunity for electricity as a business model in those regions



By having the ISP simultaneously install solar panels, the community will benefit both from power and connectivity



As solar power is cheaper than electricity of the grid (0.06 vs. 0.28 kWh<sup>1</sup>), the ISP can charge a price slightly above cost price while still being competitive



This additional revenue can be used to fund school connectivity while also connecting communities to electricity

### Orange is an example of a useful partner for this business model



The sector operates under a single-buyer model, where private parties sell the produced electricity to the national electricity company.



The government has outlined the two goals of achieving 82% off-grid electricity access target and connecting 37% of the rural population by 2030.



Orange has launched affordable solar panel packages across the poorest regions and could be interested in scaling up these initiatives





## Deep-dive: USF financing | A trustworthy USF can be leveraged as a financial mechanism



Traditional USF spending

Current mechanism of spending the fund as income comes in

#### Using the fund to raise more capital



• The USF can leverage the upcoming revenue streams to move cash flows forward. Over a 5-year period, instead of raising USD 100,000 a year, it would be able to invest 500,000 in first the year whilst paying off the investment in the subsequent year.

#### Using the USF as a guarantor



- The USF can act as guarantor for new investments. This would take some of the risk off the telco companies undertaking new projects.
- The service provider occurs the upfront cost and can be compensated retrospectively for unfair net costs.
- Safeguards against corruption and the misappropriation of funds, especially if the USF fixes a maximum compensation percentage in advance.

### Most important prerequisite to reach that is a clear regulatory framework

- Currently, there is no clear regulatory framework, neither on how the fund is provisioned or how it can be distributed in Sierra Leone
- There is still a lot of work in Africa to make USF funds work. Clearer regulations in terms of coverage & quality, and transparency & oversight are needed, but best practices can be found in Indonesia

### The Indonesian Universal Service Fund and BAKTI

- Telco operators contribute a few % of their quarterly revenue to the fund.
- It is used to fund network infrastructure and Opex subsidies in underserved areas.
- Criterium is that the region has no connection or less than 50% coverage
- Operations are carried out by Bakti, an arm of MCIT<sup>1</sup>, who's main function is to build digital infrastructure and ecosystems in underserved areas and serve as a facilitator to develop digital literacy in communities.
- BAKTI's successes include rolling out 12,000 km of fiber optic cable, building BTS stations and satellite connectivity

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### Deep-dive: USF financing | The universal access development fund is still in its infancy

Strengths

- Universal Access Development Agency (UADA) is autonomous in its decision-making and financial resource planning
- Relevant research studies such as the Access Gap Survey and voice/data penetration survey can guide the UADA's work
- Mandate of the UADF is aligned with government policy and regulations such as the National Development Plan, ICT policy, and Infrastructure sharing
- **Weaknesses** Limited stakeholder and public understanding of the UADF
  - Poor historical performance
  - Lack of comprehensive revenue generation plan or budgeting
- **Opportuniti es** • Strategic directions are aligned with the government's priority areas, such as education and health care
  - Learning from best practices in USF Management
  - Cost-effective technology advancements

Threats

- Misuse of UADF funds or use for unplanned projects
- Uncertainty of sustainability of funded projects beyond subsidy period
- Unreliable power supply in target areas
- Poor management or use of funds by community entrepreneurs
- Telco operators not complying with the levy payment.

Sierra Leone's Universal Development Agency is focused on facilitating and enabling the ICT environment, promoting universal access, and its own institutional development

It has outlined the following projects

- Research studies and surveys
- Subsidy and incentive design
- Consultation and awareness creation
- Rural connectivity, last mile fiber connectivity, and local access network facilities
- School access project, which focuses on providing connectivity in secondary schools and training teachers in ICT

#### Institutional Framework for Universal Access and Service Operations



Source: Universal Access Development Agency; BCG Analysis



## Deep-dive: Gov't-subsidized PPP|Gov't-mandated and subsidized contracts for gov't institutions can stimulate school connectivity semi-commercially



### Government has outlined connectivity goals by 2030

- The Sierra Leonean government wishes to close the usage gap by 2030. This requires improving its backbone infrastructure and affordable pricing.
- The National Innovation & Digital Strategy 2019-2029 stresses the need for an ecosystem approach that connects schools, people and institutions to broadband.
- As such, the government has clearly communicated the need and willingness to work on a solution for school connectivity.



### Investments can be made more attractive by bidding for packages

- Key institutions in one neighborhood such as police stations, hospitals, and other government institutions are bundled into a package. In addition, state-owned commercial companies can be included as anchor clients to reduce the subsidy required by the government. The package includes the requirement of free school connectivity.
- The packages are then sold via an RFP<sup>1</sup>, creating a more diverse portfolio. The service provider now has the right to supply connectivity to these clients and the government serves as an anchor tenant who will guarantee that connectivity is paid for



### Resulting in free school connectivity

- Offering the revenue streams from government-owned anchor clients leads to 'secure' revenue streams that will turn negative-NPV regions into positive NPVregions, leading to higher commercial demand, as connectivity payments are now guaranteed by the bundled package.
- Allowing connectivity in government institutions can lead to the development of an ecosystem where the community comes together for connectivity and businesses can grow.
- Schools will therefore receive sustainable funding in the longer run.

1. E.g., telco players must provide a set price per Mbps used, we recommend to set a long-term contract to decrease the prices demanded by commercial players (10+ years)

Source: Giga data; Expert interviews; Sierra Leonean government; BCG Analysis

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### Deep-dive: tax exemptions for isps|Levering tax exemptions and discounts for isps could improve school connectivity

### Telecom providers are subject to many different types of taxes

The corporate tax rate in Sierra Leone is 30%, but adding industryspecific taxes and license fees, the average effective tax rate amounts to 70%

This makes it more difficult to reinvest, as service providers' profitability is impacted by this (see the next slide)

Average effective tax rate across sectors in SL



#### Tax exemptions can be used to incentivize ISPs to expand coverage and connect schools

The tax exemptions cover internet service providers who wish to expand their infrastructure and coverage into underserviced areas or provide free connectivity services to schools

With the capital that is freed up, ISPs have more room to invest to invest in coverage and connectivity

This requires clear framework for eligible areas, quality of service and length of operation, and subsequent policing of the agreement

### 

Urban solution • Provide tax exemptions for operators who provide

#### **Rural solution**

- school connectivity for free
- Provide tax exemptions for operators who expand coverage into underserviced, rural areas
- Provide tax exemptions for operators who provide school connectivity for free

Source: International Development Foundation; Expert interviews; BCG Analysis www.gigaconnect.org | info@gigaconnect.org

## Deep-dive: tax exemptions | Government plays an active role with telecom taxes review and can promote infrastructure investment growth



Sierra Leone's high taxes leads the sector into a vicious cycle, shorting the investment of the sector...





... and lower tax burden increases tax collection and reduces social inequality, starting a virtuous cycle



# Deep-dive: fine system | Using the quality-of-service framework to improve school connectivity



### NATCOM has been monitoring Quality of Service since 2018

- NATCOM has established 6 consumer-oriented KPIs that country's 4 mobile network operators must adhere to, including network availability, handover success rate, and TCH congestion rate for 2G networks.
- If operators fail to adhere to QoS, NATCOM will distribute fines, as it has done in the past to Africell, Orange, and Sierratel





## Fines can be waived against investments

- Instead of paying a fine, a minimum investment in either backbone infrastructure in underserviced areas or provide connectivity to schools
- A downside of this funding model is that the agreements between NATCOM, operators and the Accountability court can take several years. A step forward would be to predefine what fines will be handed out when and how they can be waived



## There are certain requirements

- A clear and transparent framework will need to dictate in what areas investments can be made and the minimum quality of service for school connectivity
- This agreement then needs to be carefully policed by NATCOM
- The QoS framework needs to be extended from 2G coverage to 4G coverage

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## Deep-dive: advertising model | advertisement seen as potentially viable option for funding method, targeted ads outside of school already in place

Sierra Leone already has ads which are targeted at schools, though private sector involvement limited<sup>2</sup>...





Example ad from Freetown Hawanatu Kafula, whose community has been supported by Action Aid during the Ebola epidemic, poses for photographs in Gollu, Sierra Leone August 17, 2015 [Kate Holt]

1. Not verified by legal expert 2. E.g., the involvement of media agencies in designing content Source: Press news; Al Jazeera; BCG Analysis

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### ... increasing school-targeted ads could be a viable option as one of the funding methods

• There is no specific government ruling<sup>1</sup> found on the limitation

of using advertisements in school, though many schools have their own policy for it

- A maximum no. of ads per day should be agreed upon to avoid any type of decrease in the quality of education
- Ads would need to be shown in entire country, including urban areas; otherwise, earnings from ads would be too low
- These would be used to cross-subsidize the poorer parts
- As there are no insurmountable upfront barriers identified, advertisement could be further investigated as a viable option

as one of funding method for school connectivity

• Further research required into stance of students, parents, and teachers' community

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# Government could further increase education spend to facilitate right environment for high-quality (digital) learning

### Government spend on Education is relatively high<sup>1</sup>, having increased steeply in recent years ...



Gov't spend on education (% GDP)

#### ... further increases could continue to shape the right learning environment

Although government would probably not roll out connectivity themselves, increase in educational budget is needed to cover additional expenses, like devices and ICT labs

Moreover, teachers will likely need extra training to upgrade their digital skills

Although the focus of this project is on internet (and electricity), the roll-out of the network can be used to upgrade water facilities in schools across the country, for which additional funding is needed

1. This includes only national government spend, unclear if local authorities (e.g., municipalities) also help fund education 2. Data unknown for 2006 and 2015 Source: World Bank (2019) www.gigaconnect.org | info@gigaconnect.org |



## Connecting schools in rural areas will be extremely difficult, but the following funding methods provide hope

Funding method			Reason for suitability				
4	Electricity as a Business- Model Overlaps with urban		<ul> <li>Suitable because: Most of the population does not have access to electricity yet, and connectivity requires electricity. Synergies be electricity and connectivity providers can lead to significant advantages and profits can be used to fund school connectivity</li> <li>Reason for concern: Additional to the urban concerns, there is less backbone infrastructure to rely on than in urban areas</li> </ul>				
Ď	USF Financing Overlaps with urban		<ul> <li>Suitable because: Reforming the USF opens doors to multiple financing opportunities. It can be used in the traditional way to invest in universal access or used as a financial mechanism</li> <li>Reason for concern: During the USF's decade of existence, Sierra Leone has failed to enact transparent regulations. Clear definitions nee to be set up around how funds are collected and how it is spent</li> </ul>				
	Tax exemptions for ISPs	Overlaps with urban	<ul> <li>Suitable because: Corporate tax rate of 30% and other telco specific taxes and licensing fees make this an attractive model to stimulate school connectivity</li> <li>Reason for concern: Need clear oversight on whether telco players are delivering on agreements they make to get the tax exemptions</li> </ul>				
	Community contribution	-	<ul> <li>Suitable because: An overarching non-profit lays down backbone infrastructure, funds the Capex, and trains the community to set up a network. The community is responsible for maintaining the network and members can access the network by paying for vouchers, other part is funded by anchor clients</li> <li>Reason for concern: This requires an individual approach and is not very scalable. As such, it will be more difficult to attract investors who are willing to fund the Capex.</li> </ul>				
	Community collaboration	-	<ul> <li>Suitable because: It functions the same as Community Contribution, except an MNO lays down the backbone infrastructure instead of the non-profit. The community is still involved in the maintaining of the local network</li> <li>Reason for concern: MNOs tend to not invest as much in skills as the overarching non-profit would, making its long-run sustainability more difficult</li> </ul>				
	_		Most likely to succeed Neutral Least likely to succeed				

1. Gov't subsidized PPP and the fine system could also be applicable to rural areas, but as the NPV of these projects very negative, it is less likely that telco operators will want to expand their infrastructure here first

these projects very negative, it is less likely that telco operators will want to expand their infrastructure here first Source: BCG analysis

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# Community contribution | A community contribution model is driven by local ownership leading to lower costs

### Local ownership of the community would lead to affordable, high-quality connectivity

The goal of community networks is to set up affordable, quality connectivity

In the successful example of Zenzeleni Networks (see right side), community networks work as follows:



The local community sets up and maintains the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses



The technical set-up consists of a Wi-Fi internet backhaul, a Wi-Fi mesh and hotspot, and is powered by a solar panel with a backup battery. Excessive power can be used to charge phones at a cheap price



Opex financing comes from the community. People can buy vouchers for access or set up a dedicated line at home. Additionally, there some anchor clients in the form of NGOs and local businesses who can afford to pay a fixed fee. Schools can be connected for free



• The Zenzeleni Cooperative pioneered a community network in South Africa

• The keys to its success are the professional Not-For-Profit (NPO) structure, job creation in the community and smart financing

Financials	2017	2018	2019	2020
Hotspots	12.0	35.0	55.0	75.0
Anchor clients	2.0	5.0	8.0	21.0
<b>Data Usage</b> (TB/MTh)	0.5	6.0	13.5	23.0
Net (USD)	-203.0	-521.0	758.0	7,184.0
Gross margin (%)	0.0	-8.0	21.0	51.0

1. Excluding USD338.000 grant by University of Western Cape for R&D and Capex

Source: Include a source for every chart that you use. Separate sources with a semicolon; BCG-related sources go at the end www.gigaconnect.org | info@gigaconnect.org



# Community contribution | Zenzeleni's model is successful due to professional organization steering local communities

### Meso

Zenzeleni not-for-profit company

#### **Obtains funding to:**

- Seed and establish the micro level ISP business
- Train and develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc.



### Zenzeleni model based on meso & micro level organizations

- Model is based on inception and support of community-based micro-enterprises
- Two entities (meso and micro) work together to stimulate the digital ecosystem, e.g., health, entrepreneurship, etc.
- Government too has a role to create an enabling policy and regulatory environment and subsequently use the ecosystem to deliver its programs to stimulate growth in impoverished areas



Source: Zenzeleni networks, BCG analysis www.gigaconnect.org | info@gigaconnect.org

# Community collaboration | A collaboration between service providers and the communities

### The mobile operator provides backbone infrastructure



A large telco operator provides the backbone infrastructure in the region and lets rural communities add onto their network. These communities operate and maintain the network



Setup consists of a zero-touch base station that connects to the providers backhaul infrastructure. This means there is minimal Opex as the base station can inspect itself through an al reasoning-based system, thus eliminating the need for physical inspections



An example of this is the Nokia-Kuha community hosted network, where Capex was reduced by 90% and Opex by 75%. The end-user experience is like setting up a Wi-Fi access point, which means there is less training involved



The difference with a revenue-sharing model is that the community is not gaining revenue from this setup (unlike a commercial local ISP would), but gains connectivity for a cheaper price instead

#### The governance structure can be similar to Zenzeleni

- This model can benefit from the same governance structure as the Zenzeleni model, with the key difference being that the mobile operator gains revenue from this operation
- The revenue streams go up to the telco player instead of the community, which pays for connectivity with vouchers and certain anchor clients

#### Macro

Large telecom player

- Develops the backbone infrastructure for local communities to add on to
- Trains and develop capacity to ensure sustainability
- Continuous support on legal, regulatory, technical, advisory, backhaul, etc.

 Micro level
 Mic

 Local ownership
 Local

 Sets up and
 • Sets

 maintains the
 maintains

connectivity hub

•

Micro level

Sets up and maintains the connectivity hub *Local ownership*Sets up and

Micro level

maintains the connectivity hub

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## **P&L of average school<sup>1</sup>** | No model sufficient by itself to cover costs, though clear differences in potential arise



1. Using as example a school that does not have electricity access; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs

Note: Excludes profit margin for commercial parties. Source: BCG analysis

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### **P&L of Sierra Leone** | No model sufficient by itself to cover all schools, though clear differences in potential arise



Model 3: Regulated advertising model



Annualized connectivity capex costs Annual connectivity opex costs Annualized electricity opex & capex costs

Indirect costs<sup>1</sup>

1. Using as example a school that does not have electricity access; 2. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs

Note: Excludes profit margin for commercial parties. Source: BCG analysis

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#### Backup

## **Detailed assumptions |** These are the "what you need to believe" for these P&Ls to hold true and what targets must be met for theory to meet practice

#### Model 1: Community contribution

- Around ~760 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~11 are willing to use school connectivity in year 1, ramping up to ~76 people in year 10. This is based on the growth behavior seen in other countries with similar penetration rate, but with a assumed growth cap at 10% of population around each school.
- These 11 (Y1) to 76 (Y10) people are willing to contribute 2% of their Gross National Income (GNI) per capita, following ITU's recommendation for affordable internet. GNI pc is assumed to decrease with 2% per year, in line with the historic 5-year average compounded annual growth rate

#### Model 4: One-off government subsidy

- A one-off subsidy from the government is provided to cover initial capex expenditures and accompanying indirect costs1, which could be financed by the following methods, provided assumptions hold true:
- Fine system: Fines that are handed out are enough to cover one-off capex and the attributed indirect costs. In addition, companies are willing to change their fine for an investment
- USF financing: The USF has enough funds and is willing to attribute enough financing to cover one-off capex and attributed indirect costs
- Tax exemptions: The government is willing to provide tax exemptions that equal the one-off capex and attributed indirect costs

#### Model 2: Electricity as a business model

- Around ~760 people on average live around each school (based on total population area and no. of schools in region)
- Of those, around ~620 people can be served by a 100 m2 solar roof, given:
  - ~37,000 kWh annual output
  - 80% utilization
  - Estimate of 48 kWh average annual consumption per person, assuming that ~32% of total electricity consumed in country is in residences
- Customers will pay \$0.09 per kWh (60% of country's grid price)

#### Model 5: Government budget increase

- The government is willing to increase the average spend per student from 7.70% of GDP to 7.78%, which is equal to a 1% increase in government budget spent on education
- This additional budget will be divided by the unconnected schools equally, to be used exclusively to connectivity
- In addition, the implicit assumption is that the government will continue with the financial support, regardless of potential shifts in political priorities

#### Model 3: Regulated advertising model

- ~2.5 M students eligible to view advertisements (all students except for students at private schools)
- 100% of them will view one advertisement everyday (180 school days)
- CPM is \$5.5 (source: Magna average value for emerging markets)

1. This implies a one-off government subsidy that will cover 4 years of 4G, WISP, and satellite connection (assumed depreciation period), and 20 years for fiber; Note: For each of these models there's the assumption that the cost-side analysis is correct. The cost side analysis is based on the open-source ACTUAL model by Giga (ITU/UNICEF); Source: BCG analysis

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## **P&L of Sierra Leone** | Funding models can lead to school connectivity if assumptions turn out positive



# **P&L of Sierra Leone | Combining funding models leads to school connectivity in theory, however many hurdles need to be overcome**

Analysis shows that if the assumptions used turn out positive, a theoretical 'surplus' in funding could be achieved ...



### ... however, several practical hurdles need to be overcome

- While a theoretical surplus could be realized, lots of practical hurdles need to be overcome (see chapter "short-term next steps")
- In addition, the current model does not account for potential profit margins that commercial parties demand. These numbers have not been included to allow for flexibility in operating model choice (e.g., infrastructure may be provided on non-profit basis due to CSR efforts)
- Even though the full potential of these models may not be realized in practice, this exercise still provides us with useful insights. It shows:
  - Which models have the largest potential pay-off in covering capex and opex
  - What prerequisites "need to hold" for the funding models to work
  - The potential upside of overcoming the hurdles that require solving

1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs; Note: Excludes profit margin for commercial parties Average profit margin of 17%; Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



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Short-term next steps




### Recommendations for short-term next steps for Giga team



Help UADA set up a concrete revenue-generation plan so funding can be pulled from the UADF in the nearby future

Suggestion to start with roll-out of four pilots

- Use electricity as a business model in a rural area to connect three different schools and their communities in Falaba
  - As Falaba is one of the most challenging regions with little electricity and connectivity, start with small pilots to refine the funding model before wider implementation
  - Orange has piloted energy projects in Falaba and might be interested in a partnership to expand their efforts in this region
- Use electricity as a business model in Freetown to connect ten schools
  - Higher population and school density in Freetown would allow for testing the model on a larger scale. After refining the model, the pilots can be expanded to other cities such as Bo or Kenema
- Use government-subsidized PPP to connect all schools/government institutions in one neighborhood
  - Test this model in Freetown in a neighborhood with a high density of public buildings. If successful, it can be expanded to other neighborhoods in Freetown and other cities
- Set up three community networks in rural areas that have strong communities (and lower risk of vandalism) in collaboration with research centers following the Zenzeleni model
  - First, the non-profit at the meso level must be set up
  - Set up three pilots in different chiefdoms, varying by income levels. In this way, the model can be refined depending on how much the community can contribute.
  - It is important to choose areas where there are enough anchor clients to ensure the fixed revenue streams



Aid government in implementing reforms in regulatory network as suggested by the audit service Sierra Leone and include protections for ISPs and ESCOs operating providing services to communities

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## Important next steps include collaborating with various governmental organizations such as the UADA and NATCOM to improve their performance



### Help the UADA to overcome their weaknesses

• The UADA has outlined some weaknesses they have to deal with to bring new projects to a

successful conclusion

- Key is the lack of a comprehensive revenue generation structure and budgeting plan.
   Setting this up is paramount for future success of the UAD fund
- A second point is helping the UADA how to safeguard against the misallocation or unplanned use of funds
- Finally, it is important to share knowledge with the UADA on sustainable funding models and on how to train community collaborators. Moreover, access gap studies conducted by the UADA can be leveraged to identify good pilot areas



### Work with NATCOM to enhance affordability and implement models

- ITU and NATCOM are currently collaborating on the development of cost models and pricing framework. This could greatly enhance affordability, with positive consequences for school connectivity.
- Next to this effort, funding models in which NATCOM plays a key role can be explored. It is important that clear guidelines are set on how these funding work and what is required to implement them successfully
- The tax exemption funding model relies on NATCOM in concert with the tax authorities.
- The fine system funding model also relies on collaboration with NATCOM



### Increasing coverage and electrification is paramount

- Developing the backbone infrastructure in the following years is an integral part of bringing connectivity to schools.
- Having functional (mini-)grid electricity will significantly bring down costs for telco operators, making it easier to expand into low-coverage areas
- Identifying viable pilot areas with the government can help structure infrastructure expansion efforts

Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org



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# Kenya Case Study



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### Country profile | Kenya

Key figures	<ul> <li>Population: 53.8 m</li> <li>GDP: \$98.8 B</li> <li>GDP per capita: \$1,836</li> <li>GDP growth: 5.4%</li> <li>Investments/GDP: 17.8%</li> <li>Urban population: 27 5%</li> </ul>	<ul> <li>Total population under 18 ye</li> <li>Secondary completion rate:</li> <li>Adult literacy rate: 82%</li> <li>% of schools connected: 3.3</li> <li>Connectivity starting point: 1</li> <li>Electricity penetration: 75%</li> </ul>	ears: 50.4% 79.2% % 32.1%
Demographics of schools & country	<ul> <li># of schools in country<sup>3</sup>: ~43,000</li> <li>Average no. of students per school: 376</li> <li>Current # of schools with internet connectivity: ~19,500<sup>1,3</sup></li> <li>Target no. of schools with internet &gt;5 Mbps (%) <sup>2,3</sup>: 50%</li> </ul>	Cost to connect schools: • One-off capex: Fiber (\$11,450), 4G (534), Wireless Internet Service Provider (WISP) (3,457) • Annual opex: Fiber (\$ 2,290), 4G (107), WISP (691) • Division: 32%, 45%, 23%	LowGDP per capitaHighChallenge: 14% of population in extreme poverty; large income inequalityImage: Challenge: 14% of population in extreme poverty; large income inequality
Government involvement	% GDP spent on education 5.3 6.1 6.3 3.1 3.6 0.4 Nigeria Rwanda Indonesia Kenya Honduras Bra:	7.7 Government debt Government's edu \$248.26 Broadband a univ Operational USF a Total amount allog	: 57.25% of GDP ucation budget on a per-student basis: ersal service: Yes available: Yes cated: \$4,376 mn

1. Based on Giga's past analyses; 2. Based on historical target; current target is 20 Mbps (10 Mbps as absolute minimum); data on current number not available; 3. All primary and secondary schools, public and private; Source: Kenyan gov't; World Bank; Oxford Economics; Giga; COMESA; IMF; National Broadband Strategy; BCG analysis

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### ~36% of Kenya's population lives below the poverty line, the large majority in rural and remote areas

#### Geographical distribution of poverty by county



Rural areas in the north of the country tend to be poorer than southern parts. The richest areas are those along Nairobi City

1. Poverty incidence: percentage of total population that lives below the poverty line 2. Latest available data from 2009; graph shown to indicate relative distribution in poverty between rural and urban areas; based on World Bank standards for poverty line

Source: IMF; Socio-Economic Atlas of Kenya (2016); KNBS; Statista (via World Data Lab, 2021) www.gigaconnect.org | info@gigaconnect.org



Backup

# Electricity use is unevenly distributed, with lowest use in low-income and remote areas

#### Electricity use significantly lower both in rural and remote areas

Population using grid or solar electricity (percentage) for lighting or cooking





Population using grid or solar electricity (percentage) for lighting

Electricity use is very unevenly distributed; only 14 out of 47 counties showing rates above national average

Highest rates recorded in Nairobi (97%), Mombasa (87%), and Kiambu (93%); electricity use is still largely an urban phenomenon

Lowest rates are found in low-income quarters, where affordability and inaccessibility limit installation and use



Source: 2019 Kenya Population and Housing Census Data Volume IV www.gigaconnect.org | info@gigaconnect.org

Backup

# The uneven distribution of expenditures follows the lines of Kenya's rural-urban divide

#### Expenditure classes significantly lower in rural than in urban areas

Population of all sub-locations per expenditure class





### 1. This might be better mapped through multidimensional poverty measures; Source: Socio-Economic Atlas of Kenya (2016; using 2009 data) www.gigaconnect.org | info@gigaconnect.org

Clearest pattern is the rural-urban divide, illustrated by higher mean per person monthly expenditures of Kenya's major towns vs their rural environs

Underscored by the fact that the two highest classes of expenditure exclusively found in urban settings; lowest expenditure classes in rural sub-locations, emphasizing the role of **towns as economic hubs** with bulk of secondary and tertiary sectors, and of formal employment

The phenomenon of slums in major cities is not visible: the very lowest expenditure class is almost exclusively found in rural settings<sup>1</sup>



# Kenya has relatively high (school) coverage rates, but only 4G coverage is good enough to have meaningful connectivity

### Kenya has relatively high connectivity compared to other African countries

Connectivity distribution (%)



#### 1. Unknown how many schools are connected to 4G Source: School Census Data 2019; BCG analysis www.gigaconnect.org | info@gigaconnect.org

### ... however, 3G coverage is not enough to acquire meaningful connectivity as defined by Giga

Connec	ction Speed	Enables	
<10 Mbps	2G or 3G	<ul> <li>Not sufficient to reach meaningful connectivity in schools</li> </ul>	
10-20 Mbps	<ul> <li>Requires 4G</li> <li>Defined as "meaningful connectivity"</li> <li>Giga's minimum internet speed</li> </ul>	<ul> <li>Opening documents</li> <li>Taking assessments</li> <li>Giving feedback &amp; questions</li> <li>Watching online videos</li> </ul>	
>20 Mbps	<ul><li>Requires 4G</li><li>Giga's target speed</li></ul>	<ul><li>Video-enabled school environments</li><li>Cloud-based apps</li></ul>	





# Many schools in Kenya are connected, but network quality for schools connected by 3G or less needs to be upgraded to reach giga 20 mbps target

### While Safaricom covers majority of populated areas, there is no widespread 4G coverage



### Thus, many schools that are connected to the internet need network quality improvements

- According to the government, 97% of the 21.729 public primary schools is equipped with a digital set, which contains a digital content server, a wireless router with internet connection and a set of devices, though they are not optimally used everywhere
- This high number of connected schools has been reached through several initiatives like KENET's Schools Connectivity Initiative and the Digital Literacy program
- Kenya scored 41.7 points on the 0-100 GSMA scale, with a 34.4 score on network and a 21.9 sub-score for quality. This shows that although 3G and 4G coverage is widespread, network quality is still very low

In 2020 academic year, related to Covid pandemic: ~80% of students missed virtual learning, despite its relatively high internet penetration rate<sup>1</sup>

1. Measured using download and upload speeds and latencies; poorer than EAC and SSA average (where it is also relatively low) Source: GSMA; Giga; Forbes (2020); African Development Bank Group; BCG analysis www.gigaconnect.org | info@gigaconnect.org



Large majority of schools in Kenya has access to electricity, less than half also access to internet

#### Estimations-limited data availability

#### Access to electricity, all schools<sup>2</sup>



- Electricity, but no internet
- Off-grid

### Approach to calculations

- Given limited data availability on secondary schools in Kenya, ratio of primary-to-secondary schools from Rwanda used to determine offgrid percentage for secondary schools
- Data on primary schools from Kenyan government, triangulated with Giga insights to determine electricity access by school type, and determining this for total group of schools

1. Mandera: 94% of schools solar-powered out of 282 total; Turkana: 90% solar-powered out of 448 total; Narok: 78% solar-powered out of 714 total; 2. All primary and secondary schools, public and private Source: AfricaCheck (2020); Socio-Economic Atlas of Kenya (2016); Basic Education Statistical Booklet (2019)

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## Safaricom is by far the largest player in both the mobile and fixed internet market, and mobile market is about 87 times bigger than fixed market



1. Although Jamii has a very small share of mobile market (160k subscriptions), all their subscriptions are 4G showing they have a significantly larger market share in the 4G market Source: OMDIA; Press search; BCG analysis www.gigaconnect.org | info@gigaconnect.org 373

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## Number of subscriptions of both mobile and fixed have a lot of headroom left although there is a large uptake in subscribers in the last 5 years

Mobile broadband subscriptions (MBB) grew on average 8.4% a year between 2015 and 2020, with strong 4G uptake since 2017



Customers are very price sensitive in Kenya and use multiple sim cards, depending on which player offers the cheapest service or has the best discounts. Subscription numbers are therefore not penetration numbers -BCG expert based in Kenya Although fixed broadband (FBB) market is only 1% of MBB, total number of subscriptions grew by 325% in the past 5 years



Kenya is a very mobile market, fixed is used only in urban areas and mostly in business settings because very few people can afford fixed internet

-BCG expert based in Kenya





... and fixed broadband is even more expensive, reaching

16.2% of GNIpc; partly explaining low fixed internet

### Price of mobile and fixed is above ITU recommendation at 3.3% and 16.2% of GNIpc respectively

3.3% of GNIpc spent on 1.5 GB mobile broadband data basket, which is above ITU recommendation for affordable internet ...



penetration levels

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### Gini index

Development (2000-'15)

**Kenya's large income inequality** implies an average income for the lowest-earning groups which is much lower than average **GNIpc.** This may put pressure on their ability to pay for electricity and internet



A household using the average 200 kWh per month pays ~3756 KSh, amounting to 23% of average **GNIpc** yearly

Recommendations on affordability, as % of income: Electricity: 5% (World Bank & IEA) Internet: 2% (ITU)





**GNIpc** 

In addition to income inequality, wealth inequality is large: top 10% of Kenyans own >40% of total wealth; i.e., 90% of Kenyans share <60% of total wealth Over time, the wealth gap barely narrowed, despite large economic growth

1. Out of 159 countries; 2. 1st place is highest inequality (South-Africa); Brazil ranks 8th; Honduras 14th; Indonesia 71st; Sierra Leone 107th; 3. Applying the Gini-index equally to all income groups; 4. Based on Atlas method; GNIpc at Purchasing Power Parity is \$4,370; Note: Gini index measures net income, not net worth; Source: World Bank (via Statista, 2020), ITU, IEA (via World Bank, 2015)

# Access to electricity has increased significantly, making kenya a high-ranking country in line with its GDP growth...



1. Out of 190 countries; 2. Ranking is focused on the procedures, time and cost required for a business to obtain a permanent electricity connection for a newly constructed warehouse Source: World Bank (Doing Business); Oxford Economics; African Development Bank Group; Source: Kenyan government (via World Bank) www.gigaconnect.org | info@gigaconnect.org

### ... although reliability remains a key issue for those with access

Reliability of supply and transparency of tarrif



97Number of days<br/>per year during<br/>which electricity<br/>outage occursValue lost due to<br/>electrical outages:<br/>% of sales for<br/>affected firmsTransparency<br/>better for ove<br/>power (i.e.,<br/>geothermal)<br/>specific p

Reliability & Transparency currently better for overall gridpower (i.e., mostly geothermal) vs solarspecific power (note: links to sources in notes)

1. Measuring duration and frequency of power outages, mechanisms to monitor power outages and restoring power supply, and transparency and accessibility of electricity tariffs 2. Long-term average of potential electricity production from gridconnected PV plant

Source: World Bank (Doing Business, 2019); GSA (via World Bank, 2021); BCG Analysis



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Kenyan gov't committed to further increasing access to (reliable) electricity, both in terms of investments...

Kenyan gov't planning to invest:

- \$382 MLN in grid expansion
- \$1,242 MLN in grid densification
- \$633 MLN in grid intensification

Part of its 5-year investment plan (2018-2022), totaling \$2.8 billion

- of which ~83% for grid power
- of which 17% for solar power

Least-cost household distribution in grid and off-grid areas for current population



1. Number of households lower than noted elsewhere, data from 2018 report–in line with report, to show how gov't plans translate into grid expansion and intensification; 2. Grid densification: achieved by installing additional transformers on existing medium-voltage to connect housing clusters <600m of existing transformers; grid intensification: extending short (<2 km) medium-voltage lines and additional transformers to connect more consumers Source: Kenya National Electrification Strategy (via World Bank)



# ...and by implementing policies and schemes, focusing on energy from renewable sources

Currently, there are 19 off-grid diesel-powered stations, but there are plans to convert these 19 stations to solar-diesel hybrids, and add 43 greenfield solar "mini-grids" through the Scaling Up Renewable Energy Program (SREP)

Kenya's Energy Ministry intends to:

- Roll out an auction for wind and solar, to replace the ongoing feed-in tariff
- Introduce net metering for customer-sites generation
- Establish regulations for mini-grids

It has already started to explore the idea of local-currencydenominated tariffs in a bid to encourage local commercial banks to participate in energy projects

1. Kenya Electricity Generating Company; 2. Independent Power Producer

Source: Kenya Power Sector report (Power Africa, referencing Energy Regulatory Commision of Kenya); Enerdata; BCG analysis

www.gigaconnect.org | info@gigaconnect.org

Background on electricity landscape: KenGen, key Independent Power Producers (IPP)

#### KenGen<sup>1</sup> (70% public):

- Leading power generation company, production of ~8 TWh (71% of total, 2018)
- KenGen's power mix: dominated by hydropower (around 45%) and geothermal (around 39%)

#### IPPs<sup>2</sup>:

- Contribute ~29% of national power production
- Main IPPs are
  - Lake Turnaka Wind Power (310 MW)
  - OrPower 4 (163 MW, geothermal)
  - Others, combing 321 MW oil-fired





### Kenya is rapidly transitioning towards sustainable energy generation, the majority of which being produced by IPPs

Kenya's generation capacity in 2020

www.gigaconnect.org | info@gigaconnect.org

Excludes off-grid energy



Key developments expected in 2020 vs 2015:

### ~2,700 MW

New generation capacity to come online for a total of ~5,000 MW (from ~2,300 MW)

>80% Share of 2,700 MW new capacity coming from IPP projects, with >50% from geothermal

### 70-80%

Expected population with access to on-grid electricity by 2020, up from ~46% in 2015

Overall: Kenya's per-capita power consumption is 161 kWh (2014) vs 126 kWh in Nigeria (+28%), which has a per-capita GDP nearly 3x higher



Deep-dive | Off-grid energy is intended to power people in remote areas, using various solutions

1. As of 2015; Source: Kenya Power Sector report (Power Africa www.gigaconnect.org | info@gigaconnect.org Backup

### Kenya's off-grid landscape

		Description	Example players
	Mini-grid systems	• A local energy grid which operates autonomously from the traditional grid	<ul> <li>Husk Power Systems</li> <li>PowerGen renewable Energy</li> <li>PowerHive</li> </ul>
		<ul> <li>Use PV cells and rechargeable battery to provide electrical</li> </ul>	<ul> <li>Azuri</li> <li>d.light</li> </ul>
	Single-home systems	<ul> <li>For example, M-Kopa has sold over 225,000 units. A unit charges 4 lights, a torch, a radio, and cell phones</li> </ul>	<ul> <li>Bareloot Power</li> <li>Greenlight Planet</li> <li>M-Kopa</li> </ul>
		• Light fixture composed of a LED	• d.light
	Solar lanterns	<ul> <li>Can be single function (lighting) or multi-function (mobile charging + lighting)</li> </ul>	<ul> <li>Greenight Planet</li> <li>Renewit Solar</li> <li>Schneider Electric</li> </ul>
•	Kenyan government planning to build off-grid connections for 20-30% of population that lives in rural and remote areas <sup>1</sup> ; attractive as lower Capex-intensive alternative for these more costly-to-connect households		





# To achieve higher school connectivity, a focus is needed on increasing coverage, affordability and reliable electricity sources



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### Kenya case study | Table of contents

Country & school overview

Connectivity status & developments



Recommendations



# **Electricity as a business model | Connectivity requires (reliable) electricity and could be used to fund school connectivity**

### Funding model further facilitates connectivity, providing reliable power to the community



By having the ISP simultaneously install solar panels, the community will benefit both from power and connectivity



As solar power is cheaper than electricity of the grid, the ISP can charge a surplus while still being competitive



This additional revenue can be used to fund school connectivity while also connecting communities to electricity

Funding model is suitable for communities with no or unreliable electricity coverage. May translate into additional benefits, e.g., relating to job creation from ownership and reselling of electricity; revenue creation from smart metering, monitoring of usage<sup>2</sup>

### Examples of potential partners for this funding model (Telco and ESCO)



African Mobile Networks allows operators to expand their rural coverage by reducing risks for the operator



Bboxx designs, manufactures, distributes and finances decentralized energy solutions for rural areas



M-Kopa allows customers to lease a solar solution and pay off their debt depending on usage customers own their solar panel after 1 year

Solar panels can be put in place at a community-level so energy can be redistributed

Double-click later in deck

1. Investments in grid densification and intensification as share of total investments in grid; 2. Not elaborated on in these materials Source: Kenya National Electrification Strategy (via World Bank); Giga data; BCG Analysis www.gigaconnect.org | info@gigaconnect.org

# **Pricing |** This funding model leaves flexibility on the exact pricing, with tradeoff between affordability, funding ability, and attractiveness to suppliers

Amounts (\$)

...to have affordable prices, attractive margins, mark-up

enough to fund connectivity

Solar energy can be sold at discount vs grid, leaving space to set mark-up and margin...

#### Amounts (\$)



For the average earner, based on average energy consumption<sup>1</sup>, use of solar energy at this price would amount to <1% of income; for the bottom-20% earners, <3% of income Spending <5% of income on electricity is considered affordable<sup>2</sup>

1. Energy consumption per capita to be validated; 2. According to World Bank and International Energy Agency (2015) Source: Giga data; World Bank; BCG Analysis www.gigaconnect.org | info@gigaconnect.org Commentary

Solar prices are part of an important tradeoff to make based on community income and ability to pay:

- Higher supplier margin makes it more attractive for suppliers to partner in the project, as it increases their profitability
- Higher mark-up creates more money to fund connectivity
- Both the supplier margin and the markup impact prices charged to the community: the sum of solar cost, markup, and supplier margin is the off-grid price, i.e., the price of electricity charged to users
- Lower prices mean users need to pay less, making it more attractive to join the program, and limiting pressure on their incomes



Illustrative

Backup

**Deep-dive** | Anchor clients could provide with steady income to reduce pricing for local inhabitants

By including anchor clients in business models, some fixed income is guaranteed for the ISP. Investment becomes less risky and cheaper prices can be obtained



Source: KNBS's latest report; Ministries and government agencies publications; Press



Considerations to make the model successful in practice—Key questions to answer

Majority of these points have already been defined, tested and proven successfully by established players in other countries (see next slides for background)



#### Starting off in the right way

- What prices to set—who sets prices, who can change the prices?
- How to connect users to the model? (making them aware, persuading)
- How to explain the model to users? (benefits, responsibilities, expectations)
- How to best use government resources and integrate regulatory conditions in setting up the model?
- Which partners to engage with? See next slide
- Overarching question: how to design a partnership that fulfills expectations (from users and partners)?

### Maintaining a model that works

- Who is responsible for maintenance of the electricity infrastructure?
- What happens in case of late payment/non-payment by users?
- How to deal with theft, vandalism?
- Who decides on policy changes? (e.g., in case of changing ambitions, not achieving targets on number of schools connected)
- Overarching question: how to make sure a successful partnership will sustain over time?



Non-exhaustive



# **Model setup | Different setups are best suited to different situations**

		Giga and Keny partnership ac	an government could function as celerator for any of these models
Characteristics	<b>Option A: Telecom</b>	Option B: ESCO	Option C: Community
Initial investments required from gov't <sup>2</sup>		$\mathbf{x}$	$\checkmark$
Electricity and connectivity provided by same party			×
Uniformized infrastructure across counties <sup>3</sup>	$\checkmark$	$\checkmark$	×
Community responsible for selling excess electricity	$\bigotimes$	$\mathbf{\otimes}$	$\checkmark$
Proceeds from sales of excess electricity allow for funding of connectivity costs Key distinctive benefits	<ul> <li>Efficiencies from offering both elimiting risks of errors made be</li> <li>Setup based around experience electricity and connectivity busi</li> </ul>	electricity and connectivity <sup>1</sup> (e.g., tween both) ed parties internationally, in ness	<ul> <li>No dependency on 3<sup>rd</sup>-parties</li> <li>Gov't maintains high degree of control</li> </ul>
Critical requirement	Current energy infrastructure is relatively strong	• Current telecom infrastructure (e.g., fiber) is relatively strong	<ul> <li>Community is capable of operating and maintaining electricity and connectivity</li> </ul>

1. Efficiencies from the same party offering both electricity and connectivity (e.g., limiting risks of errors made in the process from electricity to connectivity; combining expertise for both technologies); 2. Yellow circle: dependent on design choice (gov't to fund or Telco to fund); 3. Differences between the infrastructure of electricity and connectivity may still exist when conducted by Telco or ESCO, but larger likelihood of uniform process given single party responsible for design and construction Source: BCG analysis
www.gigaconnect.org | info@gigaconnect.org | 389



### **Model setup | Overview of potential setups for funding model**

#### ESCO operates as last-mile Telco

- ESCO installs solar panels or mini-grid in the community and connects the school
- ESCO also provides last-mile connectivity solutions, which connect both school and community (potentially in combination with support from a telco provider)
- ESCO pays for initial investment for both electricity and connectivity
- Community pays fixed fee for electricity and pays for connectivity through vouchers<sup>2</sup>
- Margin on electricity is used to offset connectivity costs

### Telco provider offers both electricity and connectivity

- Gov't procures Telco to provide connectivity to school
- Gov't pays for construction/initial investment costs for the connectivity
- Telco installs solar panels at schools, sells excess electricity to surrounding community
- Gov't collects margin on excess electricity until investments of connectivity have been covered
- Or: initial investment made by telco; gov't is not involved<sup>1</sup>
- Telco uses proceeds from selling electricity to offset annual connectivity op. costs

#### Details per funding model flexible

#### Community energy model

- Gov't funds initial investment to install both solar panels and connectivity solutions in community
- The school is connected in the process, does not pay for connectivity or electricity
- Community is responsible for operating and maintaining the electricity and connectivity, charging for both services through vouchers
- Margins can be used to cross-subsidize and offset costs

ESCO and Telco models generally work on a Pay-as-you-Go basis, meaning consumers pay for electricity after usage (not before). This is the preferred method, to prevent poorer households from getting into debt, by giving them more time to collect money for payment<sup>3</sup>

1. Impacting the extent of 3rd-party engagement; 2. To prevent large financial strain on community; 3. Another benefit found in research is that households buy smaller amounts in pre-paid scenarios, even though it incurs the burden of purchasing electricity more frequently; or buy less electricity overall, to limit this burden. Electricity consumption goes down as a side-effect, resulting in lack of electricity when it was needed. This burden falls disproportionately on poorer households; Source: International Growth Centre; BCG analysis www.gigaconnect.org | info@gigaconnect.org







### Option A: Telecom

### —Option B: Electricity company (ESCO)—

### 1 AMN

		Dist of Lot 1
AMIN	i goal to to allow operators to expand their runal, see by reducing risks, for the operator	AMN offers two operating models, depending on local circumstations
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# **Partner deep-dive: Telco | Business model geared towards connecting underserved communities**

Example partners

### AMN's goal is to allow operators to expand their rural coverage by reducing risks for the operator

Africa Mobile network is a UK-registered company that has full ownership of the local operating companies and is responsible for overall management



They work with licensed Tier-1 mobile network operators and currently operate around 2000 mobile network base stations in Africa and connect approximately 7 million people, but are not present in Kenya yet



AMN funds the construction of the mobile base stations in rural communities, connects the rural base stations to the operator' existing core network, and operates the network of rural base stations, delivering voice and data services, and distributing airtime to the operator's subscribers



The technical set up is based on small cells which deliver strong signal to cover an area of between 1–5km from the tower. The AMN design is highly scalable, and each tower can be upgraded to add more capacity as needed to meet demand

### AMN offers two operating models, depending on local circumstances

Revenue-Share model: AMN takes all Opex risks and a revenue share generated by site, after deduction of operator's direct costs

- Guaranteed positive margin/EBITDA for the operator
- Revenue-share sites selected according to AMN's criteria: sufficient people, no existing usable network coverage
- OPEX model: AMN builds sites wherever the operator chooses in return for a fixed fee per site per month
- Operator has upside benefits of high-traffic and high-revenue sites

For both models, AMN funds Capex, acquires the site and permits, builds, commissions, operates and maintains the base stations, in return for either a fixed or variable fee

The vision of AMN is a fully-connected Africa, with no community of any significant size being without basic telecomunication services —Michael Darcy, Founder & CEO of AMN





# Partner deep-dive: ESCO | Bringing cleaner and more affordable energy to rural Africa using Pay-as-you-Go model (1/2)

### Bboxx provides affordable, reliable and clean electricity to people using a Pay-as-you-Go model



Bboxx designs, manufactures, distributes and finances decentralized energy solutions as a vertically integrated business



The Pay-As-You-Go (PAYG) model provides affordable energy access from renewable sources to off–grid communities, using available technologies to facilitate payment by installments



They provided 2 million people with access to clean energy which can be installed in homes or community-wide, of which 300.000 Kenyans



Through its network of distributors, Bboxx is already present in 10 African & Asian countries, including Nigeria, Kenya and Rwanda, with products sold in 27 markets



Bboxx is expanding and scaling by forging strategic partnerships with governments and large corporates



	2017	2018	2019
Revenues in million USD	4.7	13.2	27.2
Gross profit	1.8	5.9	12.4
Operating income	(13.9)	(16.8)	(16.8)
Net income	(11.8)	(17.3)	(24.4)





# Partner deep-dive: ESCO | Bringing cleaner and more affordable energy to rural Africa using Pay-as-you-Go model (2/2)

#### M-Kopa provides affordable, reliable and clean electricity to people using a Pay-as-you-Go model



M-Kopa (M = mobile, Kopa = to borrow) aims to make solar products affordable to low-income households on a pay-per-use installment plan. Customers acquire solar systems for a small deposit and then purchase daily usage "credits". After one year of payments customers own their solar systems outright and can upgrade to more power

The company develops and markets solar home systems and sells its products through dealers and retail shops



Since launch in October 2012, M-Kopa has connected >200,000 homes in Kenya, Tanzania and Uganda to solar power; currently adding >500 new homes each day



M-Kopa have processed nearly 100 million mobile money payments from low-income households since its inception, with volume growing 170% CAGR over seven years



This provides transposable model in schools; also, children study hours reportedly double once solar system enters home; 94% of parents report school performance improvement<sup>1</sup>

1. According to an M-Kopa survey; Sources: M-Kopa official website, M-Kopa impact report, Press www.gigaconnect.org | info@gigaconnect.org



#### M-Kopa's impact in key metrics

- 140,000 people generated income with an M-KOPA Solar system in 2018
- 3.7 million lives impact with clean, modern energy services
- 467 million amount customers have saved from fuel displacement
- 47 thousand individuals connecting to the internet for the first time

#### M-Kopa's targets for 2030

- 20 million lives with improved energy access
- 10 million loans issued
- 30 million tonnes of CO2 avoided
- 500,000 customers directly generating income
- 2,000 full-time staff and 10,000 sales agents



Example partner

Recommendations for short-term next steps for Giga team



Answer key questions

- Choose the appropriate funding model setup
- Consider alternative funding model for schools if more applicable<sup>1</sup>
- Initiate conversations with potential partners (AMN, Bboxx, M-Kopa); identify potential other candidates

1. For schools where access to reliable electricity is already strong, other models might be better suited




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## Nigeria case study



www.gigaconnect.org | info@gigaconnect.org

## **Country profile** | Nigeria

<b>Key figures</b>	<ul> <li>Population: 206 m</li> <li>GDP: \$429 B</li> <li>GDP per capita: \$2,083</li> <li>GDP growth: -1.8%</li> <li>Investments/GDP: 25%</li> <li>Urban population: 53%</li> <li>Total population under 18 years: 50%</li> <li>Secondary completion rate: 49%</li> <li>Adult literacy rate: 62%</li> <li>M of schools connected: n/a</li> <li>Electricity penetration: 57%</li> </ul>
Demography of schools	<ul> <li># of schools in country: 151.4k</li> <li>Average no. of students per school: 189</li> <li>% students in government schools: 58%</li> <li>% of schools that lie in 3G/4G coverage area: (81,6% / 41,3%)</li> <li>% of schools within 10/20 km of a fiber node: (34% / 61%)</li> </ul>
Government involvement	<ul> <li>% GDP spent on education</li> <li>6.1</li> <li>6.3</li> <li>3.1</li> <li>3.6</li> <li>0.4</li> <li>3.1</li> <li>3.6</li> <li>6.3</li> <li>6.4</li> <li>6.5</li> <li>6.5</li> <li>6.5</li> <li>7.5</li> <li>6.5</li> <li>7.5</li> <li>7.5</li></ul>

Source: National Bureau of Statistics, UN World Population prospects, UN World Urbanization prospects, IMF, UNESCO, Ministry of Education, Ministry of Finance, Press Search



## Nigeria case study | Table of contents



### School and Country overview

Connectivity status and developments

Telco landscape

Recommendations



Four main hurdles to overcome in Nigeria to connect all schools to the internet **Deep-dives on next pages** 



## There is high regional economic inequality between Nigeria's 36 states and Federal Capital Territory

% Population below the poverty line<sup>1</sup>



States of Borno, Yobe and Adamawa are terrorism threat zones, with recent attacks conducted by Boko Haram and ISWA. In these states, at least 802 schools remain closed, and 497 classrooms are listed as destroyed, with another 1,392 damaged but repairable.



### Country average: 40%

Nigeria is a tale of two extremes, with high contrast between southern and northern states

-Nigeria-based BCG network



206m inhabitants



44m total households



53% urban population 7 cities with pop. >1m



514 U\$ m 2021 GDP 2021-24 +14% y-o-y



923,850 km 2

#### 1. Based on national standards

Source: 2019 Poverty and Inequality in Nigeria Report (National Bureau of Statistics), UNICEF, Euromonitor, IMF, United Nations www.gigaconnect.org | info@gigaconnect.org

# More than half of Nigeria's population live in rural areas, half of which in areas with very low economic activity





Peri Urban Moderately populated and connected to urban



Rural Oasis Small, sparsely populated, but some economic activity



Rural frontier Small, sparsely populated, no economic activity

## Although GDP per capita increased, electricity rates are still down at 26% in rural areas—increasing electricity is a prerequisite for school connectivity



Unreliability of GDP growth makes long term (foreign) investments difficult

Nigeria ranks 171 out of 190 countries in the "getting electricity" dimension of the 2020 World Bank report

The lack of reliable power is a significant constraint for citizens and businesses, resulting on annual economic losses estimated at \$26.2 billion (~2% of GDP)

Total share of population with electricity access rises mainly because more people move to urban areas, as rural electricity rates have hardly improved at all the past 20 years



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Nigeria

Source: Nigeria Living Standards Survey - 2018/2019 (National Bureau of Statistics) www.gigaconnect.org | info@gigaconnect.org Backup

## **Back-up school attendance** | Lack of support from family and lack of money are main reasons for not attending



In some northern states there is a problem around enrollment due to terrorism. There is no stability to give the parents comfort for their kids to travel to schools

-Nigeria-based BCG expert

Nigeria

1. As a percentage of individuals above 6 years of age who have never attended school Note: data unavailable for Borno state; Source: National Bureau of Statistics www.gigaconnect.org | info@gigaconnect.org

# Large usage gap between states and genders can be decreased by teaching digital literacy at primary schools across country

## Internet is clearly used most in southern belt and by male population

% Population aged 15-49 that used the internet in past year (2018)



In Northern regions, school attendance and gender index are significantly lower, especially at secondary level



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... thereby having denser mobile and fixed broadband infrastructure Internet networks - Fiber optic cable Microwave 4G coverage 3G coverage

1. Latest GDP information is from 2017 on 22 states, other 15 states are extrapolated from 2010. Source: ITU broadband maps, Nigerian Bureau of Statistics www.gigaconnect.org | info@gigaconnect.org



# Roughly half of schools are covered by 3G, but few schools lie in 4G coverage areas or close to nodes



Note that although about half of the schools lie in 3G coverage area, this does not mean that they do indeed have internet access



# Mobile internet has grown rapidly in Nigeria since 2017, with penetration reaching 41% in 2020 and expected to grow further





1. Percentage of population that uses internet on a mobile device at least once a month. Source: OMDIA; Statista www.gigaconnect.org | info@gigaconnect.org







## Nigeria's average internet speed is below that of other African countries, especially on fixed internet

Fixed and mobile internet speed for 18 African countries<sup>1</sup>



11 🤸 🥵 gi

# Players have improved their service quality, and Nigeria has doubled its 4G data traffic between 2018–2020



#### ... leading increasing delivered connection speed, although still far below other countries GSMA score on average mobile broadband download speeds (out of 100) 60 Brazil 40 Honduras Sierra Leone Indonesia 20 Rwanda Nigeria 0 2014 2016 2018 2020

Source: OMDIA, GSMA Mobile Connectivity Index www.gigaconnect.org | info@gigaconnect.org

412 5



# While service prices for mobile broadband are below recommended level, fixed broadband is unaffordable to most



#### ... however, Nigeria's fixed internet costs are among the highest in the world Spent on fixed broadband (5GB) as % of gross national income per capita-2019 160 140 Average spent on fixed broadband is 120 at 22.1% of GNIpc, making it 100 accessible only to the wealthiest citizens 80 60 40 22.1% 20 9.6 average 2% ITU recommendation Nigeria

Countries (N = 178)

for affordable

internet

## To achieve higher school connectivity, a focus is needed on increasing and upgrading coverage, electrifying schools and increasing affordability

### Only 10% of Nigerian population has access to meaningful connectivity ....

#### **Connectivity access Needs**

26%	<b>Coverage Gap</b> No mobile internet	<ul><li>Increase coverage</li><li>(Electrify schools)</li></ul>
26%	<b>Investment Gap</b> Covered by 3G network only and not used	<ul> <li>Upgrade coverage</li> <li>Electrify schools</li> <li>Increase digital literacy</li> </ul>
37%	Usage Gap Uses 3G network although majority of group is covered by 4G	<ul> <li>Increase affordability</li> <li>Increase digital literacy</li> </ul>
10%	<b>Connected</b> Uses <b>4G</b> network	<ul> <li>Fuel the digital economy</li> </ul>
Not cov	vered3G covered not use	ed 📒 3G used 📃 4G usec

#### ... showing we need a clear focus on 5 topics 26% of the population is not yet Increase covered by 3G, providing no internet connection to 1 coverage in 4 people Upgrade coverage networks need to be upgraded Increase electricity electricity • Only 26% in rural areas Increase many due to inequality Fixed is 7x higher than ITU affordability guidelines Increase **ġ**, (digital) literacy

1. See Chapter 2 Source: OMDIA Q1 2021; BCG analysis www.gigaconnect.org | info@gigaconnect.org

- Only 38% of population is covered by 4G, showing many existing 3G
- 55% of population has access to
- Mobile internet is unaffordable to
- Only 63% of the population can read and write, posing large obstacle to use of digital devices



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#### Current status of Nigerian telco market

Last mile connectivity is mostly mobile, with mobile broadband taking up 99% of total broadband market and 4 main players dominating the market



Uptake of 3G and 4G is slower than anticipated, mostly due to lack of access in rural areas and quality and affordability issues



There are 6 submarine cables, all landing in Lagos, and 55 satellites throughout the country providing international first mile connectivity



There are large regional differences in coverage rates, with majority of southern states covered but very few areas in Northern states, partly due to attacks

#### Several upcoming changes might provide new possibilities for school connectivity



The Nigerian national broadband plan (2020-2025) aims to deliver download speeds of 25Mbps (urban) and 10Mbps (rural) with effective and affordable coverage for at least 90% of the population by 2025.



Two of the main pillars are infrastructure and policy, providing many opportunities for change in the coming years that could be used to connect schools



In June 2021, the government has installed a committee that will prepare the 3.5 GHz spectrum auction, which will be used for 5G



Several projects are currently in process using money from World Bank or Exim bank aiming to increase electricity and connectivity in rural areas

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Backup

## Nigeria

## **Overview of telco landscape in Nigeria**

Characteristics	Description
Current status of fiber and 4G, WISP, and of satellite coverage in country	<ul> <li>In 2013, Nigeria developed its first 5-year National Broadband plan. At the start of the plan, internet penetration and broadband services were going through a period of fast growth coming off the issuance of 3G licenses in 2007, and the landing of several submarine cables in Nigeria between 2010 and 2013</li> <li>The plan established the objective of achieving a five-fold increase in broadband penetration from the 6% rate in 2012. Current broadband penetration rates of 37.8% (with mobile broadband accounting for approximately 99.8% of the broadband base) indicate the objective was achieved</li> <li>Demand for internet access and availability of spectrum has stimulated the growth in 3G services which covers about 75% of the population, while 4G deployments have been limited to the major urban areas in the past 3 years and are currently available to approximately 37% of Nigeria's population.</li> <li>First mile infrastructure providing international and inter-continental connections to Nigeria are equipped with adequate capacity given 6 submarine cables, all landing in Lagos, as well as up to 55 licensed satellite operators delivering services across the country. Last mile connectivity on the other hand is largely mobile with comparatively lower investments made in fixed lines infrastructure within the past two decades</li> </ul>
Gap between coverage and adoption rates	<ul> <li>While broadband penetration has increased in Nigeria with the deployment of 3G and 4G coverage, the results achieved in terms of end user adoption has not matched expectations. The main reasons for this are a lack of access to and affordability of smartphone devices, low quality of service and speed, and little access to such services beyond major urban areas</li> </ul>
Disparity between states in internet access	<ul> <li>Despite the telecoms sector having developed rapidly in recent years, many parts of the country have underdeveloped telecom infrastructure. In particular, areas in the North-Eastern part of the country where Boko Haram is active have seen considerable disruption to telecom services following the theft and destruction of equipment</li> <li>Access of fiber networks within 5 kilometers of the population (middle mile) currently stands at an average of approximately 39% reach, with a high of 85% in Lagos State and a low of 12% in Jigawa</li> </ul>
Consolidated mobile segment vs Fragmented fixed wireless segment	<ul> <li>The mobile internet market is dominated by four Mobile Network Operators (MNOs) operating Global System for Mobile Communication (GSM) networks: MTN Nigeria, Airtel Networks, Glo Mobile (Globacomm) and 9Mobile (EMTS). Together, these MNOs account for over 99% of mobile internet subscriptions in the country</li> <li>There are two large players in the fixed-wireless services in Nigeria, covering most of the urban areas, and about 30 more smaller local players. However, the fixed line segment of Nigeria's telecommunications industry has been in a decline since 2009</li> </ul>

Source: Nigeria Communications Commission; BuddeComm; GSMA; Press research; BCG analysis www.gigaconnect.org | info@gigaconnect.org

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Backup



## Overview of major upcoming changes in telco landscape and resulting school connectivity expected

្លិ៍ Major changes	Description
Nigerian National Broadband Plan 2020–2025	<ul> <li>The new Broadband Plan is designed to deliver data download speeds across Nigeria of a minimum 25Mbps in urban areas, and 10Mbps in rural areas, with effective coverage available to at least 90% of the population by 2025 at a price not more than N390 per 1GB of data</li> <li>The plan identifies 8 different objectives across 8 key areas and sets quantified targets for each. These areas include: 4G coverage, internet speed and penetration, fiber reach (including to schools at a rate of 100% to tertiary, 50% to secondary and 25% to primary schools), data affordability, cost of devices, digital literacy and gender equality</li> <li>In order to achieve these ambitious targets, the plan is focused on recommendations in 4 critical pillars</li> <li>Infrastructure: Focused on building integrated infrastructure that is counter-part funding based, sustainable and resilient to close the gaps in addressing the broadband needs of the country</li> <li>Policy: Ensure that regulations and poliecies drive the optimal rollout and uptake of broadband services-incentivizing investments by incumbent and aspiring service providers, and ensuring transparency in the regulatory process</li> <li>Demand drivers: Promoting affordability (e.g. through the incentivization of local OEMs to produce low-cost devices), digital content, literacy and awareness as well as consumer trust in broadband and digital services</li> <li>Funding and incentives: Identifying relevant financial incentives, fiscal policy, economic models and funding options that help achieve the broadband penetration targets</li> </ul>
5G Deployment	<ul> <li>In June 2021, the Nigerian Communications Commission (NCC) has inaugurated a committee to develop the Information Memorandum (IM) for an auction of spectrum in the 3.5GHz band which will be used for the early deployment of 5G services in in the West African country</li> <li>The NCC had previously (May 2021) signed a memorandum of understanding (MoU) with Nigerian Communications Satellite (NigComSat) to enable the rollout of 5G services</li> </ul>
National fiber backbone	<ul> <li>There are plans to construct a national fiber backbone, owned by a governmental organization or one of the main telco companies. However, until now, very little progress has been made although the topic has been discussed a lot</li> <li>This could provide long-term potential for school connectivity, but is currently hindering roll-out of commercial players as they wait for a national network to add onto</li> <li>Part of the plan is to create national guidelines for Right-of-Way charges and other fees</li> </ul>



# In 2019, the government announced a comprehensive plan to develop Nigeria's digital economy



Nigeria

1. Communications and Digital Economy

Source: Nigerian Digital Economy Policy and Strategy (2020-2030); Nigeria National Broadband Plan 2020 -2025; Nigerian Digital Economy Policy and Strategy (2020-2030); Nigerian E-government Masterplan; Press Search

www.gigaconnect.org | info@gigaconnect.org



Nigerian Digital Economy Policy and Strategy (2020–2030) has a range of key ambitions, designed to create a better digital environment for business and citizens

Source: Nigerian Digital Economy Policy and Strategy (2020-2030) www.gigaconnect.org | info@gigaconnect.org

### Objectives

- 1 Target 70% broadband penetration in 4 years;
- 2 To accelerate the digitalization of government processes and improve service delivery, transparency and accountability;
- To improve trust, confidence and security around digital processes and activities;
- 4) To attract and grow digital jobs across all sectors of the economy;
- 5 To develop the technology start-up ecosystem by actively promoting innovation and entrepreneurship;
- 6 To support the digital literacy of Nigerian Citizens, Business and Government workers and enable them to acquire cutting edge digital skills;
- 7) To achieve a 95% Digital Literacy Level in Nigeria within the next 10 years;
- 8 To develop digital education curriculum to meet the current and future needs of the Digital Economy;
- 9 To ensure that indigenous technology companies can participate actively in the government funded technology programs; and
- 10 To ensure that the policy and regulatory instrument are fit-for-purpose and support the digital business environment.

Nigeria

Non-exhaustive

# Large mobile internet market is dominated by four players, while fixed segment is much smaller and more fragmented



Note: we only deep dive on mobile players as mobile market is 100 times larger than fixed market Source: National Communication Commission, BCG analysis

www.gigaconnect.org | info@gigaconnect.org



## **MTN Nigeria** | Key facts and figures

### Key figures



#### Overview

- Provider of telecommunications services. MTN primarily offers cellular network access and ICT solutions in Nigeria
- MTN holds ISP licenses in Namibia and Kenya and value-added service license in Ethiopia. It serves to small and medium enterprises (SME), public sector and corporate clients

### **Recent Developments**

- May 31, 2021-MTN Group CEO Ralph Mupita has made a three-day visit to Ghana and launched major projects that the operator aims to achieve by 2022, Ecofin reported. It intends to improve and expand network infrastructure to bring quality telecom services to rural areas
- MTN Nigeria's board has approved the appointment of Tsholofela Molefe as a non-executive director of the company effective 03 May
- Apr 06, 2021- MTN South Africa launches new fixed-LTE packages

#### Strategic Partnerships

- In February 2021, the company entered a partnership with Ayoba messaging platform to meet the needs of consumers in Africa
- In March 2021, the company and Zenith General Insurance Company Ltd partnered to provide the mobile insurance service in Nigeria

Mobile customers (M)



Fixed customers (k)



Source: Company website, annual reports, Press research www.gigaconnect.org | info@gigaconnect.org

422 **giga** 

## **Globacom** | Key facts and figures

1.715

2020

### Key figures

2016

Revenue

2017



#### Overview

- Globacom offers mobile products, USB devices, international private leased circuits, mobile Wi-Fi routers, third party mobile handsets and USB dongle devices
- Globacom operates as a subsidiary of Conpetro Nigeria Ltd

#### **Recent Developments**

- In October 2019, NCC granted Airtel approval to partially disconnect Globacom from its network for failing to settle interconnect debts. The partial disconnection made it impossible for Glo subscribers to make calls to the Airtel network, but they were able to receive calls from Airtel
- Globacom plans on launching fixed line services for the enterprise segment, leveraging its submarine cable and fiber network

#### Strategic Partnerships

 Globacom and Vodafone announced a non-equity partnership agreements covering Nigeria and the republic of Benin. Under this agreements, they will work together to boost the experience for both consumers and business customers

Fixed customers (k)

2018

Mobile customers (M)

42.25

37.75 38.16

2016

2017



Source: Company website, annual reports, Press research www.gigaconnect.org | info@gigaconnect.org

2019

2018

54.84

2020

51.69

2019

## **Airtel** | Key facts and figures

### Key figures



**Headquarters** UK

**Ownership** 

Public company





#### Revenue

Overview

 The company offers integrated telecommunication services, including mobile voice and mobile data services and Airtel money services. The company's service portfolio includes prepaid wireless voice services, postpaid wireless voice services and international roaming

**Recent Developments** 

• Airtel Africa intends to expand its network and distribution infrastructure to increase its mobile and connectivity, and financial inclusion across countries. It focuses on expanding its 4G network coverage across footprint, development of new sites in rural areas, and offers high speed data to customers. Airtel Africa intends to expand its customer base by constructing multi-brand and exclusive franchise channels, and offer self-service app

### Airtel Africa revenue by segment 2020 (USD M) 3,210 Mobile services / Mobile money

🎵 airtel



#### Strategic Partnerships

- September 2020, Airtel entered into a partnership agreement with Mastercard, together with Samsung and Asante Financial Services Group, to launch a Pay-on-Demand payments platform service across Africa
- In March 2021, Airtel entered into agreements to sell its telecommunications tower companies in Madagascar and Malawi to Helios Towers plc

Source: Company website, annual reports, Press research; Source exchange rate: IMF. 24.11 HLN = 1 US Dollar www.gigaconnect.org | info@gigaconnect.org



Backup

## **9mobile Nigeria** | Key facts and figures

### Key figures



#### Revenue

Source: Company website, annual reports, Press research www.gigaconnect.org | info@gigaconnect.org

#### Overview

• The company offers integrated telecommunication services, including 20.81 mobile voice and mobile data services and Airtel money services. The company's service portfolio includes prepaid wireless voice services, postpaid wireless voice services and international roaming

#### Mobile customers (M)



#### Recent Developments

- In February 2020, 9mobile revealed that part of the USD230mn loan facility, received from the Africa Finance Corporation (AFC) in August 2019, will be used to expand its fourth generation, long-term evolution (4G LTE) network to reach 16 cities in Nigeria and improve network quality
- In December 2019, 9Mobile signed a partnership with Next TV and the League Management Company (LMC) to broadcast and produce Nigeria Professional Football League output

### Strategic Partnerships

• In the retail market, the operator has been developing value-added services, in view of increasing customer usage of data in its network. Such initiatives include GTEasysavers a mobile financial service developed in conjunction with Guaranty Trust Bank Nigeria and Cliqlite, a web-based platform which provides access to primary and secondary school-related education content



**S**mobile

## Nigeria case study | Table of contents

School and Country overview

Connectivity status and developments

Telco landscape



Recommendations

## Top three tips in rolling out school connectivity: Leverage existing projects, tailor approach to each region and let commercial players connect schools



Leverage running projects and existing institutions to reach school connectivity

- The Universal Service Provision Fund aims to provide universal ICT access to underserved and unserved areas and can be used to fund projects or as collateral
- The World Bank funds several projects in Nigeria that improve the electricity network in rural areas and just started a project which will improve digital literacy of 300.000 female students
- The Nigerian Research and Education Network (NgREN) connects 26 universities and could potentially be used to connect (secondary) schools
- Many large telco players undertake CSR activities which can be used to connect more schools



Service providers to connect schools directly, rather than via government

- Because government historically had lower efficiency of spend, it can be hard to attract the right funds and loans needed for school connectivity
- Commercial players have proven to be more effective than public players in the region in rolling out connectivity in a short time frames
- However, (financial) support of local and national government is needed to provide the right environment and incentivize companies to provide access and high-quality service to schools by updating regulatory framework and providing financial benefits (e.g., tax exemptions)



Tailor approach to each region while rolling out connectivity at a similar pace in all states

- Historically, many connectivity projects were executed in southern and more developed states, which results in a large digital divide
- The large regional differences are reiterated by the federal system in which each state has their own regulations and fees
- It is therefore important to tailor the business and funding model to each state, while rolling out school connectivity at a similar pace in all states to achieve digital inclusion
- Deep dives on the funding models and their applicability for each region in next section



427 😯 🥵 gig



### USP Fund, World Bank, NgREN and CSRs of national companies should be leveraged for additional (temporary) funding to connect all schools

USP Fund	<ul> <li>The Universal Service Provision Fund (USPF) was established by the Federal Government of N goals for universal access and universal service to information and communication technolog.</li> <li>The fund obtained 41 M US dollars of revenue in 2018, 99% of which came from domestic grates.</li> <li>The fund is being managed to facilitate the widest possible access to affordable telecommunifor the people of Nigeria.</li> <li>The government has invested NGN1.5 billion from the Universal Access Provision Fund to bu The project, completed in early 2016 and which formed part of the former National Broadbard.</li> </ul>	ligeria to facilitate the achievement of national policy gies (ICTs) in rural, un-served and under-served areas. ants. ications services for greater social equity and inclusion ild 20,000km of fibre-optic cable in <u>underserved areas</u> nd Plan 2013-2018, linked 26 universities.	
World Bank	<ul> <li>Active projects that are (partly) funded by the World bank are</li> <li>Nigeria Distribution Sector Recovery Program (2021-2026) – goal is to support the Nigerian government in improving its electricity distribution sector. World Bank invested 500 M USD</li> <li>Adolescent Girls Initiative for Learning and Empowerment (2020-2025) – goal is to improve secondary education opportunities among girls in Northern states. World Bank invested 500 M USD and part of that investment will be used to improve digital literacy among 300.000 girls</li> <li>Nigeria Electrification Project (2018-2023) – goal is to increase access to electricity services for households, public educational institutions and enterprises. Invested amount by World Bank is 350 M USD and a large part of this will be used to implement economically viable solar mini grids</li> </ul>		
NREN	<ul> <li>Nigerian Research and Education Network (NgREN) is founded in 2012. The goal of this network is to provide reliable and high quality (at least 155 Mbps) internet to the 27 Nigerian public universities</li> <li>In Phase 1, NgREN received support from the World Bank to roll out its network to all Federal Universities</li> <li>The organisation is currently rolling out a second phase, connecting major cities throughout the country and significantly reducing network costs</li> </ul>		
CSR	<ul> <li>MTN Foundation funded ICT laboratories in 60 secondary schools and carries out another project that empowers youth across Nigeria with ICT and business skills.</li> <li>MTN's Community Development Project supports communities with basic infrastructure</li> <li>9Mobile's adopt-a-school program provides schools with ICT facilities, labs and textbooks</li> <li>Smile provided 30 GB of internet bundles to 50 public schools in two Southern states in 2014</li> </ul>	Don't underestimate the PR for companies, that has lots of value. You can let them connect schools and then let them claim it's theirs. It'll give them a good bargaining chip <b>- BCG Nigeria Expert</b>	



### Government needs to increase education spend to facilitate right environment for high-quality (digital) learning



#### ... and needs to be increased to provide the right environment and support for digital learning

- Although government would probably not roll out connectivity themselves, increase in educational budget is needed to cover additional expenses, like devices and ICT labs
- Moreover, teachers will likely need extra training to upgrade their digital skills
- Although the focus of this project is on internet (and electricity), the roll-out of the network can be used to upgrade water facilities in schools across the country, for which additional funding is needed

Nigeria would be a hot spot for the so called Tesco model, where you provide a school or community of power, connectivity and water at once. The grid in Nigeria needs to be upgraded and it requires a lot of capital but it would work well in Nigeria

-Doyle Gallegos, World Bank ICT Policy Lead



## Research suggests that the following five funding models would likely work well in Nigeria, if the right conditions are put in place

***				
Coverage as a service —revenue sharing	Electricity as a business model	Spectrum auction/ minimum subsidy	Government subsidized PPP	Community contributions
Local player (e.g. ISP) builds and maintains network in an area otherwise not attractive for large commercial players	School sets up solar panels next to school and sells electricity to community	School connectivity can be a prerequisite in upcoming 5G auction, saying the winner has a certain obligation to connect schools	Local government organizations (police station, hospital, school) work together as one big off-taker	Community builds and maintains own network using help from NGO who trains community members
Large player allows local player to add onto their network and operates network	As solar power is cheaper than electricity off the grid, some profit can be made	Government can also send out an RfP and ask for minimum subsidy needed to connect x% of schools in each state	Government guarantees payment for certain capacity for long period of time (e.g., by using USF) and community will pay depending on monthly demand	Initial funding could come from NGO or another donor; Opex mainly covered by key clients likes doctors, expats and hospitals in the area who pay fixed monthly fee
Positive business case as local player can maintain network more efficiently and reach more people	This profit is used to cover costs of school connectivity, solving two problems at once	Important to do this on a national level as some states are more attractive	Local players will now deploy network in otherwise not viable areas	Community will pay depending on monthly demand e.g. using vouchers
Co-Co collaboration	Co-Co collaboration	Government-contributed	Full ecosystem	Community based
Note: Archetypes are not final – can include different partnership types depending on operating model chosen. On this slide we have shown the default.				

Note: Archetypes are not final – can include different partnership types depending on operating model chosen. On this slide we have shown the Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org |



## A regional focus will be needed when rolling out connectivity as economic and political differences between the three belts are large

• More than half of the poorest people live in the North, and poverty North rates are rising Northwest Zone • School attendance rates are lowest in the North, resulting in lower Northeast Zone digital literacy rates and therefore less users • Due to Boko Haram attacks, telco materials need to be secured even better and there is more need for a community driven solution • Urban areas in middle region are often connected to 3G and there is an Middle operational fiber backbone in some areas North Central • Use of digital devices, school attendance and literacy rates are higher in Zone Middle region than in Northern region, showing a decent opportunity for commercial parties to expand their network • A combination of commercial and community driven solutions will be needed to connect urban and rural areas in the Middle region 3G and 4G coverage rates are highest here, which means that for many • South schools the focus will be on connecting the school to the available Southeast Zone infrastructure rather than rolling out a new network South Zone • For schools that are not covered, extending coverage will be cheaper as Southwest Zone distance to current connection is lower Purchasing power is higher and therefore region is more commercially attractive

Although the different regions will need different business and funding models, this does not mean that more commercially viable regions should be prioritized over others

Note: Belts are currently based on Nigeria's six zones. A more robust method for dividing the states into regions (based on poverty rates, electricity access, connectivity rates) might be needed when rolling out the different funding models. Source: BCG analysis www.gigaconnect.org | info@gigaconnect.org




#### Northern belt most suited for community driven funding models, Middle and South benefit most from commercial interest

High potential

	Funding model	South	Middle North	Reason for regional difference
	Coverage as a service	$\checkmark$	< ≈	Will be harder (but not impossible) to find local players in the North who are willing to build and deploy a network in rural areas. Optional: train local community members to provide maintenance to reduce Opex and probability of vandalism (especially feasible in rural areas)
	Electricity as a business model	×		Southern regions tend to be well-connected to the grid which will reduce possible profits. In North and Middle belt, there are many schools and communities that are not connected to electricity and many sunny days (especially in the North), making it the ideal location. Do note that a license from the NERC is needed when distributing more than 100 kW.
	Spectrum Auction/ Minimum subsidy model per state	$\checkmark$	<b>e</b>	In the past, the result of spectrum auctions was that mostly urban and Southern regions would be covered. It is therefore important that when new auctions come up, requirements are posed on a national level to not further widen the connectivity gap. This can be done by including requirements like "10% of schools in each state need to be covered with at least 10Mbps"
	Government subsidized PPP	~		This model would work in most Northern regions but does not generate enough revenue on its own. It will work well in the Middle as there's enough economic activity there, but there are more effective commercial options to connect the South.
	Community contribution	$\overline{\mathbf{x}}$		In the South, there are plenty of commercial models that will be more effective in connecting schools, but this model would work well for rural areas where there's little commercial interest. Moreover, by actively involving the community, (digital) literacy rates and use of digital devices will go up, making it more attractive for commercial players in the long run

 $\approx$  Medium potential

Low potential





# AMN's Network as a Service | Example of a collaboration model geared towards connecting underserved communities

## AMN's goal is to allow operators to expand their rural coverage by reducing risks for the operator



Africa Mobile network is a UK-registered company that has full ownership of the local operating companies and is responsible for overall management



They work with licensed Tier 1 mobile network operators and currently operate around 2000 mobile network base stations and connect approximately 7 million people



AMN funds the construction of the mobile base stations in rural communities, connects the rural base stations to the operator' existing core network, and operates the network of rural base stations, delivering voice and data services, and distributing airtime to the operator's subscribers.



The technical set up is based on small cells which deliver strong signal to cover an area of between 1km and 5Km from the tower. The AMN design is highly scalable, and each tower can be upgraded to add more capacity as needed to meet demand.

### AMN offers two operating models, depending on the local circumstances

AMN offers two different commercial models to the operator, for both of which AMN funds the Capex, acquires the site and permits, builds, commissions, operates and maintains the base stations, in return for a fixed or variable fee:

With the Revenue-Share model, AMN will take all Opex risk and a share of the revenue generated by a site, after deduction of the direct costs of the operator, which means the site is guaranteed to have a positive margin/EBITDA for the operator. Revenue-share sites are selected according to AMN's criteria which require that sites have sufficient people and have no existing usable network coverage

With the OPEX model, AMN will build sites wherever the operator chooses in return for a fixed fee per site per month, leaving the operator to enjoy the upside benefits of high-traffic and high-revenue sites.

The vision of AMN is a fully-connected Africa, with no community of any significant size being without basic telecommunication services —Michael Darcy, Founder and CEO of AMN



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## To identify relevant business models, BCG suggests analyzing a country's macro & school status, connectivity, & service provider landscape

To support the use of the 5-step Roadmap with relevant information tailored to the specific context...



... we recommend analyzing three topics that are key to assess optimal business models

#### Country & school overview

Understanding of country's status, plans and policies by gathering data on economic, political, and regulatory landscape; specific deep-dive on situation for schools

#### Connectivity status & developments

Analysis of country's coverage & penetration rates of mobile & fixed broadband, developments over the last few years, and infrastructure gaps that need solving

#### Service provider landscape

Documentation of the relevant market players that can be leveraged in reaching school connectivity during implementation, including ISPs, MNOs, and NRENs



The following pages are relevant if you would like to replicate BCG's methodology for case studies

## Country & school overview

Understanding of country's status, plans and policies by gathering data on economic, political, and regulatory landscape; specific deep-dive on situation for schools

**Goal:** Determining what the starting point is, what country-specific (or regional) nuances need to be taken into consideration, and what boundaries exist in suggesting business models

#### Key questions

What are the main socioeconomic hurdles that need to be overcome that are country-specific to connect all schools to the internet?

#### Purpose



Determines which issues need to be addressed to reach sustainable connectivity

Determines whether

same country

business models need to

be differentiated within the

Is the country homogeneous or are there large differences between regions?

What are the characteristics of the different regions in terms of income, population density, and any other relevant factors?

Are there any country-specific challenges that need to be taken into consideration in rolling out school connectivity? (corruption, electricity access, multilayer administration, etc.)



Determines potential cost differentials and suitability of funding models in different regions



Determines practical barriers that are ingrained in the country and need to considered in suggesting business models





The following pages are relevant if you would like to replicate BCG's methodology for case studies

#### **Connectivity status &** developments

Analysis of country's coverage & penetration rates of mobile & fixed broadband, developments over the last few years, and infrastructure gaps that need solving

**Goal:** Identifying main connectivity (usage & connectivity) gaps, potential tailwinds that can be leveraged / headwinds that need to be considered, and what the main infrastructure hurdles to solve for are



#### Key questions

What are the main hurdles that need to be addressed when it comes to the coverage (& usage) gap to reach school connectivity?

#### Purpose



Determines which telcospecific issues need to be addressed to reach sustainable connectivity

Determines the ongoing

momentum that can be

What is the current penetration level of mobile & fiber broadband and how has this developed over the last few years?

What does the geographic division of broadband access look like? I.e., what portion of the population & how much of the area in the country is covered with connectivity?

What is the general price level in the country? Are mobile & fixed broadband accessible to all?



leveraged or flywheel that needs to be set in motion Determines whether there

are any major gaps that need to be solved in order to reach a highly connected population



Determines whether interventions are needed to ensure affordable internet. including roll-out of new, cheaper infrastructure



The following pages are relevant if you would like to replicate BCG's methodology for case studies

#### Service provider landscape

Documentation of the relevant market players that can be leveraged in reaching school connectivity during implementation, including ISPs, MNOs, and NRENs

National research and education network
 Universal Service Fund
 Source: BCG analysis
 www.gigaconnect.org | info@gigaconnect.org

**Goal:** Uncovering what potential partnerships can be set up and what the available options are in terms of infrastructure roll-out operating models to reach sustainable business models

#### Key questions

What does the current service provider landscape look like in terms of its structure? E.g., state-owned monopoly vs. market with lots of competition

#### Purpose



Determines potential partners and whether international parties can be engaged

What are some key changes that are relevant for school connectivity that will either accelerate or decelerate Giga's efforts?

Determines whether there are any initiatives ongoing that can be leveraged, e.g., upcoming 5G auctions

What is the health & strength of each of the service providers and which ones could be potential partners in rolling out connectivity?

Are there any NRENs<sup>1</sup> and/or USF<sup>2</sup> funds that in place that Giga could consider partnering up with?

Determines which parties are more suitable than others in partnering up with

Determines the ability to partner up with established organizations that could be expanded to include school connectivity



#### BCG suggests leveraging a wide variety of sources to analyze business model opportunities

#### 1 DESK RESEARCH

Suggest to start with desk research, including assessment of data available on ITU, UNICEF, and other UN organizations; assessment of government websites; press searches; etc.

#### **2** ORGANIZATION REACH-OUTS

Reach out to local institutions and government bodies to uncovering additional, relevant data. For example: Sierra Leone's USF shared their strategy upon request

#### **3** EXPERT INTERVIEWS

Conduct interviews with country experts from ITU, UNICEF and other UN organizations, local institutions & companies and governmental organizations to uncover important non-tacit cues

Source: BCG analysis www.gigaconnect.org | info@giga.partners



After identification of key challenges and finding potential partners, BCG suggests to leverage tools provided to identify the best business models

The following pages are relevant if you would like to replicate BCG's methodology for case studies	Goal: Determinin country-specific ( taken into consid exist in suggesting	g what the starting poi or regional) nuances ne eration, and what bour g business models	nt is, what red to be Idaries			
Country & school overview Understanding of country's status nans	Key questions What are the main a need to be overcom connect all schools of	tocloeconomic hurdles that the that are country-specific to the internet?	t to Determines which iss need to be addresser reach sustainable connectivity	ues I to		
gathering dat political, and landscape; sp on situation f	g pages are relevant if ike to replicate BCG's ogy for case studies	Goal: Identifying r connectivity) gaps leveraged / heady what the main inf Key questions	nain connectivity (usage & . potential tailwinds that car vinds that need to be consid rastructure hurdles to solve	t be ered, and for are Purpose	٣	
Source: BCG analysis www.gigaconvect.org   Analysis o & penetra	t <b>ivity status &amp;</b> pments f country's coverage tior	What are the main h addressed when it o usage) gap to reach	nurdles that need to be omes to the coverage (& school connectivity?	Determines which tel specific issues need t addressed to reach sustainable connection	co- o be	
& fixed bro developm years, and that need	Dad ent inf sol	evant if BCG's Jdies	Goal: Uncovering what be set up and what the terms of infrastructure to reach sustainable bu	potential partnerships available options are i roll-out operating mod siness models	can n leis	
	Service provid landscape	er	Key questions What does the current ser landscape look like in term E.g., state-owned monopol of competition	rice provider s of its structure? y vs. market with lots	Purpose Determines potential partners and whether international parties can be engaged	
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	MINOS, and NRENS		service providers and whic potential partners in rolling Are there any NRENs <sup>1</sup> and place that Giga could cons with?	n ones coulo be g out connectivity? or USF <sup>2</sup> funds that in der partnering up	Determines the ability to     partner up with     organizations that could be	
	1. National research and education 2. Universal Sandra Fund Source: BCG analysis www.gigaconnect.org:   info@gigac	network connect.org			expanded to include school connectivity	





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www.gigaconnect.org | info@gigaconnect.org

## Two complementary financial and impact tools developed by ACTUAL, Giga and BCG are publicly available

#### **ACTUAL + Giga model**

Cost, technology and impact model developed by ACTUAL with Giga that determines:

- How much bandwidth a school needs and the technology best suited to deliver it
- The cost to connect the school to the internet
- How connectivity impacts the community around that school

#### BCG-Giga funding tool for school connectivity

Financial model developed by BCG with the objective of investigating the financial feasibility of funding models for school connectivity in specific areas by:

- Starting by the total costs of connection from the ACTUAL + Giga model
- Estimating annual revenues that could be achieved with each funding model



## **Objectives of the tool |** The tool aims at investigating funding models for school connectivity in specific regions



Investigating the financial feasibility of funding models for school connectivity in specific areas by:

- Calculating total costs of connection, leveraging estimates from Giga
- Estimating annual revenues that could be achieved with each funding model



#### What is included in the tool?

5 countries (and their respective relevant divisions): Brazil, Honduras, Indonesia, Rwanda and Sierra Leone

7 funding models:

- Community contribution
- Electricity as a business model
- Coverage as a service (revenue sharing)
- Tax revenue-linked financing
- One-off government subsidy
- Government increases school funding
- Regulated advertising model



#### Who can use it?

Companies, governments, NGOs, or any institution or individual that would like to make high-level country assessments of school connectivity, investigate funding models or pilot projects



## **Objectives of the tool** | The tool generates P&Ls in three granularity levels for school connectivity of specific regions



#### What are the outputs of the tool?

Three different P&Ls for a project of school connectivity in a specific area (which can be a country, region, state, city or village, or any relevant area):

- P&L for an average school
- P&L for an average village/city
- P&L for the whole area



#### What are the inputs of the tool?

Data specific on the area of analysis, including:

- General economic data (e.g., population, GDP etc.)
- School connectivity data (e.g., number of schools with access to the internet and electricity etc.)
- Cost data (e.g., Capex and OPEX required to connect one school in area, technology division etc.)



## **Operation of the tool** | Model is designed to be easy to use and fully flexible, allowing for analyses of different granularity levels

#### 1 Summary page

- User can choose area and funding models for calculations
- Visualization section shows annualized results for chosen models

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#### 2 Input sheet

- User can insert new areas for analysis, being the model fully flexible in terms of areas that can be included (e.g., country, region, state, city etc.)
- List is comprised of ~50 inputs, most of which come from public sources

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## **Operation of the tool | Calculations are made for an average school and extended to avg. village/city and whole area**

#### <sup>3</sup> P&L for average school

- Revenues and costs for each funding model are calculated for 10 years
- Funding models can be combined to measure final results

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• Results are extended to village/city and whole area levels based on number of unconnected schools

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#### **Funding model tool | Where to Access the Tool**

#### Accessing the Funding model

- The funding model is publicly available and can be found on the Giga website:
  - <u>https://gigaconnect.org/bcg-report-assessment-of-sustainable-business-models/</u>
- Please note some sheets have been locked to ensure consistency
- If you would like more information, contact details are disclosed on the website

mancial Model Tool to Assist with Identifying Optimal Business Models
part of the stocket for identifying sustainable business modes. BCG has prepared and made publicly available a dynamic handleg model to apport fearesist analysis.
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## **Note of caution |** Model was developed to allow for high-level analyses of funding models—further refinements can increase accuracy

More granular analyses to optimize locally: Due to data availability, the analyses are currently made on a country, regional or state level for the implemented countries. However, the model allows for more granular analyses, such as of cities or villages, which are recommended in order to determine optimal funding models for specific areas.

Further refinements of input data and assumptions: Currently, the model uses mostly public data. In some cases, due to data availability, estimates had to be made using proxies or expert advice. Besides this, several top-down assumptions were used. Therefore, ideally, these specific data points and assumptions should be refined with relevant bodies in order to achieve more accurate numbers.

Expansion of the analysis to comprise the connection of whole communities: The model only considers the connection of schools, which may serve as an internet hub for the population living around them. However, the connection of whole communities (including households and businesses) can yield more satisfactory results, since revenue streams would increase, and fixed costs could be shared by more subscribers. As Giga's goal is to connect schools first & foremost, the modelling of the whole community was not included.

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## **Expert advice |** What are lessons learned from previous projects in terms of business model dos & don'ts?





Have a clear and quantifiable goal

## Enlist the right people and organizations



Keep costs to a minimum



Consider practical implications

The number of schools that require connectivity, as well as the internet speed aimed for throughout the region Can be in terms of government buy-in, as well as having the right commercial parties aboard So that the need for external funding is lower, and therefore by definition more sustainable in the long-term Before rolling out infrastructure, as connecting schools is more than just "putting down a cable or a tower"



# **Expert advice deep-dive |** Goal-setting requires "mapping" in order to determine how many schools should be connected to internet and by when

#### "Mapping" is critical to setting clear and quantifiable connectivity goals

- Goal refers to the number of schools that require connectivity, as well as the internet speed aimed for throughout the region
- In partnership with governments, Giga has started by mapping connectivity demand, using schools as a base point, and identifying where there are connectivity gaps
- This information, combined with existing ITU mapping data, allows countries to take stock of their existing infrastructure and assess wired and wireless availability
- Giga-provided maps, or other data from reliable sources, allows for clear target setting in terms of how many schools should be connected by when



#### Head of a regional development bank





## **Expert advice deep-dive |** Ensuring the right people and organizations, both public and private, are in place is key to achieving connectivity goals



#### Government buy-in

- The creation of the right conditions, and receiving dedicated funding, is critical
- There are several levers at gov't's disposal to help private sector involvement i.e., cost containment, revenue enhancement, and risk reduction

#### Private sector involvement

- Traditional partners, such as SPs and ISPs, are important in considering school connectivity. However, broader thinking could potentially lead to innovative revenue streams
- The sectors that may benefit from increased school connectivity vary by nation, so a country-by-country approach should be used to identify those sectors and leverage that knowledge to monetize connectivity

### Caution: Consider beneficiaries of gov't and donor funding



• While commercial organizations naturally require profit margins, direct/indirect funding of commercial organizations by benefactors eventually leads to meaningful connectivity and that minimum standards are met at all times "Government involvement is key, and you need to involve the government early on. At the end of the day, we're a company. The way to make it sustainable is if the government can pick up some of the work too. We have had plenty of failure, however the projects that worked out are the ones that were best integrated and took a holistic approach. It's not just about devices, it's not just about teacher training, and it's not just about content. It's about all of the above, while working together with the government. Every school system works differently"

### Director of a Commercial Infrastructure connectivity company







# **Expert advice deep-dive |** Low costs is critical to sustainability—involving commercial partners can help and balance financiers' required rate of return

#### Involving private sector partners can curb costs, balancing higher returns demanded by financiers for riskier projects

- Keeping costs low means the need for external funding is lower, and therefore by definition more sustainable in the long-term
- Involvement of commercial parties is known to keep costs relatively low. In addition, pilots with new costeffective innovations could lead to lower costs
- It is important to keep in mind that the country risk premium1 is usually significantly higher vs. developed markets. Thus, as a commercial company, getting access to finance is a significant issue, in terms of pricing, timing, and viability

"In OECD we have what we call zero or negative interest rates. You and I can borrow money for virtually nothing. We go to the bank and our interest rate is 0.25% plus admin. If you want to do that in developing nations, it may be 14% for a commercial company today. There is a financing divide of costs. As a commercial company, getting access to finance is the biggest issue"

Member board of directors at Africa-based network company

1. The additional return or premium demanded by investors to compensate them for the higher risk associated with investing in a foreign country, compared with investing in the domestic market (Investopedia 2020) Source: Expert interviews, BCG analysis www.gigaconnect.org | info@gigaconnect.org



# **Expert advice deep-dive |** Practical activities and complementary infrastructures should be established before connectivity infrastructure is laid down

Careful consideration of practical inputs and downstream consequences are crucial for a sustainable digital infrastructure project

- Successful school connectivity is much more than just "putting down a cable or a tower"
- Examples of practical implications include teacher training, protection of the infrastructure against stealing, methods to stimulate consumer demand, having locals who are able to operate and maintain the networks placed, electricity connection, etc.

"The whole notion of digital literacy is a real challenge. What you'll find is that kids everywhere are savvier than the teachers with the use of technology. There needs to be essential teacher training and support initiatives happening concurrently. The other important thing is that you need to figure out how networks are operated, maintained, supported and extended. In many of the focus countries in this report, there is a lack of a critical mass of network engineers to do this. Once they get good, they get poached away from the schools by commercial providers and government agencies"

Director at nonprofit focusing on internet networking technology



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