Meaningful school connectivity:
An assessment of sustainable business models

Giga in collaboration with Boston Consulting Group (BCG)

October 2021

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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 (Connecting the Dots) 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 well-being of countries around the world.

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

BCG scope as Knowledge Partner to Giga

"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[1] 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 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.

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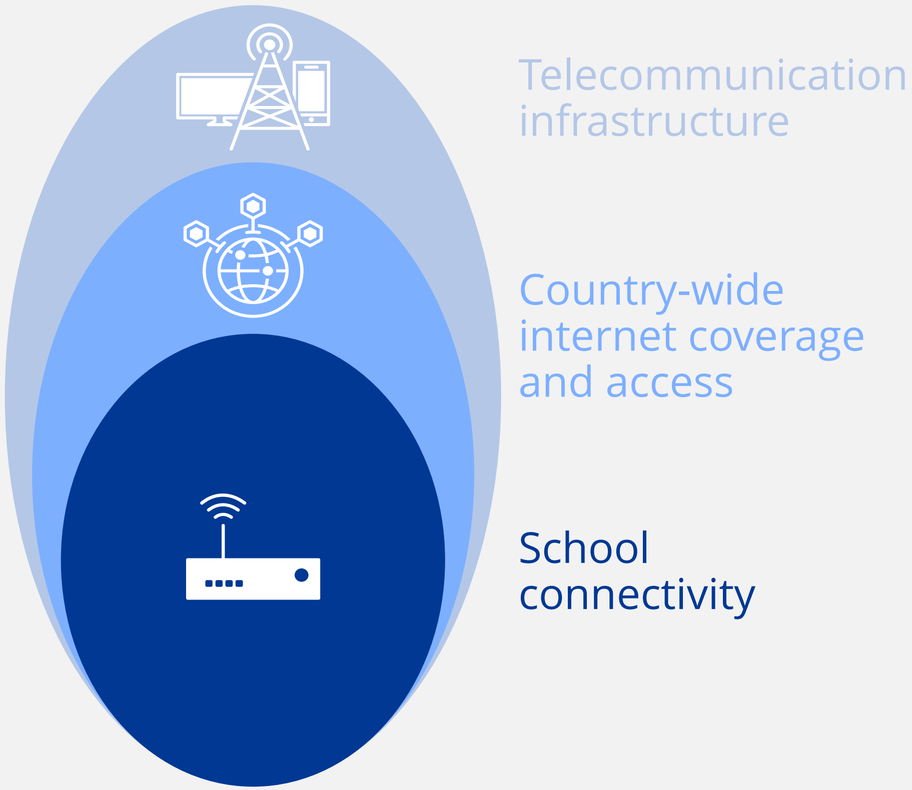
Scope of report focuses on sustainable business models for infrastructure to reach school connectivity

Problem scope



Emerging markets

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

Expert interviews

Authors (BCG, UNICEF, ITU)
- Wide variety of BCG Principals, Partners, Managing Directors & Directors
- Wide variety of country officers & other ITU experts
- Wide variety of country officers & other UNICEF experts

Governments and regulators
- Director at CONATEL (Honduras regulator)
- Director at CONATEL
- Manager at CONATEL
- Advisor at Honduras Secretary of Education
- Coordinator at Honduras Secretary of Education
- Coordinator at Honduras Secretary of Education

International organizations
- Manager at GSMA
- Specialist at IFC
- Program specialist at UNESCO
- Lead at World Bank

NGOs/Non-profit
- Co-founder at Guifi.net
- Researcher at Guifi.net
- Sr. VP at the Internet Society
- Coordinator at Lemann Foundation
- Manager at Lemann Foundation
- Consultant at NSRC
- Director at NSRC
- C-suite at Zenzeleni

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

Desk research

Assessment of data available on ITU, UNICEF and other UN organizations, government & regulators websites, international institutions such as The World Bank and IMF; press searches; etc.

Organization reach-outs

Reached out to local institutions and government bodies to uncover additional data and tailor analyses to local context. For example, Sierra Leone's USF shared their strategy upon request

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 key learnings …

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

- Country & school overview
- Connectivity status & developments
- Service provider landscape

… from 7 country case studies

- Rwanda
- Sierra Leone
- Brazil
- Honduras
- Indonesia

Light-touch only[1]

- Nigeria
- Kenya

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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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:

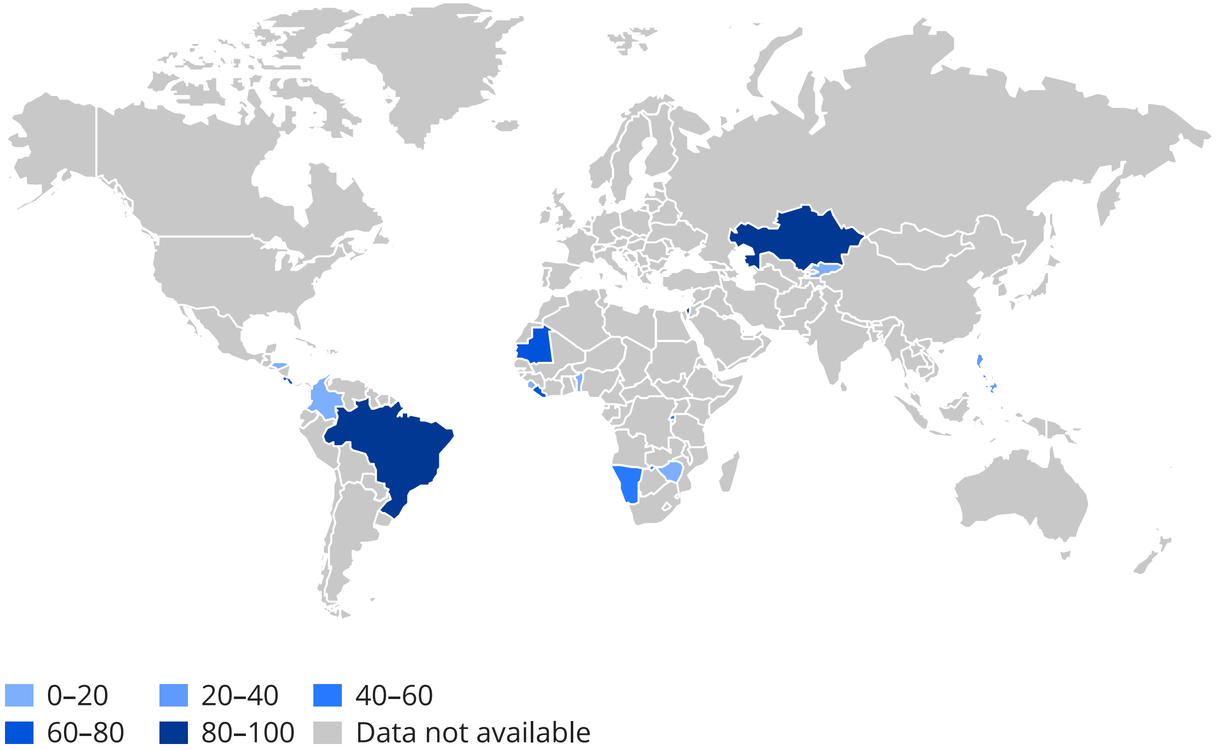
- **Technology**: refers to the decision around the technology to be applied, balancing both the quality desired and the availability of funding.
- **Cost structure**: comprised of both upfront & ongoing expenditures, which are affected by regional characteristics, as well as by decisions made regarding 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, 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[1]



86 thousand schools (11%) are currently unconnected in the 17 countries[2] 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

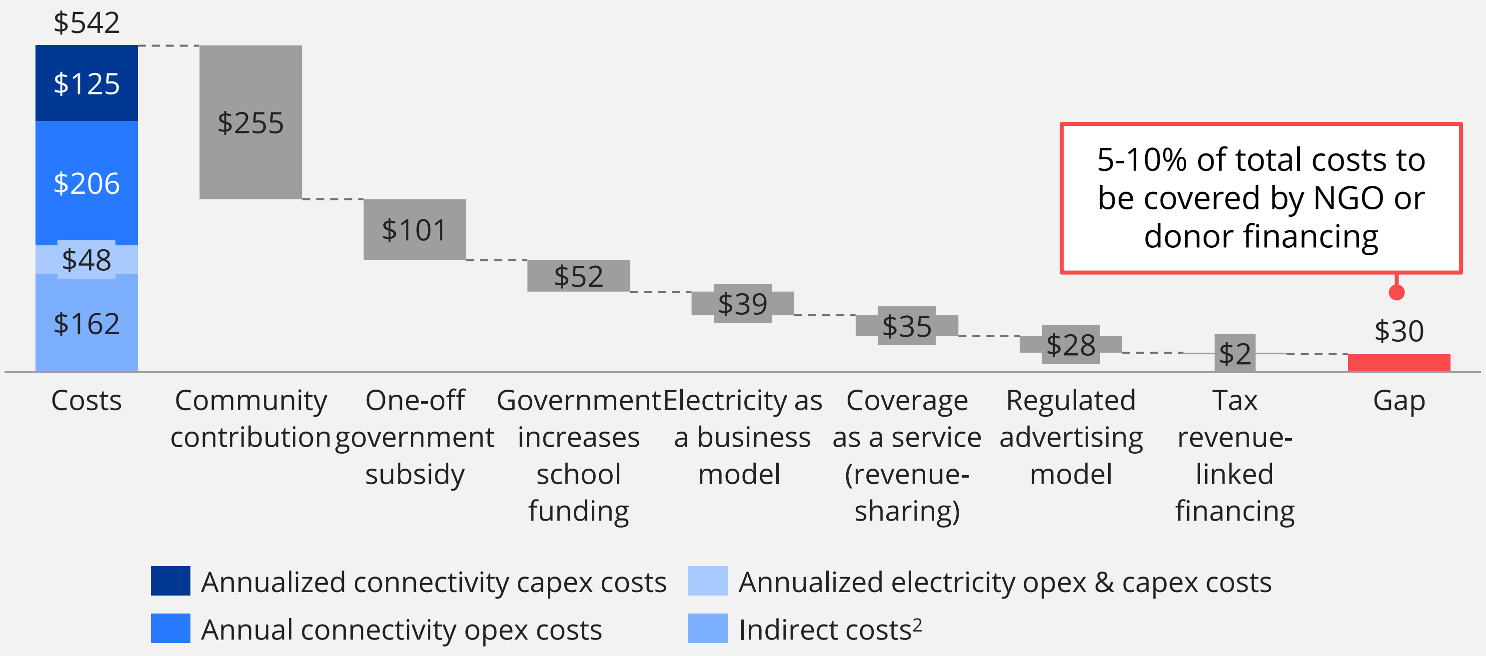
With sustainable funding, 25.8 M students and teachers will benefit from connectivity

1. Out of all schools in country, including schools with no information regarding connectivity; 2. 40 countries joined project Connect. Thus far, Project Connect has mapped 17 countries with connectivity in real time. An additional 8 countries have mapped school connectivity, but with static data. For the remaining countries, either school locations have been mapped, or the country has joined the project, but no mapping has been published at the time of writing; Source: Giga, BCG Analysis

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

For the five countries modeled[1], 90% of costs could be covered by using commercial funding models[2]...

Annualized P&L for school connectivity in selected emerging countries[1] (USD M)



... Which extended to the 17 countries mapped by Giga could represent:

80,000
schools

24 million
students & teachers

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

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	Apply multiple funding models where possible to minimize funding gap
Merge electrification & connectivity	Provide internet and electricity to increase revenues streams and share costs
Long-term affordability & demand stimulation	Ensure schools (and communities) can sustainably pay for connectivity
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

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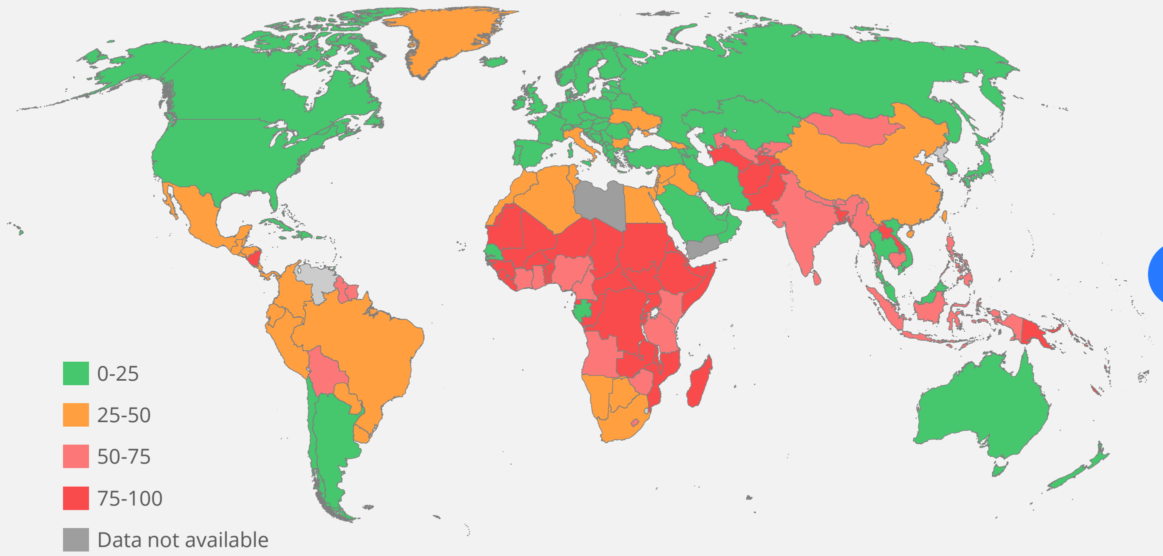
Large part of the world population is without internet connection, and schools are no exception

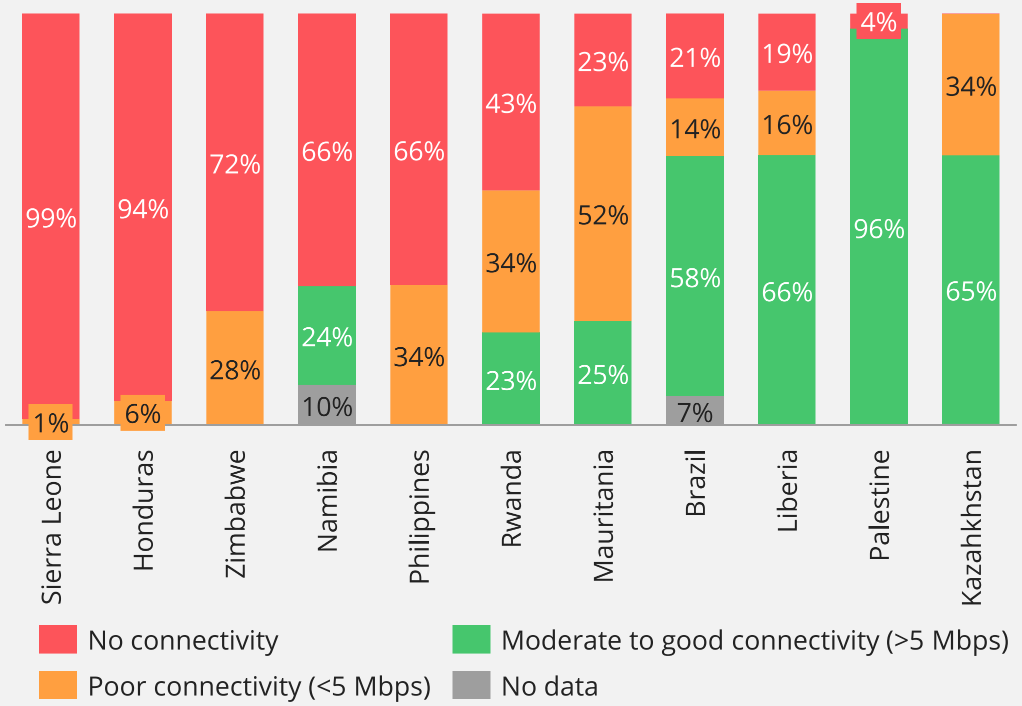
Large percentage of population with no access to the internet globally …

Percentage of population not using the internet (%)



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

Connectivity distribution (%)

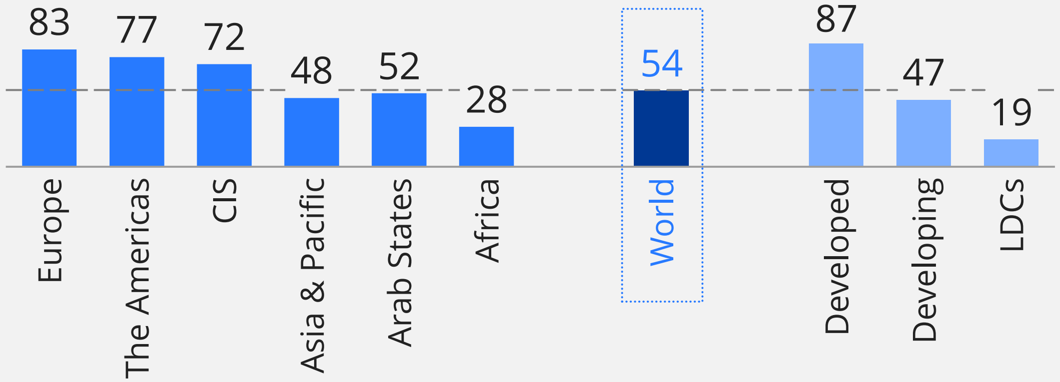


Source: ITU data, Giga school mapping, BCG analysis

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

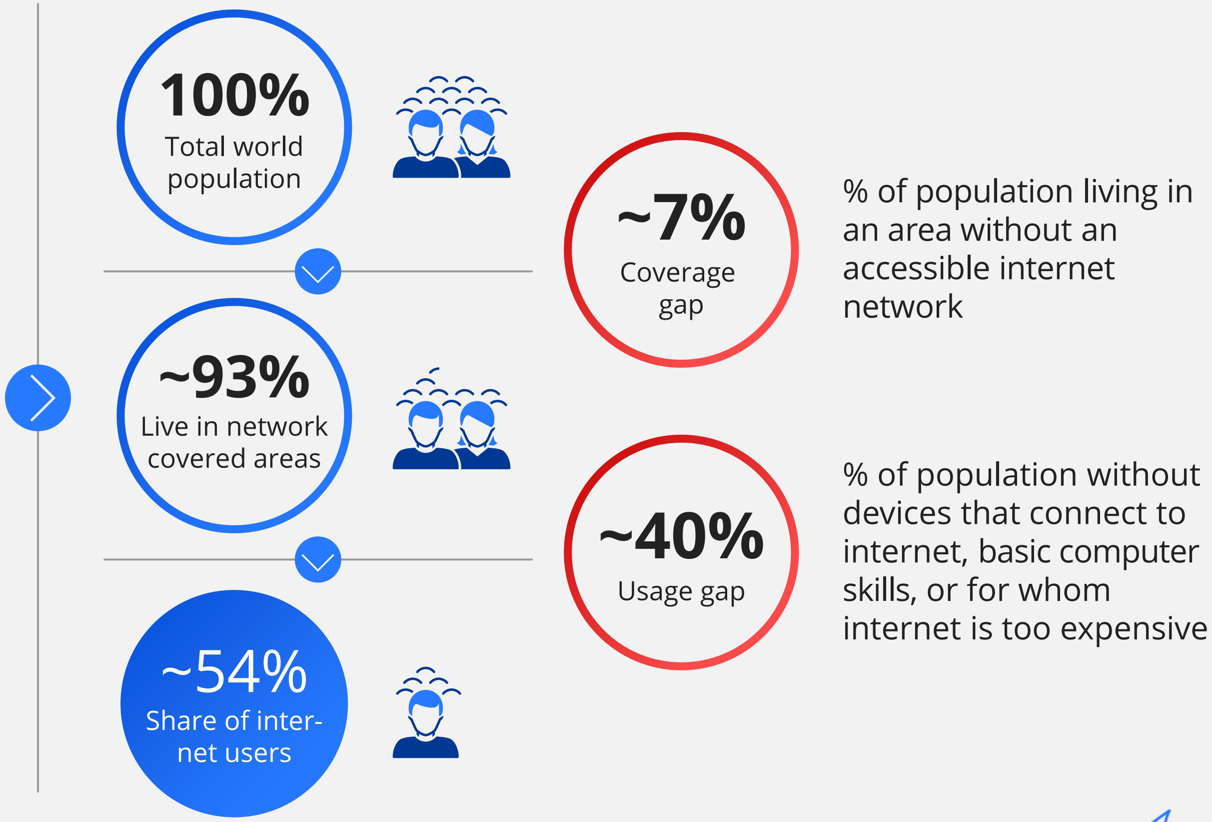
~50% of the world's population is not using the internet…

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

…driven by gaps in coverage & usage



LDC – lesser developed country
Source: ITU (2019), World bank (2019, 2021), BCG analysis

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

Emerging markets face different sets of barriers

Brazil
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

Nigeria
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%

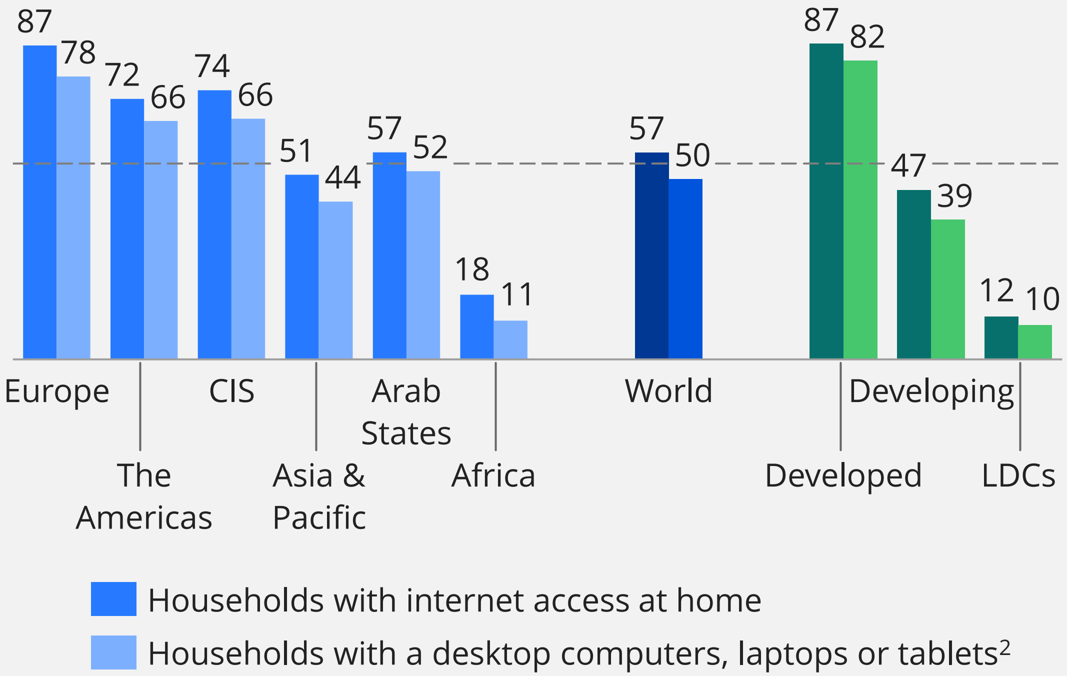
Honduras
Only larger cities are covered by 4G network, connecting 75% of the population but only a fraction of the land area. However, only ~41% uses a network, leaving a usage gap of about ~3M people

Rwanda
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[1] per capita

Sierra Leone
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[1] per capita

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

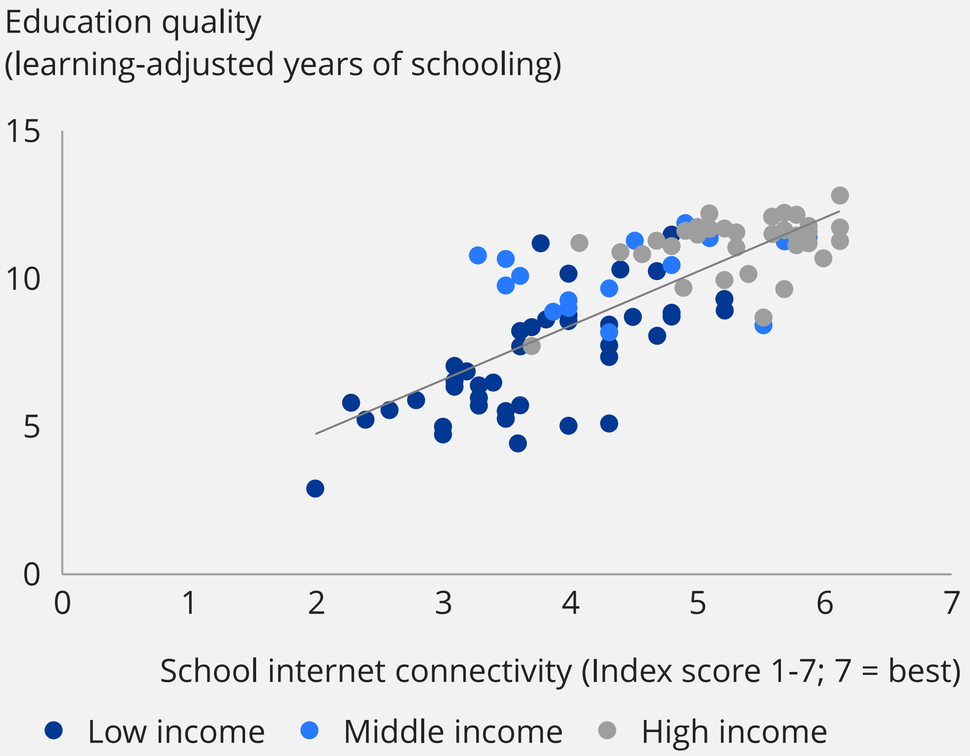
Percentage of households with Internet access at home and with a computer, 2019



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

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…



…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

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

Technology

Technology is part of the business model assessment as the **desired internet speed to reach meaningful connectivity in schools leads to certain infrastructure requirements**. This in turn influences the amount of capital that is required, as well as the size of operational expenditures on an annual basis

Cost structure

Comprised of both **upfront and 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 **use of one or multiple funding models to finance upfront & ongoing expenditures**, ensuring that they are sustainable and tailored to the characteristics of the specific area

Operating model

Refers to the **set-up to execute, build, operate and maintain the infrastructure**, including the role of different parties. For example, internet infrastructure could be deployed and operated by the government, private parties or different sorts of PPPs

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

Technology

- Internet speed to enable meaningful connectivity
- Technology options and trade-offs

Cost structure

- Key determinants of costs
- Opex and capex needs

Funding structure

- Funding model and archetypes
- Evolution over time

Operating model

- Setup to execute, build, operate and maintain
- Role of government, companies and community

Summary
Technology

Minimum internet speed defined to enable meaningful connectivity	The consensus among ~30 experts interviewed was in favor of setting a minimum connection speed target to reach meaningful school connectivity
Meaningful connectivity allows for skill development & safe navigation	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...	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
... Implying that some technologies are sufficient, whilst others must be excluded	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
Trade-offs exist between technologies and regional analysis is required	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

Source: BCG analysis

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

> "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

Connectivity stages ▶ / ▼ Connectivity enablers	No connectivity	Basic connectivity	Meaningful connectivity
Infrastructure	No infrastructure	Signal available	Fast and reliable
Affordability	Too expensive	Affordable	Cheap
Device	No device	Access to a device	Ownership of a 'smart device'
Skills	No skills	Basic skills	Advanced skills
Content	No content	Some content/ services available	Meaningful content and services available
Security and safety	No security	Secure infrastructure	Safe navigation

Source: UNSG's Digital Cooperation Roadmap

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

2024 target

Level of detail

20 Mbps per school

IN 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

NUANCED:
- 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
- For larger schools, 1Mbps / 20 students is the target. This means ~15 Mbps for an average sized school of ~300 students
- The monthly minimum on data is 100 GB. Giga will advise on a target of 200 GB per month

20 Mbps per school
1 Mbps per 20 students
Monthly minimum of 100 GB
Download speed of 20 Mbps
Upload speed of 5 Mbps

IN DETAIL:
- Target of 10 Mbps per school. Even in case of small schools, 10 Mbps should be minimum
- For larger schools, 1Mbps / 20 students is the target. This means ~15 Mbps for an average sized school of ~300 students
- The monthly minimum on data is 100 GB. Giga will advise on a target of 200 GB per month
- 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 and upload speed

Source: Methodology of Education Superhighway: Equivalent organization to Giga in the USA, industry expert interviews, Giga team, BCG analysis

Target needs to change over time as technology develops

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

Giga's **minimum**

Giga's **target**

10 Mbps

Minimum internet speed for Giga projects; defined as "meaningful connection"

- Open a document
- Take an assessment
- Give feedback & questions
- Watch online videos

20 Mbps

Target speed for video-enabled school environments

- Open a document
- Take an assessment
- Give feedback & questions
- Watch online videos
- Several video-stream per school
- Cloud-based apps

>20 Mbps with 2 Mbps at home

Hybrid learning where access to online platform is possible at school and at home

- Open a document
- Take an assessment
- Give feedback & questions
- Watch online videos
- Cloud-based apps
- 1 video-stream per class
- At home: Open a document, take an assessment, give feedback & questions, watch an online video

Source: Methodology of Education Superhighway: Equivalent organization to Giga in the USA, industry expert interviews, Giga team, BCG analysis

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	✓	**Local WISP operated networks**: 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	✓	**Satellite:** 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	✓	**4G:** 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	—	**Not sufficient for meaningful connection**
2G	—	

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.

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

Characteristic	Terrestrial				Satellite	
	Fiber	WISP	4G	5G	GEO	LEO (e.g., Starlink)
Capacity (speed)	Highest Can support >10 Gbps	Highest Can support >10 Gbps	Medium 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	Medium ~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[1]	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	Medium Mid-, high bands preferred	Medium 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

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

Technology
- Internet speed to enable meaningful connectivity
- Technology options and trade-offs

Cost structure
- Key determinants of costs
- Opex and capex needs

Funding structure
- Funding model and archetypes
- Evolution over time

Operating model
- Setup to execute, build, operate and maintain
- Role of government, companies and community

Summary
Cost structure

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

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

Smaller school sizes present a greater challenge to widespread connectivity

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

Infrastructure availability and technology needs also greatly affect costs per school

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

Optimal technology should be determined with regional analysis

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

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

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

Source: BCG analysis

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

RFP

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

Note: ACTUAL's website: https://www.actualhq.com/
Source: BCG analysis

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

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

Source: BCG analysis

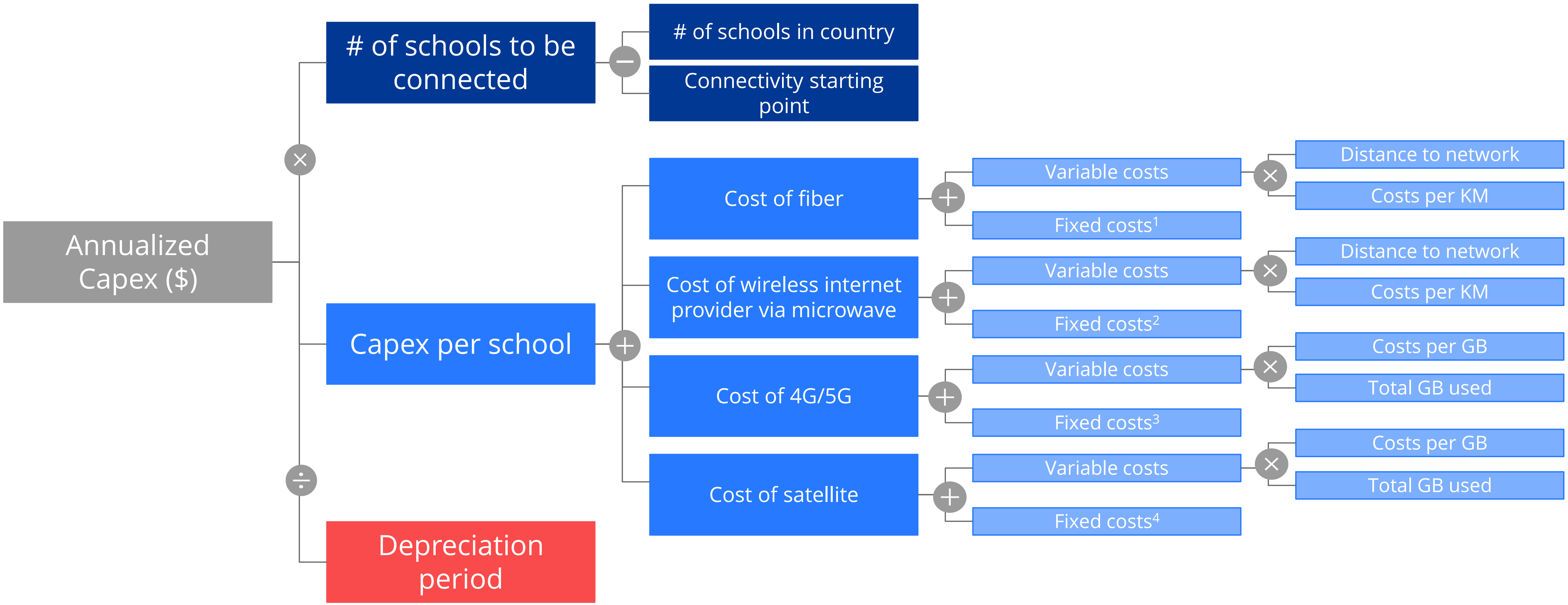
The three key determinants of the cost structure are driven by multiple factors

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
Electricity penetration	Yes, trustworthy	Yes, but not trustworthy	No
School remoteness	Remote	Rural	Urban
Operating model			
Operational responsibility	Telecommunications comp.	Local electricians	Service Providers
Partnership model	Public	Public & private	Private
Funding structure			
Funding partners	Government only	Community	Commercial

» **Capex and opex needs**

Source: BCG analysis

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

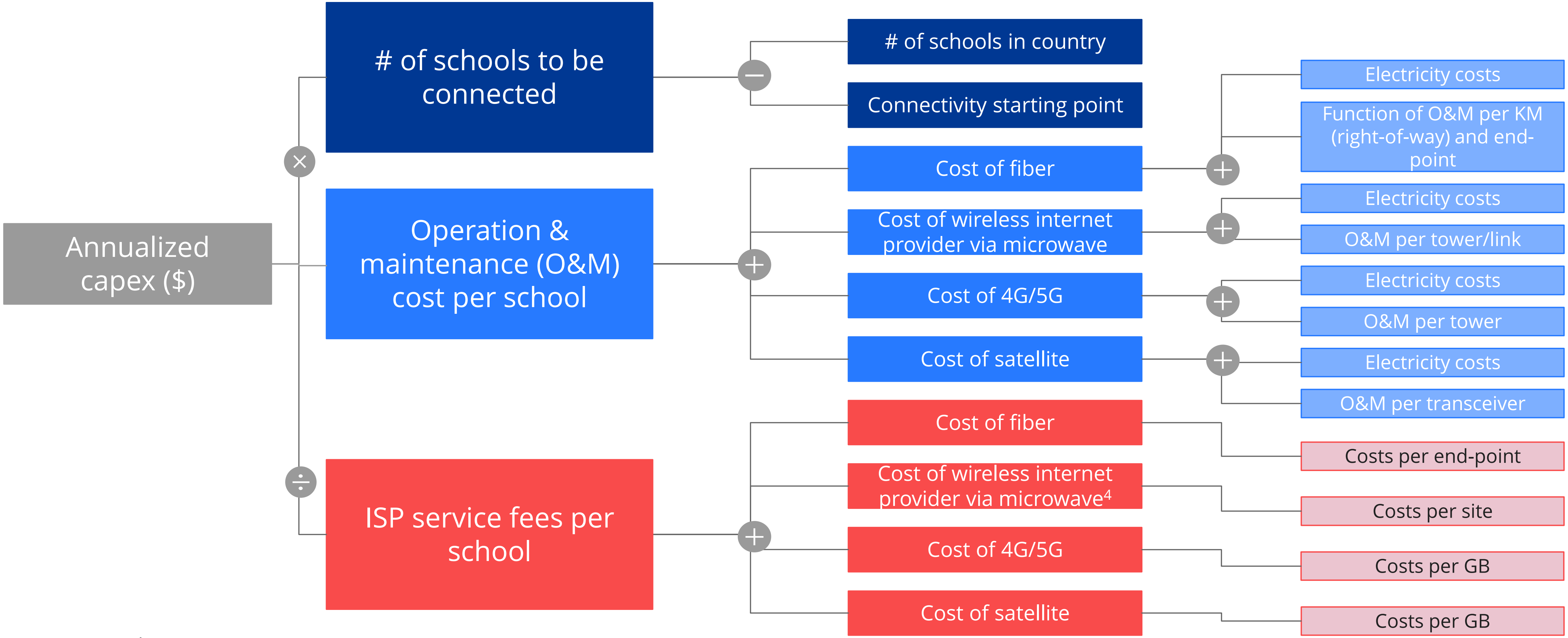


Source: BCG analysis

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

Depending on business model of ISP and/or MNO

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



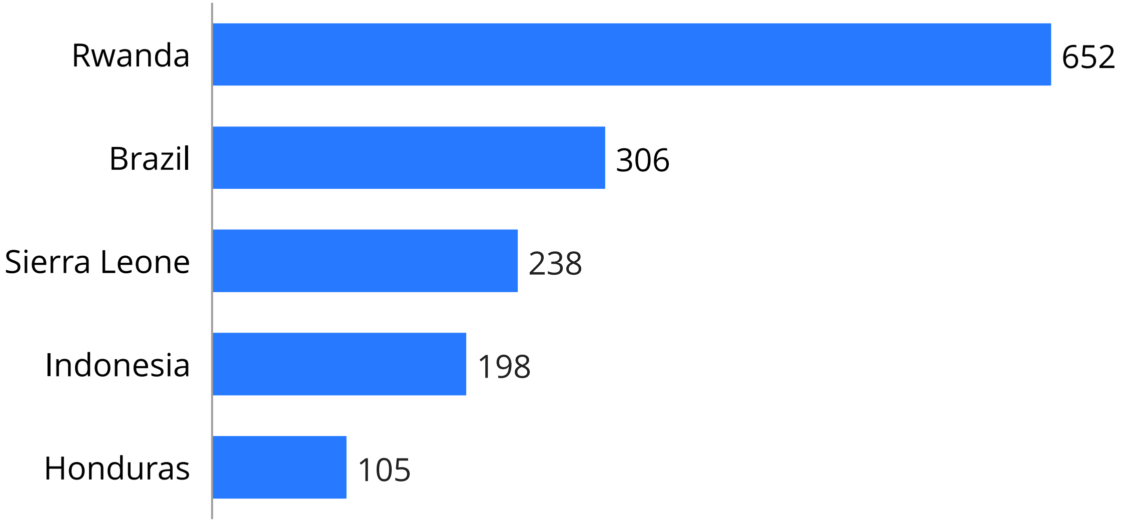
Source: BCG analysis

1. Telco & (optional) electricity; 2. Telco & (optional) electricity; 3. One-off technology costs; 4. Not frequently provided by ISP

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

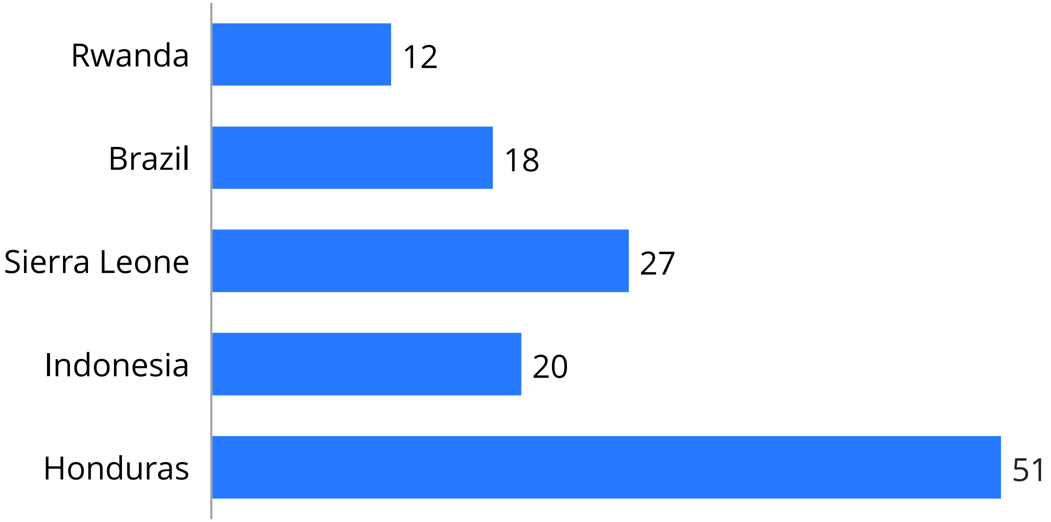
School size varies significantly between countries, with avg. school in Rwanda ~6x larger than in Honduras…

School size (avg. number of students per school)



… which affects considerably the investment required per student

Cost of school connectivity per student (USD)[1]

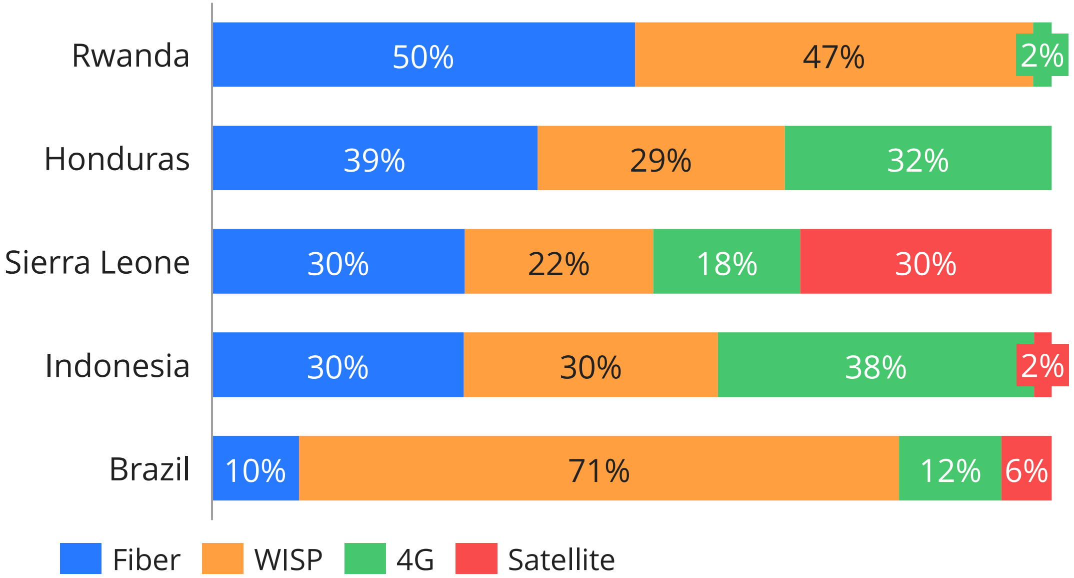


1. Including CAPEX, OPEX and Indirect Costs (estimated at 30% of total costs)
Source: Giga data, BCG analysis

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

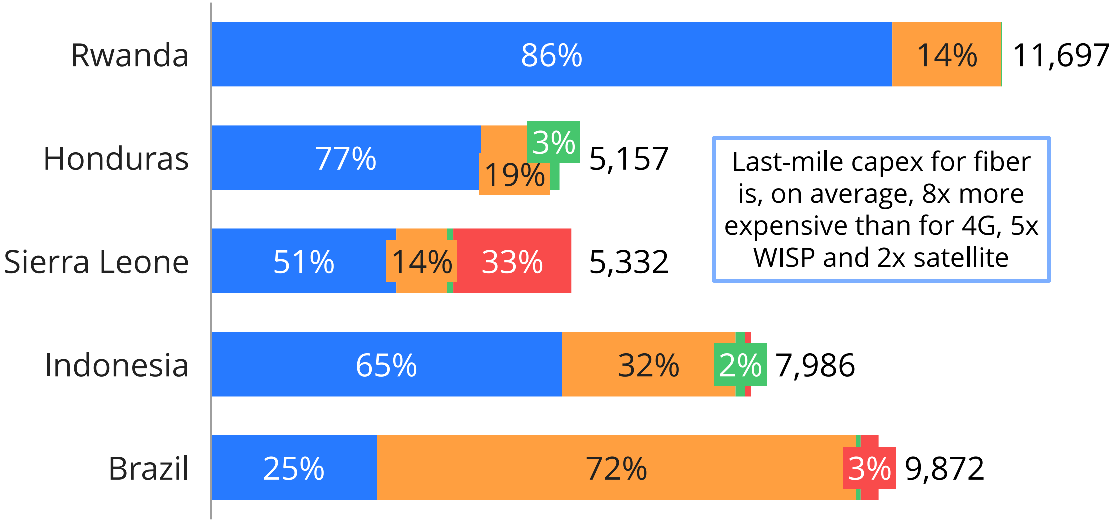
Countries have distinct technology needs to connect schools...

% of schools to be connected with each technology



... which leads to substantial cost differentials between them

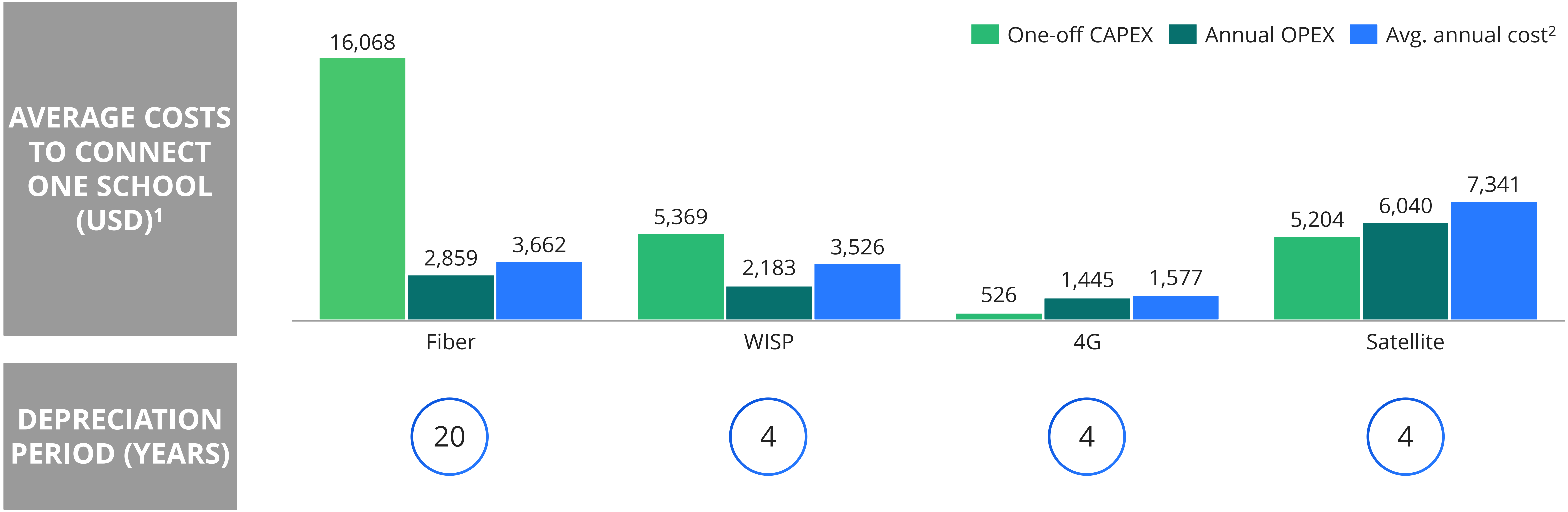
One-off CAPEX investment required per school (USD)



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

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

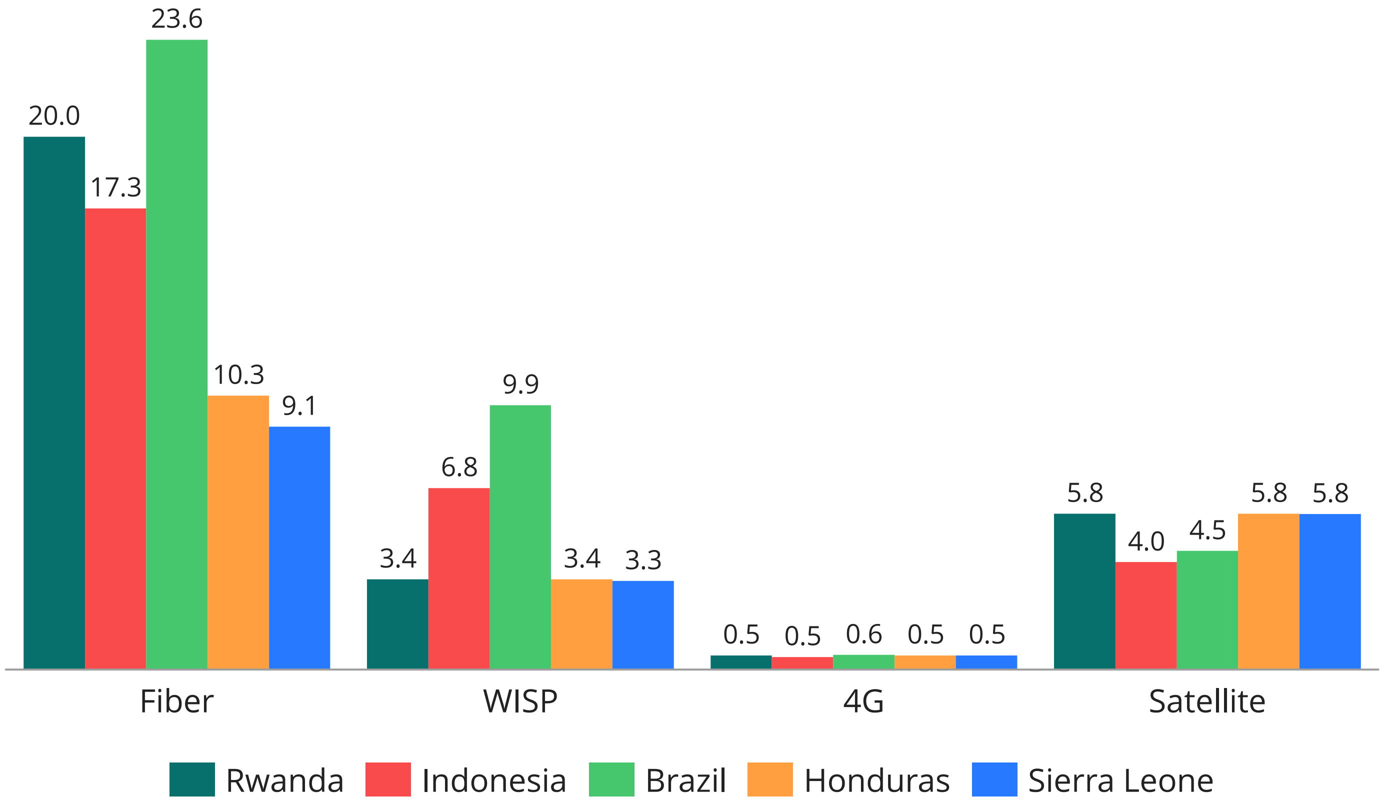
Whilst fiber has high upfront costs, it has low operational expenditure and long depreciation period, which equalizes its avg. annual costs to those of WISP; 4G remains as the most affordable technology to connect schools



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

… Especially given that costs of technologies vary between countries

CAPEX requirements to connect one school with technology (USD)



Source: ITU

CAPEX costs vary between countries since…

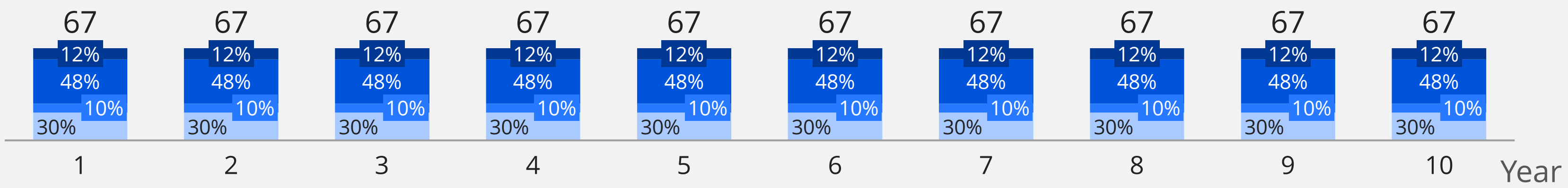
… Variable parameters (such as the average distance to network nodes) differ depending on infrastructure availability, country size or population density

… Labor, fees and hardware costs differ and cause smaller, but noticeable variations in CAPEX values

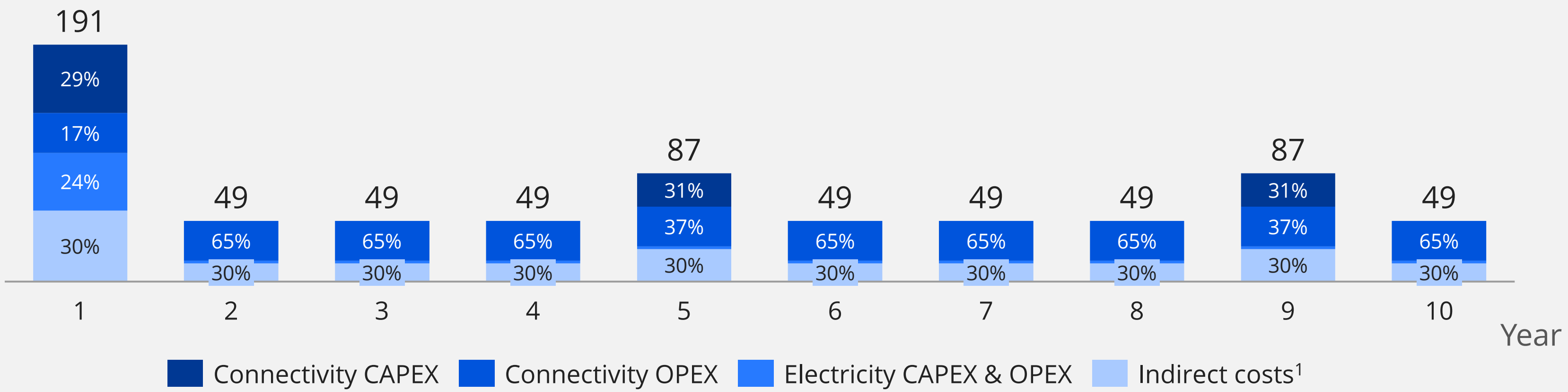
OPEX accounts for the largest portion of annualized spend, but CAPEX represents a considerable one-off investment

Example of model for Sierra Leone

P&L of Sierra Leone (USD millions)



Cash Flow Statement of Sierra Leone (USD millions)

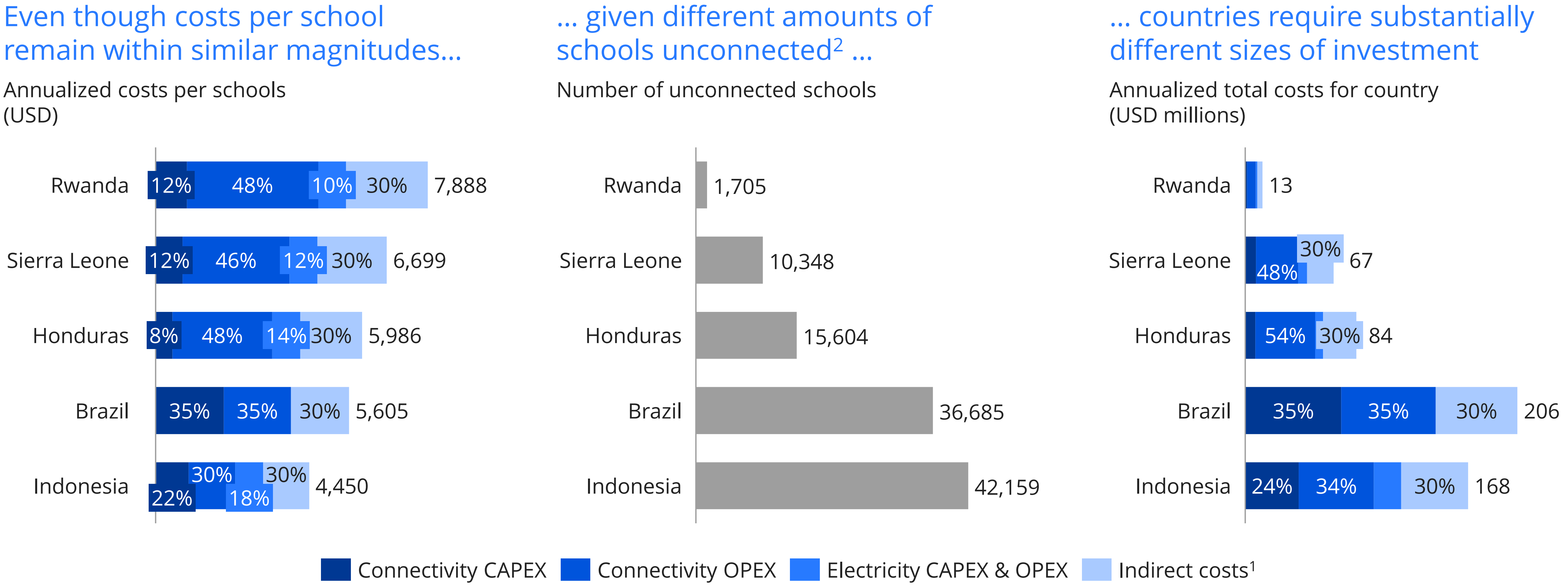


1. Assumed, based on external academic sources on telecommunications sector, at 30% of total costs

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

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



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

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

Technology
- Internet speed to enable meaningful connectivity
- Technology options and trade-offs

Cost structure
- Key determinants of costs
- Opex and Capex needs

Funding structure
- Funding model and archetypes
- Evolution over time

Operating model
- Setup to execute, build, operate and maintain
- Role of government, companies and community

Summary
Funding structure

7 funding archetypes were identified, from which multiple models derive

- 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 terms of archetypes allow for scalability & replicability of funding

- 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.**

Country-specific situations drive applicability of funding archetypes

- **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

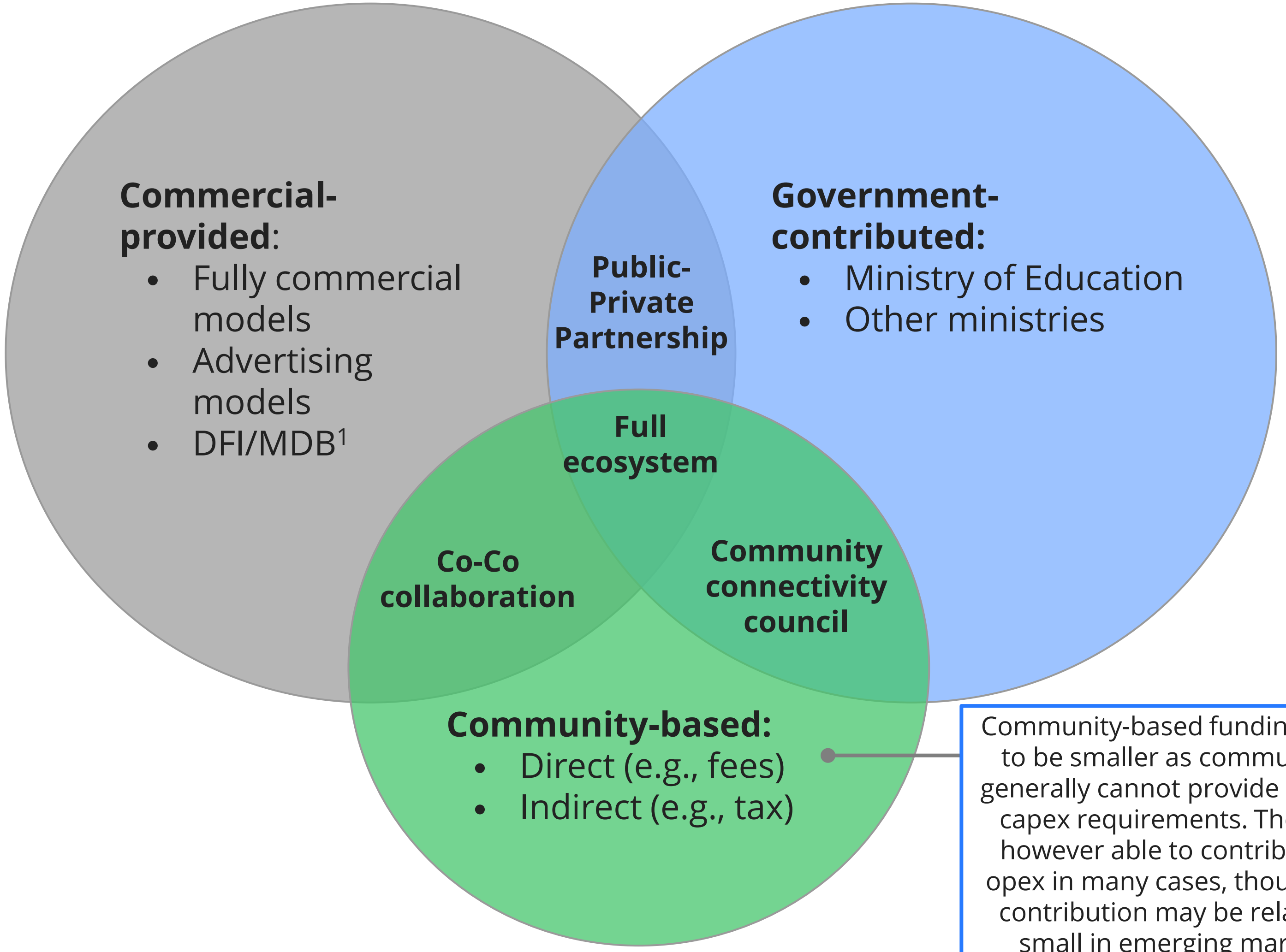
Start with private sector funding and keep funding changes over time in mind

- 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

Source: BCG analysis

Seven country archetypes arise based on funding opportunities

3 primary archetypes (commercial-provided, government-contributed and community-based) and 4 secondary archetypes were identified:



Community-based funding tends to be smaller as communities generally cannot provide upfront capex requirements. They are however able to contribute to opex in many cases, though this contribution may be relatively small in emerging markets

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

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

	Commercial-provided	Government-contributed	Community-based

Description of likely characteristics	• Higher potential returns for MNOs/ISPs
	  ◦ Higher GDP community
	  ◦ Lower cost of infrastructure roll-out (lower labor costs, easier landscape or climate)
	  ◦ Lower expected cost of opex vs. potential revenue generated
	  ◦ More transparent & lower risk government policy
	  ◦ Supportive government framework
		• Reasonable government debt levels and allocated budget
		• Lower potential returns for MNOs/ISPs
		• Lower GDP of community
		• Higher cost of infrastructure roll-out
		• Higher expected cost of opex vs. rev.
		• Private sector unable to meet demand (e.g., due to monopoly)
			• High demand for internet services, however relatively lower opportunity for MNO/ISP returns and absence of existing connectivity providers
			• Enough available spectrum that can be used without a license
			• Spectrum licensing framework that supports communities
			• Local knowledge / ability to install, maintain & operate networks
			• Closely-knit community sense

Successful examples of countries	• Wide variety of nations, including but not limited to: UK, France, Italy, South Africa, Germany, USA, etc.	• The Australian government has provided funds on a competitive basis to carriers to address broadband and mobile telephone blackspots and gaps in service provision	• 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 • South Africa has successfully set-up several community-led initiatives, though the majority is still provided by commercial parties • Another successful, large-scale project, is Guifi in Spain

> "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

Source: Expert interviews, UNHCR, World Bank, BCG analysis

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

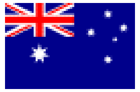
Government-contributed

Description of likely characteristics

- Reasonable government debt levels & allocated budget: Government has to be able to pay for connectivity
- Lower potential returns for MNOs/ISPs: Commercial involvement would be preferred choice to reduce pie of funding required to be paid for by government
  - **Lower GDP of community:** Often correlated with no involvement of MNO/ISPs
  - **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
  - **Private sector unable to meet demand:** May happen in case of monopoly/duopoly and unwillingness to cooperate or lack of skills

Successful examples of countries

- The Australian government has set up a Mobile Black Spot Program
- This program provides funds on a competitive basis to carriers to address broadband and mobile telephone blackspots and gaps in service provision
- 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
- 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
- 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
  - Mobile network operators: Optus, Telstra, TPG Telecom (Vodafone) and Field Solutions Group



Source: Expert interviews, UNHCR, Australian government, World Bank, BCG analysis

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

Commercial-provided

Description of likely characteristics

- **Higher potential returns for MNOs/ISPs:** Which ensures the market is attractive for commercial firms to be involved
  - **Higher GDP community:** Community can pay for connectivity either directly or indirectly
  - **Lower cost of infrastructure roll-out** (lower labor costs, easier landscape or climate): To ensure initial costs can be contained
  - **Lower expected cost of opex** vs. potential revenue generated: To keep running costs low
  - **More transparent & lower risk government policy:** Risk-return has to be in line with MNO/ISP expectations
- **Supportive government framework** That allows for commercial involvement without insurmountable entry barriers

Successful examples of countries

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

> "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

Source: Expert interviews, UNHCR, Australian government, World Bank, BCG analysis

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

Equity investors
- Country-related angel investors
- Local businesses
- Local governments
- Venture capital
- Infrastructure funds
- Tech companies, such as Facebook, Google, Microsoft, etc.
- Crowdfunding

Debt financing
- Local banks
- National banks
- International banks
- International philanthropic banks
- Innovative financing organizations
- Public market bonds

Operators
- Mobile network provider (MNO)
- Internet service provider (ISP)
- Fiber network operator (FNO)
- Other infrastructure owners[1], e.g., electricity, road, or water company
- Local entrepreneurial set-up

Development money
- Development finance institution (DFI)
- Multilateral development bank (MDB)
- Development venture capital funds
- Country-related angel investors
- Impact funds

1. Technology becoming increasingly less complex. Requirement of local knowledge who can solve 1st line problems

Source: Expert interviews, BCG analysis

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

Non-exhaustive

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 **Lead specialist at Interamerican Development Bank**
Provide access to current infrastructure	“ 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)	“ 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 **Lead specialist at Interamerican Development Bank**

Source: Expert interviews, BCG analysis

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

Community-based

Description of likely characteristics

- High demand for internet services: To ensure there's an incentive for community-based internet connectivity
- Relatively lower opportunity for MNO/ISP returns & therefore absence of existing connectivity providers: Community-based networking initiatives are more likely to exist in the absence of alternatives
- Enough available spectrum that can be used without a license: To ensure a high-quality service, e.g., Wi-Fi
- Spectrum licensing framework that supports communities: To ensure legal guidelines are in line with community networks
- Local knowledge / ability to install, maintain & operate networks: In order to ensure that the network can be set up, but can also be fixed / maintained when needed
- Closely-knit community sense: So that there's an incentive to help the wider community & ability to take leadership

Successful examples of countries

- 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
- South Africa has successfully set up several community-led initiatives, though most of 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
- Other small community networks can be found in countries like Zambia and Mexico
- 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.

Source: Expert interviews, UNHCR, World Bank, BCG analysis

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.

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

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

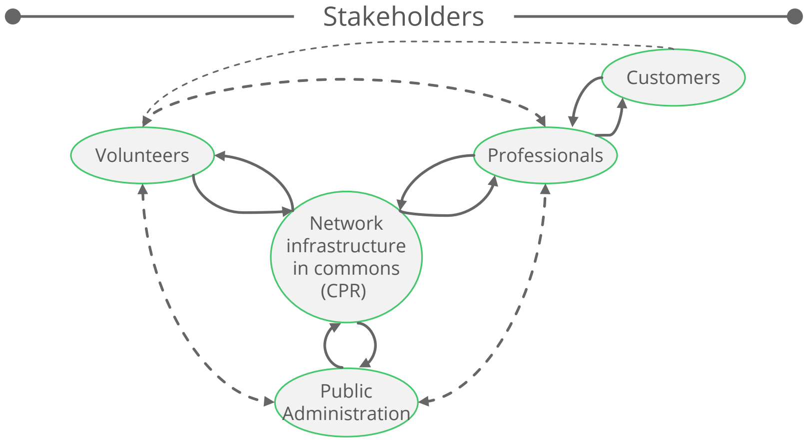
- Guifi.net began in 2004 as a telecommunications technology project in the Osona region (Spain) to solve the difficulties of broadband Internet access in rural areas, given the lack of interest of traditional operators to provide service.
- Whereas Guifi.net started out using WiFi radio links only,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

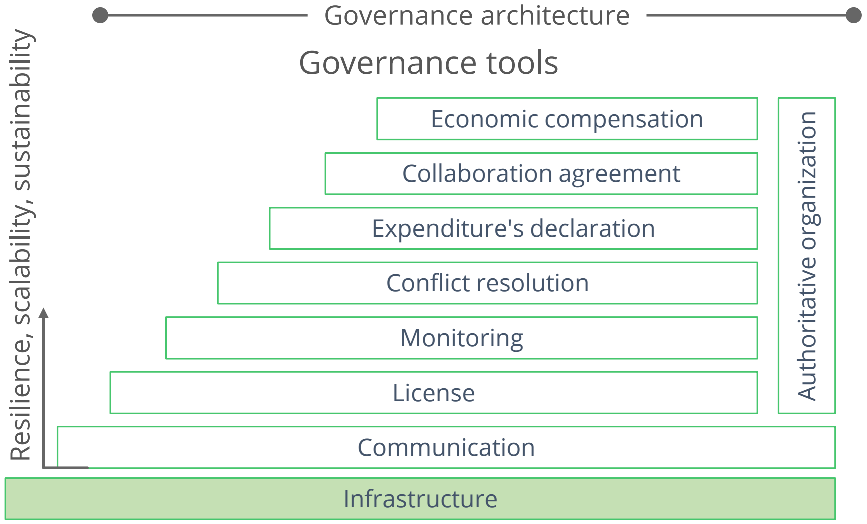
Funding model

- 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

Various operating models derive from the archetypes identified

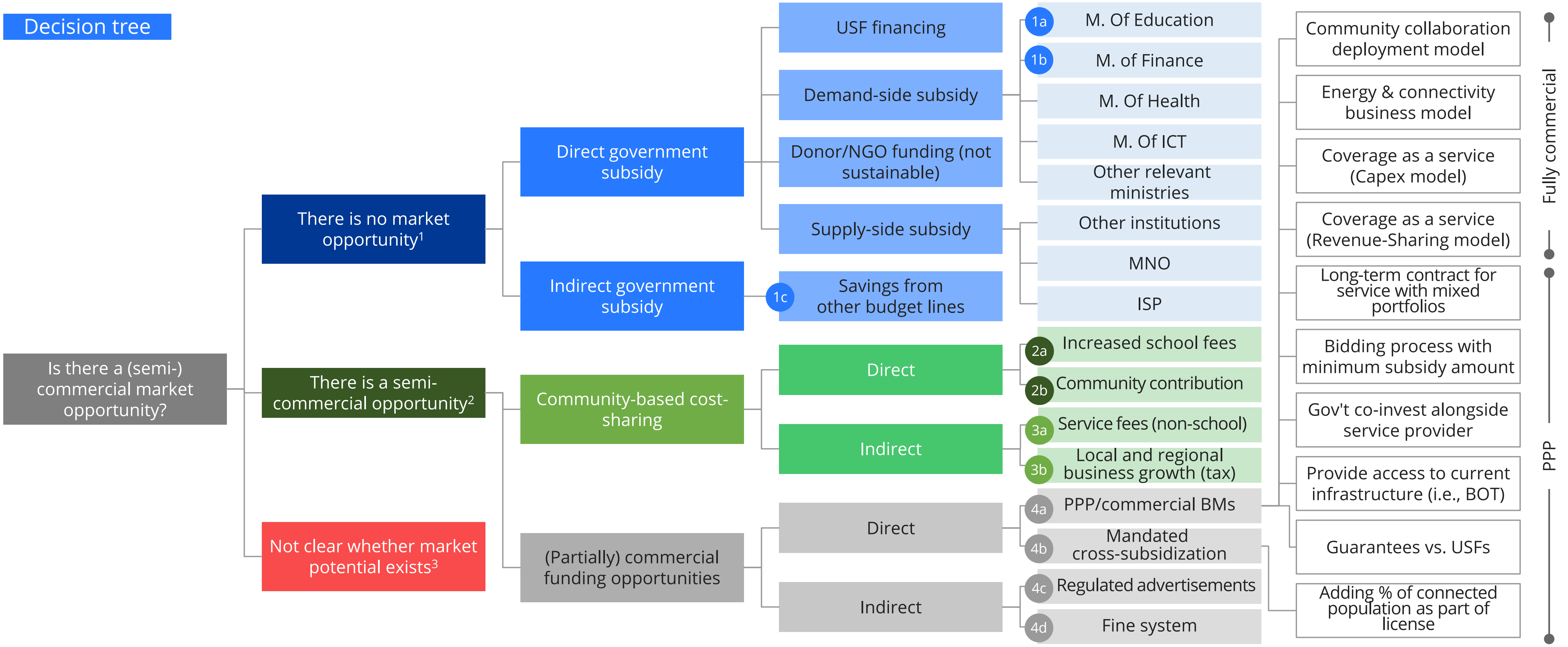
Archetype	Operating model	Key considerations
Government-contributed	1a Additional budget from education department	• Structural increase in budget per student must be feasible & sustainable in the long-term
	1b Budget/contributions from other ministries (e.g., infrastructure, ICT, or energy)	• Structural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

Source: Expert interviews, Giga input, BCG analysis

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

Decision tree



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

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

… 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

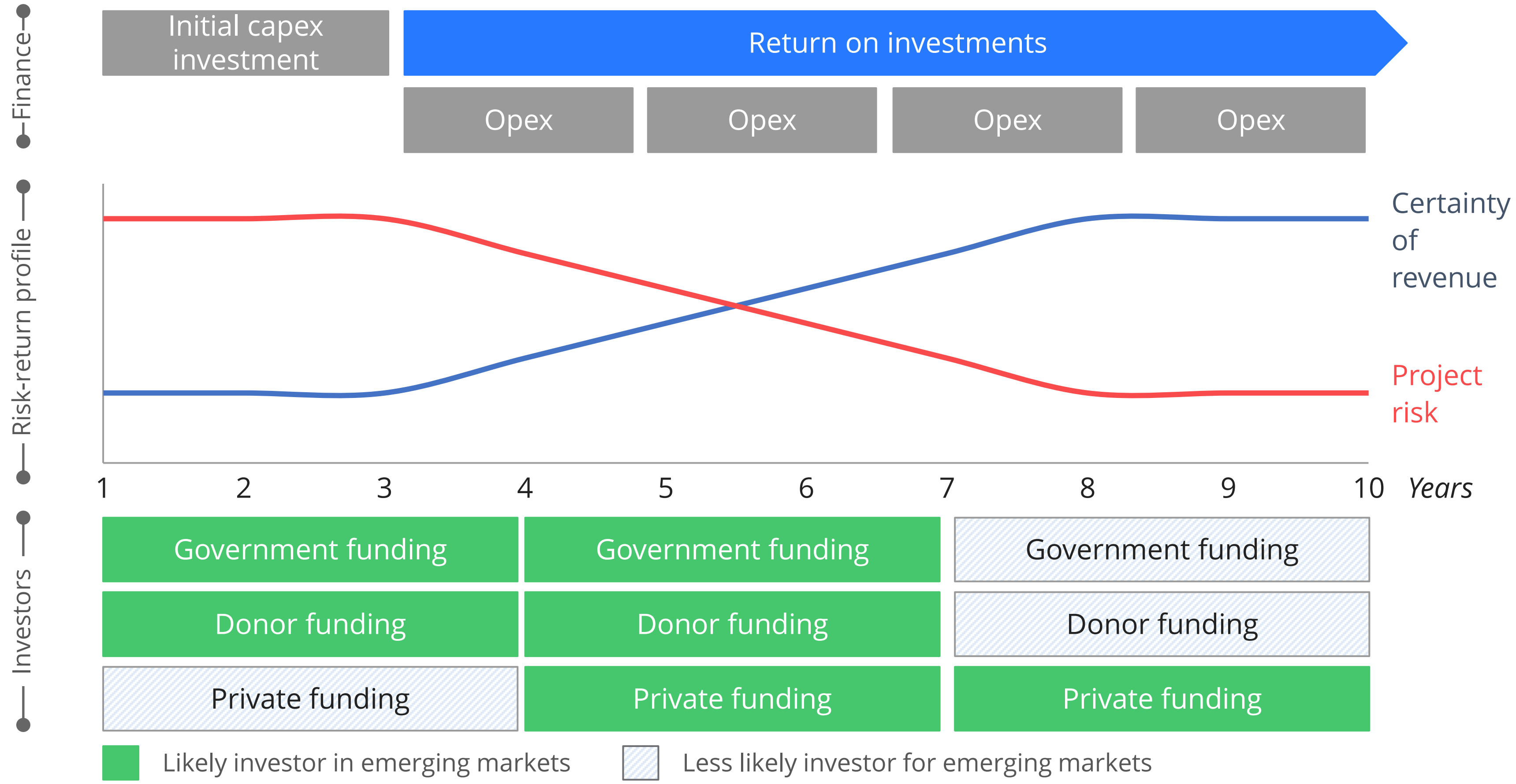
"The government has to play a very, very big role. Private sector involvement is important as well, but the government needs to take lead"

Director at CourseNetworking USA

1. Representing separate organizations
Source: Expert interviews, BCG analysis

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

Illustrative



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

“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 to show a relatively lower risk at that point. There should then be 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

Technology

- Internet speed to enable meaningful connectivity
- Technology options and trade-offs

Cost structure

- Key determinants of costs
- Opex and capex needs

Funding structure

- Funding model and archetypes
- Evolution over time

Operating model

- Setup to execute, build, operate and maintain
- Role of government, companies and community

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

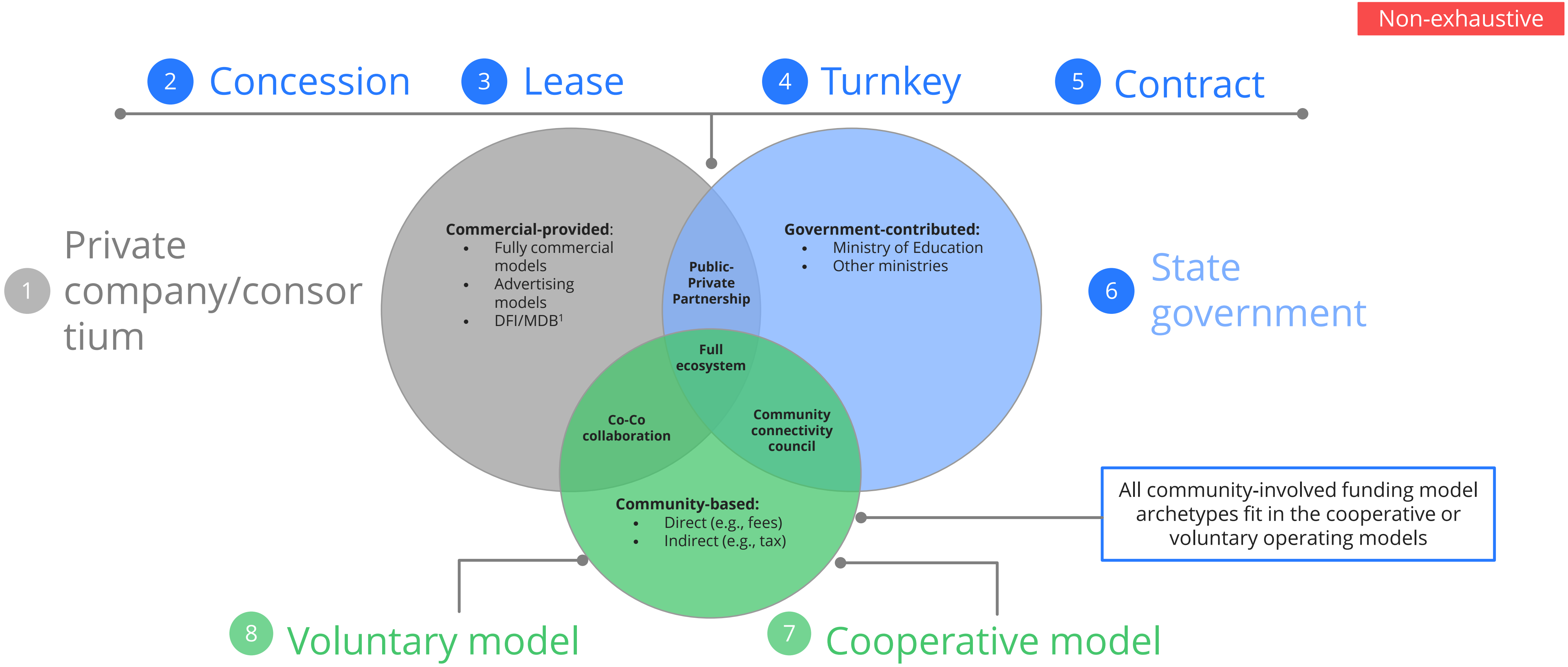
The most typical ways to structure PPP projects are via SPVs or JVs, where the latter is more attractive in case government stays actively involved

Working together with NRENs may be an interesting operating model

NRENs have several attractive features as an operating model in countries with well-connected NRENs

Source: BCG analysis

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



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

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	• BoFiNet (Botswana) • ALTÁN Consortium (Mexico) • Eassy.org (South Africa)
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	• Red Compartida project (Mexico) • Peru RNDFO (Peru) • Chorus UFB (New Zealand)
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	• Magellan Advisors (Colorado, USA) • ZTE (Spain) • Even Telecom (Mexico)
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	• KT Rwanda Networks (Rwanda) • Alcatel Submarine Networks (France)
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	• Cable Consortium of Liberia (Liberia) • Burundi Backbone System (Burundi) • Gamtel (Gambia)

Government-focused

Source: World Bank, Investopedia, UNESCAP, expert interviews, BCG analysis

… 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	• Build-Operate-Own (BOO) • Design-Build-Finance-Operate (DBFO)	Private	Private	Private	Indefinite
Concession[1]	• Franchise • Build-Operate-Transfer (BOT)	Private/public	Private/public	Private/public	3–7 years
Lease[1]	• Build-lease-transfer (BLT) • Lease	Public	Public	Private/public	3–20 years
Turnkey[1]	• Turnkey	Public	Private/public	Private/public	1-3 years
Contract[1]	• Outsourcing • Maintenance/operational management	Public	Public	Private/public	1-5 years
State/government	• Public Design-Build Operate (DBO)	Public	Public	Public	Indefinite

Public | Private | *Private/public*

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

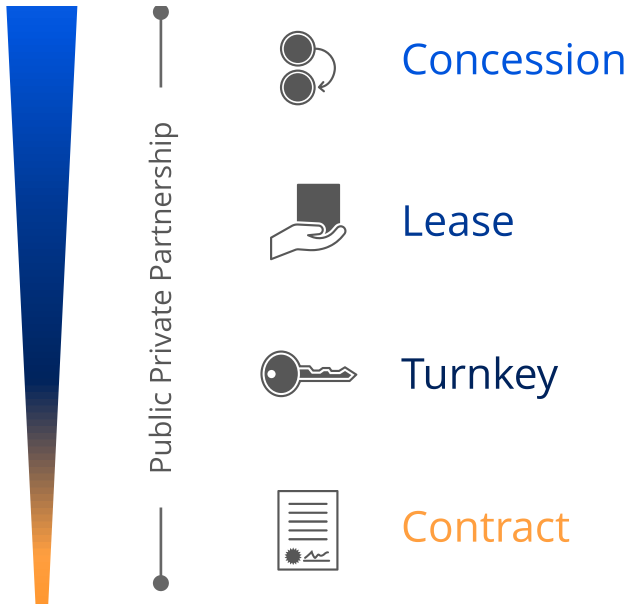
Each management option has its own distinct pros and cons

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

Source: World Bank, Investopedia, UNESCAP, expert interviews, BCG analysis

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

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)

SPV

- 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

JV[1] (PPP)

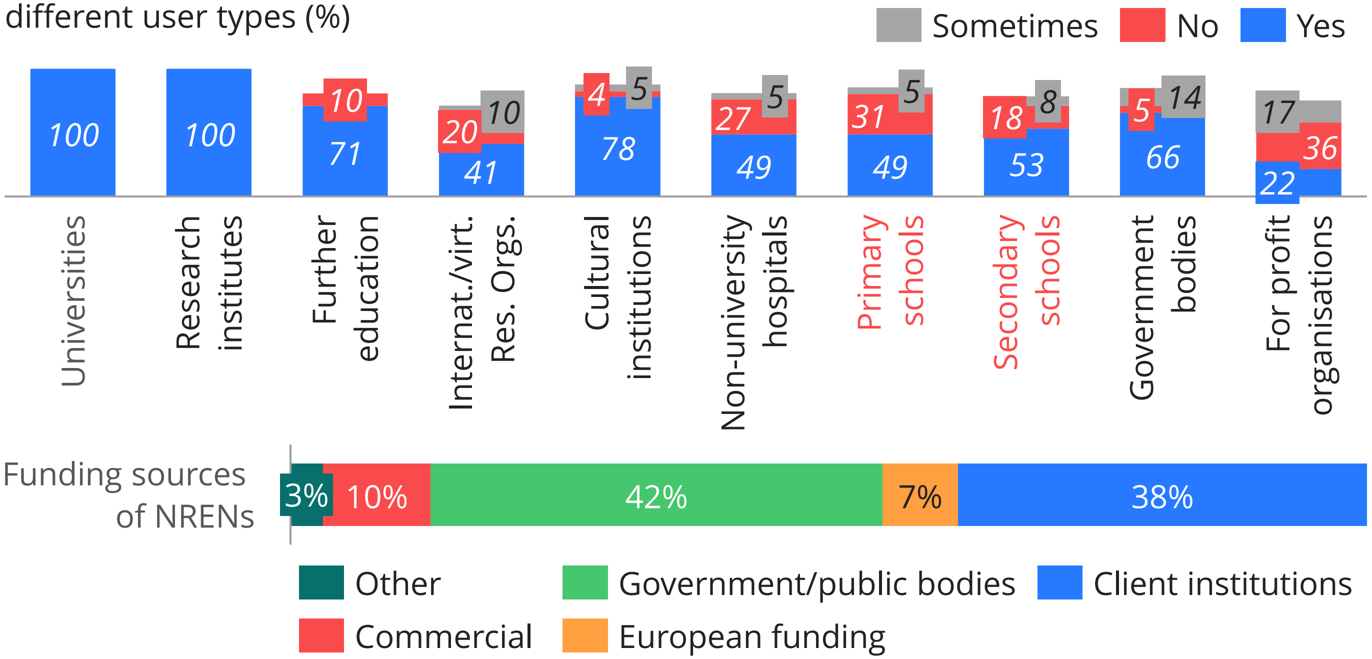
- A Joint Venture is a symbiotic business alliance whereby complimentary resources are mutually shared
- It is often used in case the government wants to ensure a continued interest in the mgmt. and operations of the telecommunication infrastructure
- A JV is easier to incorporate in the parent company, once the private company is ready to take over full ownership and buy-out the government (if applicable)

1. A JV that's not a PPP is also an option. In that case, the JV would be between private parties, who in turn could engage in a PPP with the government via a concession, lease, turnkey or contract; Source: World Bank, Investopedia, expert interviews, BCG analysis

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[1]

Percentage of EU NRENs connecting[2] different user types (%)

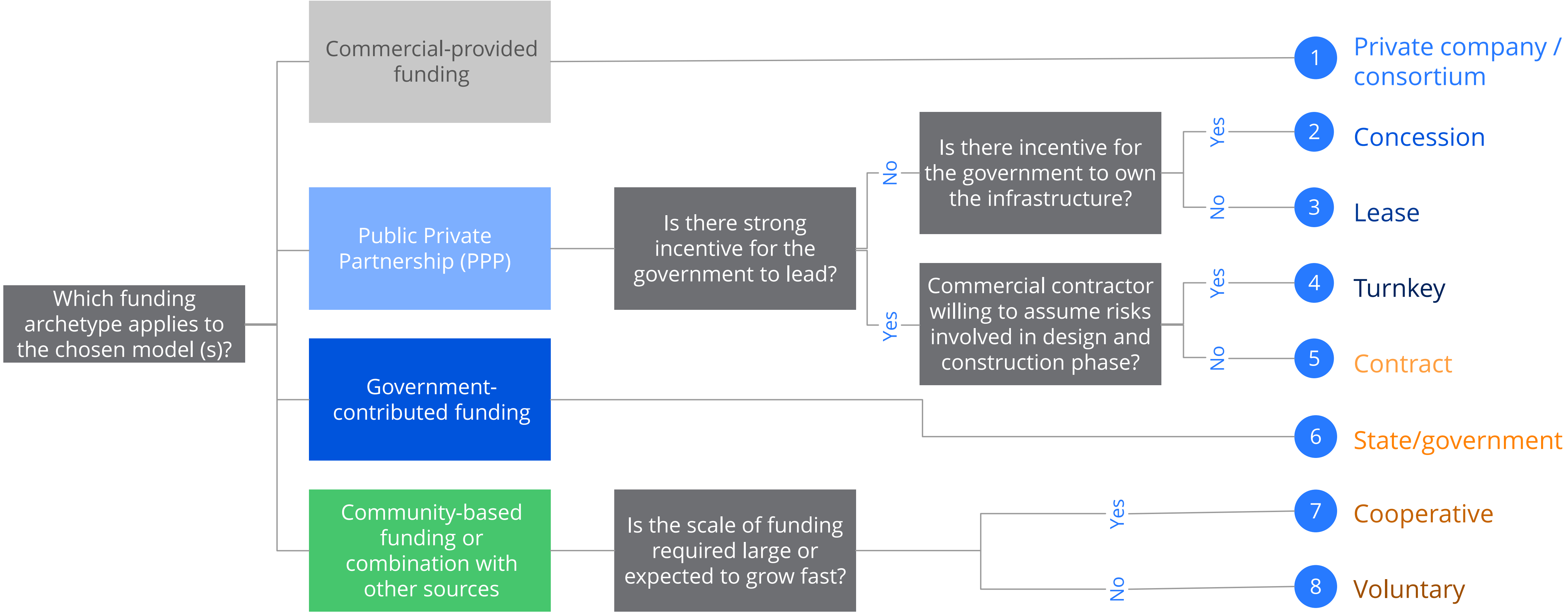


NRENs have several attractive features as an operating model in countries with well-connected NRENs

- 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)



Source: BCG analysis

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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	Apply multiple funding models where possible to minimize funding gap
Merge electrification & connectivity	Provide internet and electricity to increase revenues streams and share costs
Long-term affordability & demand stimulation	Ensure schools (and communities) can sustainably pay for connectivity
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[1]
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	• Urban-rural division in Rwanda and Sierra Leone • North/Northeast vs. other regions in Brazil • Province division in Honduras and Indonesia • South, central and north belts in Nigeria
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.	• This applies to all countries that experience a funding gap when using private-sector only funding
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
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	• Honduras, Kenya, Rwanda and Sierra Leone have internet prices above ITU's recommended level for affordable connectivity (2% of GNI per capita) • Prices in Brazil, Indonesia and Nigeria are below ITU's recommendation, but given inequality, internet is currently unaffordable to many
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.	• Community contribution models could be relevant in specific areas of all countries analyzed
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.	• Funding models such as tax revenue-linked financing, tax exemptions, 5G auctions etc. require government support in countries like Rwanda, Honduras and Brazil • In Nigeria, regulatory asymmetries between states hinders the deployment of country-wide broadband infrastructure

1. Based on case studies conducted (non-exhaustive). Source: BCG analysis

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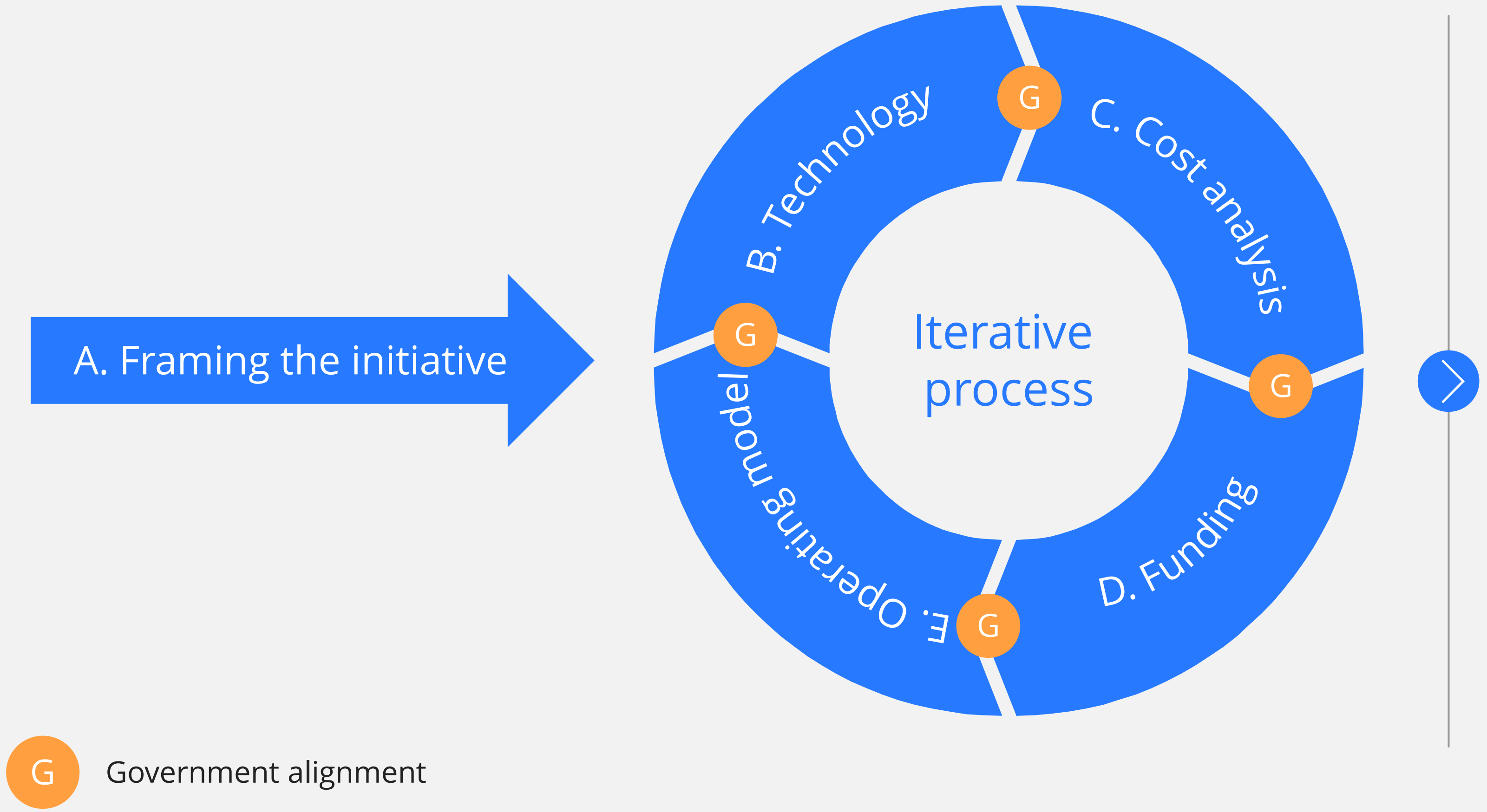
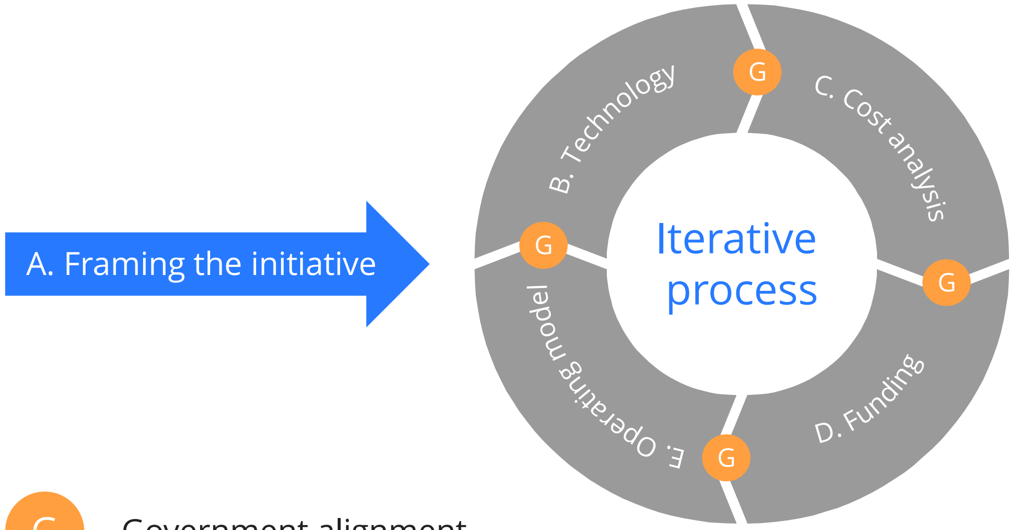
Roadmap for rolling out school connectivity in a country is an iterative 5-step process with frequent government touchpoints



- 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

Source: BCG analysis

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



G Government alignment

> "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**

A. Frame the initiative

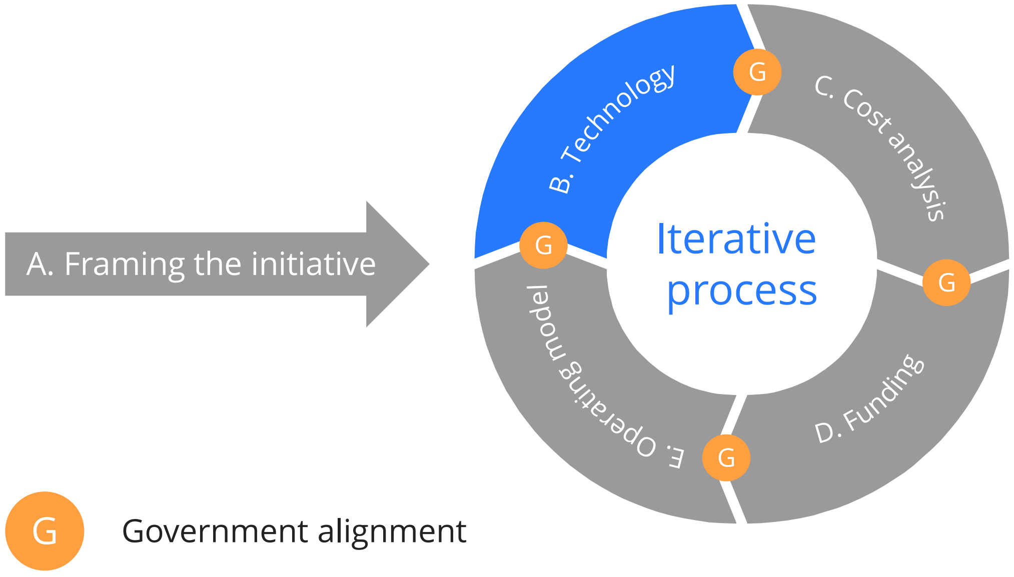
The first step is target-setting. This entails understanding the number of schools without a sufficient internet connection at present, and then setting a target number of schools the project aims to connect. Corralling stakeholders behind this overarching vision of the project and the strategy to get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

Source: BCG analysis

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.

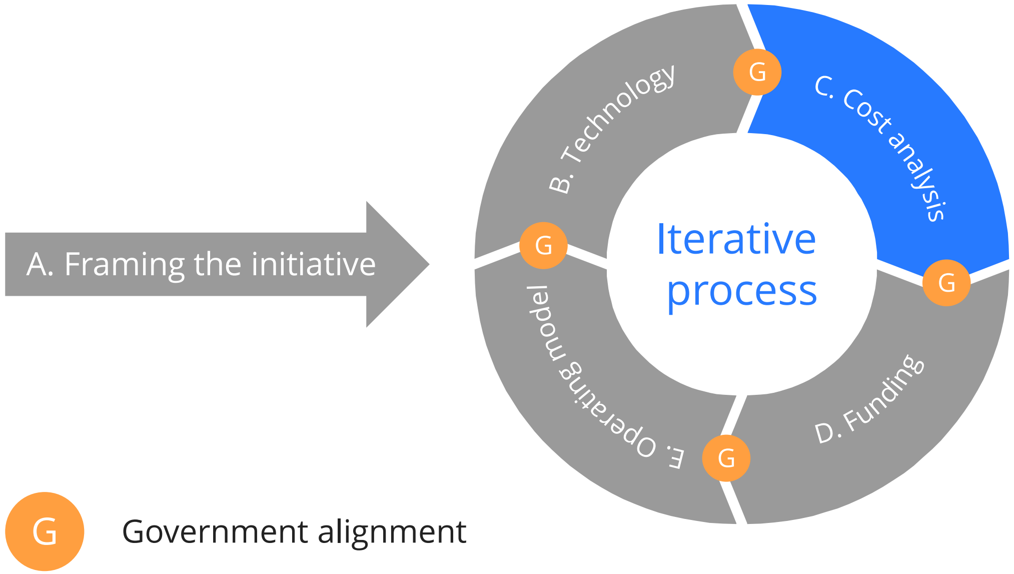
Several parameters should be considered when determining the technology needed to meet these goals. For example, climate, existing backhaul, topography, and remoteness should influence the optimal mix of technology.

RFPs should be sent out to commercial parties in a technology-agnostic 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

Source: BCG analysis

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



> “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**

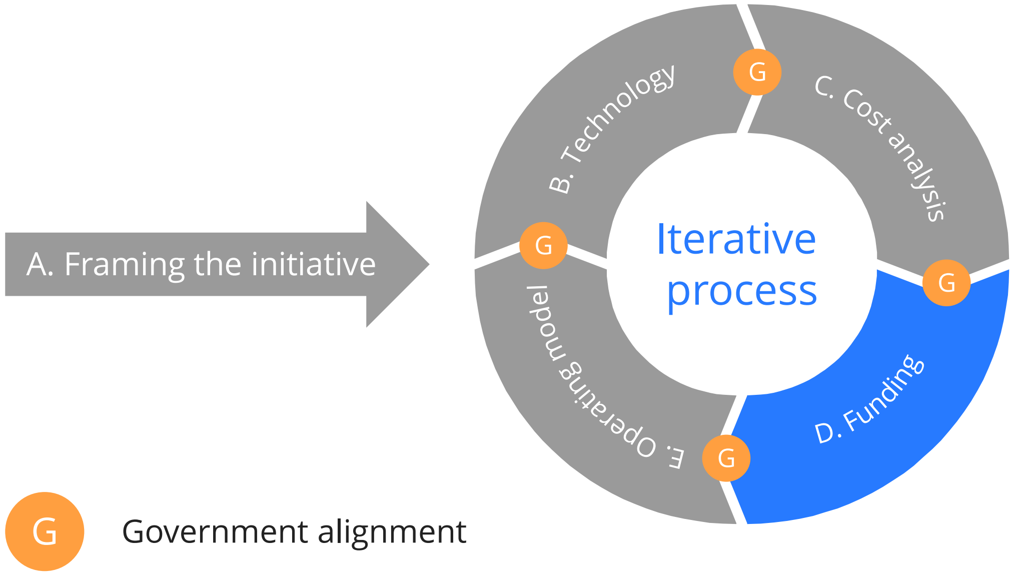
C. Conduct a thorough cost analysis

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.

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

Source: BCG analysis

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



> “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**

D. Investigate potential funding models

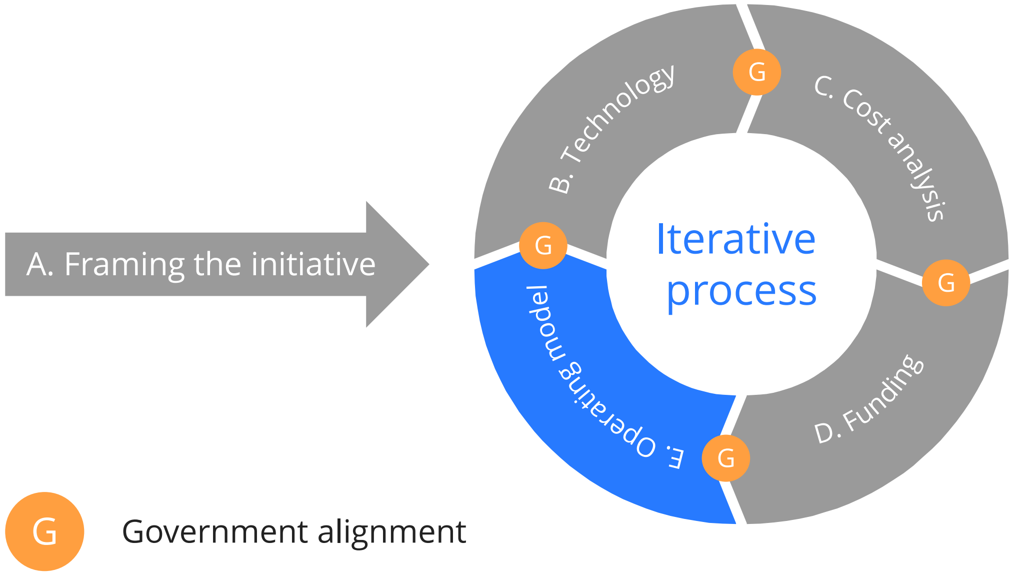
Next determine the 'archetype' that most closely describes the country of interest. Understand macro-level socioeconomic data, the SP landscape, and the relevant legislative environment. Once the 'archetype' has been decided, a decision tree (shown elsewhere) should be followed to identify specific sources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

Source: BCG analysis

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



> "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

Source: BCG analysis

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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 government-owned 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

Source: Expert interviews, GSMA, Softbank, BCG analysis

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 by international organizations”

Partner at Blue like an Orange Sus. Capital

Source: Expert interviews, GSMA, Softbank, BCG analysis

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For more information, contact us at **info@gigaconnect.org**
or through our website **www.gigaconnect.org**

United Nations Children's Fund (UNICEF)

www.unicef.org

3 United Nations Plaza
New York, NY 10017
USA

International Telecommunication Union (ITU)

www.itu.int

Place des Nations
1211 Geneva 20
Switzerland

Boston Consulting Group (BCG)

www.bcg.com

Gustav Mahlerlaan 40,
1082 MC Amsterdam
Netherlands