January 2024

Market assessment

Connectivity solutions for schools in Eastern, Western and Southern Africa

Disclaimer

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While Giga is an initiative of the ITU and UNICEF, the descriptors, lexicon and focus of the market assessment is that of UNICEF's Supply Division alone, with its many years of experience creating healthier sustainable markets for products and services that help children to survive and to thrive.

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Executive Summary

To support Giga with positively influencing the school connectivity market in Africa, a market assessment has been conducted in 9 focus countries in Eastern, Western and Southern Africa

Introduction

- "**Giga**" is an initiative from UNICEF and the International Telecommunication Union (ITU), which has the aim to **connect all schools in the world to the internet** by 2030
- To achieve this objective, Giga **designs and recommends interventions** to positively influence the market and improve access to affordable and quality school connectivity
- To support Giga with **positively influencing the market** for school connectivity in **Eastern, Western and Southern Africa**, a **market assessment** is conducted
- The **scope** of the market assessment is focused on **9 focus countries**[1], on the **last-mile connectivity market** and on the **fiber, wireless and satellite connectivity** market segments

Approach

- The market assessment is based on **desk research** and **interviews with connectivity suppliers** and **subject matter experts** (e.g. from UNICEF, ITU, Deloitte). Furthermore, an **industry consultation** has been conducted at **Africa Tech Festival** (November 2023) to discuss and validate the main findings
- The market assessment is built bottom-up from a **country-level** assessment of the connectivity market in the **9 focus countries**, which is brought together in a **regional synthesis** for each of the three regions (EAC, ECOWAS and SADC[2]) as well as an **overarching overview** of the identified barriers, root causes and recommended actions
- In each of the 9 focus countries, the market assessment provides insights into the **broader context** (e.g. connectivity status, access to electricity), **the fiber, wireless & satellite market segments** (e.g. market players, pricing, trends) and the **enabling environment** (e.g. regulations, access to finance)
- Subsequently, the **market health** is assessed based on **UNICEF's 7 market dimensions**[3] resulting in an overview of the identified **market shortcomings** and their **root causes**
- **Recommended actions** for Giga on how to positively influence the market by addressing the identified root causes are provided **on a regional level** (in the regional syntheses), and are linked to **UNICEF's 4 market-shaping levers**[4]

General market characteristics

- Overall, in the school connectivity markets across the 9 focus countries, it has been found that the **availability of connectivity solutions** as well as the **experienced barriers to school connectivity differ** for **urban**, **semi-urban** and **rural areas**
- In **urban areas,** the **fiber** backbone extends to all main urban areas across the country, and **mobile** (mostly 4G) connectivity is also available. Because of high population density and high level of commercial activity, **profitability of suppliers** in urban areas is **generally high**, which **facilitates the provision of school connectivity**. However, in some countries (e.g. Malawi, Sierra Leone, Zimbabwe), also in urban areas there are significant barriers to school connectivity such as the affordability of connectivity and a lack of access to electricity

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Notes: 1) Kenya, Rwanda, Nigeria, Sierra Leone, Benin, South Africa, Botswana, Malawi, Zimbabwe; 2) the East African Community (EAC) assessment covers Kenya and Rwanda, the Economic Community of West African States (ECOWAS) assessment covers Nigeria, Sierra Leone and Benin, and the Southern African Development Community (SADC) assessment covers South Africa, Botswana, Malawi and Zimbabwe; 3) Acceptability, affordability, availability, competition, delivery, funding security and quality; 4) Increase market information, reduce transaction costs, balance supplier & buyer risks and improve access to finance & technology

Executive Summary

The school connectivity market varies between urban and rural areas, with large MNOs driving the market and new technologies emerging in the market (e.g. LEO satellite internet)

General market characteristics *(continued)*

- In **semi-urban / semi-rural areas,** deploying fiber often is a challenge given the larger distances between customers and the scaling of deployment costs, but there is often **mobile** coverage (3G/4G) and Fixed Wireless Access (**FWA**). However, the lower density of population, businesses and schools **reduce the profitability of suppliers** and their economic incentive to invest in deploying infrastructure. Besides the fact that the barriers of affordability and access to electricity are more severe further away from the main urban areas, there are also additional barriers such as higher cost of providing maintenance & after-sales support and access to finance for infrastructure investments

- Lastly, in each of the 9 focus countries, there are **rural & remote areas** where there is often **no fiber or mobile network available** and **satellite internet** is **perceived as the most viable connectivity option**. In these deep rural areas, **connecting schools** in the 9 focus countries is considered **difficult**, given that the high **fragmentation of demand** and **challenging natural environment** results in **low revenue density** and **high investment & operating costs for suppliers**. As for satellite connectivity, affordability of connectivity, providing maintenance & after-sales and security of equipment are considered significant challenges

Market players

- The **connectivity market** in the 9 focus countries is largely concentrated in the **mobile segment of the market (3G/4G)**. Fiber internet connectivity only covers a small percentage of the overall connectivity market. The satellite internet market is emerging in most countries, and the entrance of LEO satellite internet (e.g. Starlink, Eutelsat OneWeb, Amazon Project Kuiper) could provide a competitive new connectivity solution

- In most focus countries, the **connectivity market** is mostly driven by **2 or 3 Mobile Network Operators (MNOs)** and in **some countries** there is a **one dominant MNO** with a **>60% market share** (e.g. Safaricom in Kenya, MTN in Rwanda, Econet in Zimbabwe)

- Besides the MNOs, there are often a **significant number of Internet Service Providers (ISPs)** offering fiber, mobile or satellite connectivity directly to customers, but most ISPs are small and operate locally

Market trends

- Overall, across the focus countries the **affordability of connectivity is increasing** when considering the price of connectivity as percentage of Global Net Income (GNI) per capita, with the price of **mobile** connectivity **nearing Broadband Commission's target** of 2% of GNI per capita in many countries. However, in some countries (e.g. Malawi, Zimbabwe) this target is still far away

- The entrance of **LEO satellite internet** is considered a promising trend in the connectivity market, given that it can provide a **competitive solution particularly in (semi-)rural areas** and that it will increase the **level of competition** in the market

- Other **technology trends** include the **roll-out of 5G** by the main MNOs as well as more **niche connectivity solutions** such as **community networks** and Fixed Wireless Access (FWA) using **unlicensed frequencies** (e.g. TV White Space) which could serve as a **low-cost connectivity solution** for **underserved areas**

Note: 1) Increase market information, reduce transaction costs, balance supplier & buyer risks and improve access to finance & technology

Executive Summary

Barriers to school connectivity range from digital literacy to affordability of connectivity and access to finance, and a total of 37 root causes underlying these barriers have been identified

Barriers to school connectivity

- A distinction is made between **usage gap** (i.e., percentage of schools which are covered by a good-quality internet network (>3G) but are not connected) and **coverage gap** (i.e., percentage of schools which are not covered by a good-quality internet network (>3G))
- In **6 of the 9 focus countries** (Kenya, Rwanda, Nigeria, Benin, South Africa and Botswana), the **coverage gap is relatively small** (<20% of schools) and the **key barriers exist in closing the usage gap**
- In **3 of the 9 focus countries** (Sierra Leone, Malawi, Zimbabwe) on the other hand, there are not only key barriers in the usage gap for schools that are covered by a good-quality network but **also significant barriers to increase network coverage and close the coverage gap**
- To overcome the **usage gap, access to electricity, affordability of connectivity & devices, security of connectivity equipment & devices** and **providing maintenance & after-sales support** are considered some of the main barriers for school connectivity across the 9 focus countries, and these are particularly severe in **rural areas**
- To overcome the **coverage gap,** a lack of **business viability** for suppliers to invest in infrastructure and **access to finance** are considered some of the main barriers

Market shortcomings & root causes

- A **variety of market shortcomings** and a **total of 37 root causes** have been identified across the 9 focus countries, which can be addressed by Giga to positively influence the market and help suppliers provide more connectivity to schools
- **Examples** of identified root causes include a **high cost of wholesale internet prices** (e.g. because of countries being landlocked or limited competition in the middle-mile market), **high cost of networking equipment** (e.g. because of import duties, inflation, lack of foreign currency/unfavorable exchange rates), and a **lack of access to finance for smaller players** (e.g. because of difficulty to access Universal Service Fund (USF) funding, development aid or private sector financing)
- In the **EAC region,** some important root causes include the **perceived hesitance from schools & teachers to transition to digital learning as experienced by suppliers,** the **lack of electricity infrastructure**, **limited competition in the mobile market** and **theft or vandalism** of equipment, devices & energy infrastructure
- In the **ECOWAS region,** root causes of market shortcomings revolve around a **high price of connectivity** due to **high inflation, limited competition in the first-mile** and **high cost for maintenance & after-sales support** to customers. Furthermore, root causes underlying the **difficulty of expanding network coverage** include the **lack of access to affordable finance** and the **low business viability to expand to rural areas** for suppliers given the low population density, low disposal income per capita and challenging natural environment

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Note: 1) Increase market information, reduce transaction costs, balance supplier & buyer risks and improve access to finance & technology

Executive Summary

A total of 30 recommended actions are provided to address the root causes and positively influence the market

Market shortcomings & root causes *(continued)*

- In the **SADC region,** there are **major differences** in the market shortcomings and root causes experienced across countries. In **South Africa**, the **low reliability of electricity infrastructure** and **theft & vandalism** are some of the main root causes for the remaining usage gap. In **Botswana,** the **high price of connectivity** given that the country is **landlocked** and **high cost for infrastructure development & maintenance** are some of the main challenges. In **Malawi and Zimbabwe,** important root causes include the **high inflation** and the **lack of access to foreign currencies** (e.g. US dollars), which is **reflected in the high cost of importing equipment, lack of electricity** and **lack of access to affordable finance**

Recommended actions

- A variety of possible solutions have been identified resulting in a **total of 30 recommended actions for Giga**
- **Examples** of recommended actions (for each of UNICEF's 4 market-shaping levers[1]) include:

  - **Increase market information**: for example, include the proximity of other potential customers (town hall, health clinic, etc.) and proximity of existing infrastructure/electricity in Giga's connectivity map of schools, or create a dashboard with prices for school procurement contracts to help governments benchmark what an appropriate price is

  - **Reduce transaction costs**: for example, look for opportunities for (cross country) pooled procurement of last-mile school connectivity and devices to bring down prices

  - **Balance supplier & buyer risk**: for example, establish long-term agreements (5-10 years) with Internet Service Providers (ISPs) to reduce their risk and ensure return on investment

  - **Improve access to finance & technology**: for example, create more operational expenditure (OPEX)-oriented financing vehicles to cover the recurring costs of connectivity (e.g. to accommodate for satellite connectivity)

Potential next steps

- A '**catalogue of recommended actions**' has been developed, covering all 30 identified recommended actions, for consideration by the Giga team. This catalogue can serve as a **starting point**, from which the Giga team should assess which of the proposed actions will be pursued and when
- After **prioritizing** the **market-influencing actions**, a **roadmap** should be defined to plan the activities in time (from short-term to long-term)
- Lastly, the Giga team is encouraged to leverage the **relationships with suppliers** as developed during the market assessment (through interviews and industry consultation), and to **continue strengthening the collaboration** among governments, market players and other relevant organizations to further capitalize on the recommendations

Note: 1) Increase market information, reduce transaction costs, balance supplier & buyer risks and improve access to finance & technology

2 **Introduction**
Objectives, approach and scope

Introduction

As part of the Giga initiative, UNICEF is interested in gaining a better understanding of the market of connectivity solutions for schools in Eastern, Western and Southern Africa regions

Background

- Currently **more than 80 percent of schools** in Africa **do not have access to the internet**[1]
- This **lack of connectivity deprives African children** from digital resources, the possibility of remote learning, and the chance **to develop digital skills which are crucial for their future**
- To tackle the digital school divide, UNICEF and the International Telecommunication Union (ITU) launched the **"Giga" initiative**
- Giga has the objective to **connect all schools in the world by 2030** through supporting governments to **contract for connectivity**, among other strategies
- Leveraging UNICEF's expertise in promoting healthy markets, **Giga designs and recommends interventions to improve access to affordable and quality school connectivity**

Aim of the study

- To support Giga with developing adequate interventions, **a market assessment is conducted** into **the market structures**, **market actors**, **market dynamics** and **market health**
- Insights are derived from a combination of desk research and input from subject matter experts from UNICEF, Deloitte and ITU and **interviews with connectivity suppliers**
- Based on these insights, **market shortcomings and root causes** are identified as a foundation for recommended actions to positively influence the connectivity markets
- The research approach is **further detailed on the next page**

Scope

- The study focusses on **9 focus countries** across the EAC, ECOWAS and SADC regions. The focus countries are presented on page 9. The country-level insights are brought together in a **regional assessment** for each of the 3 regions
- The focus of the school connectivity market assessment is on **last-mile connectivity solutions** using fixed, wireless and satellite technologies
- Based on Giga's definition of meaningful connectivity (target of 20 Mpbs download) and the ambition to stimulate scalable and futureproof solutions for school, the connectivity technologies in scope include **optic fiber, 4G/5G cellular internet and GEO- and LEO-satellites**. The selection of technologies is further detailed on pages 11.
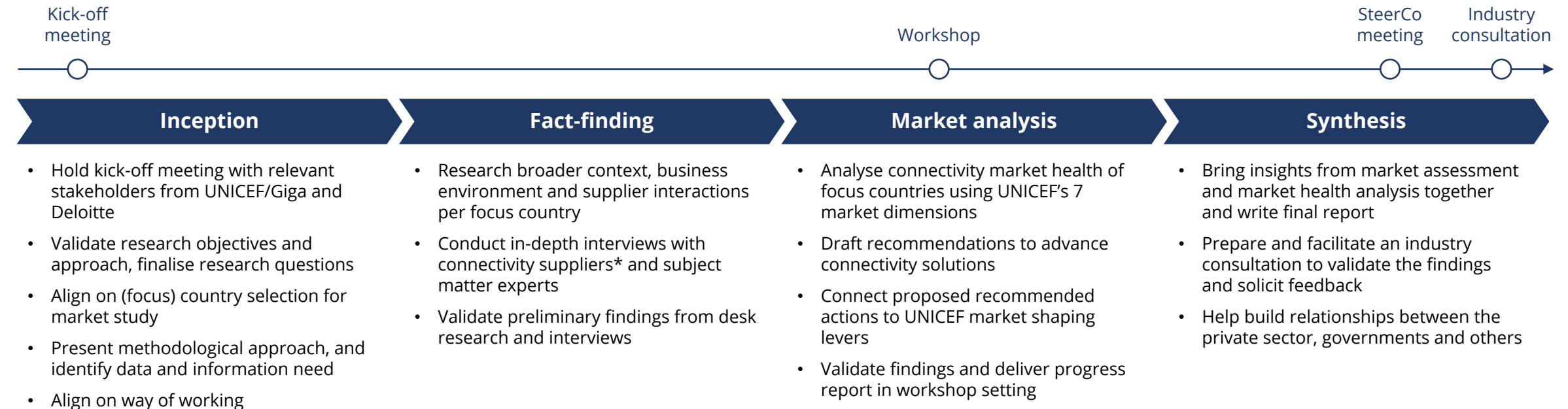
On the next pages the approach and scope of the project is further detailed. Chapter 3 contains the overarching insights from the study which provide a summary of the identified barriers, market shortcomings and root causes and a catalogue of recommended actions. Chapters 4, 5 and 6 include the underlying insights from the EAC-, ECOWAS- and SADC-region.

Note: 1) As estimated by Giga based on Giga's Project Connect data

Approach

We have assessed the market for school connectivity solutions in 9 focus countries through desk research and in-depth interviews, and developed possible options for market-shaping

Project timeline

Kick-off meeting · Workshop · SteerCo meeting · Industry consultation

Inception	Fact-finding	Market analysis	Synthesis
• Hold kick-off meeting with relevant stakeholders from UNICEF/Giga and Deloitte • Validate research objectives and approach, finalise research questions • Align on (focus) country selection for market study • Present methodological approach, and identify data and information need • Align on way of working	• Research broader context, business environment and supplier interactions per focus country • Conduct in-depth interviews with connectivity suppliers* and subject matter experts • Validate preliminary findings from desk research and interviews	• Analyse connectivity market health of focus countries using UNICEF's 7 market dimensions • Draft recommendations to advance connectivity solutions • Connect proposed recommended actions to UNICEF market shaping levers • Validate findings and deliver progress report in workshop setting	• Bring insights from market assessment and market health analysis together and write final report • Prepare and facilitate an industry consultation to validate the findings and solicit feedback • Help build relationships between the private sector, governments and others

*Please note: the market assessment reflects the **perspective of connectivity suppliers** as retrieved through interviews, complemented with desk research. The insights have been validated with subject matter experts from UNICEF, ITU and Deloitte, but have not been confirmed with governments or schools*

Scope | Focus countries

The focus is on a selected number of focus countries, with significant differences in terms of network coverage and affordability
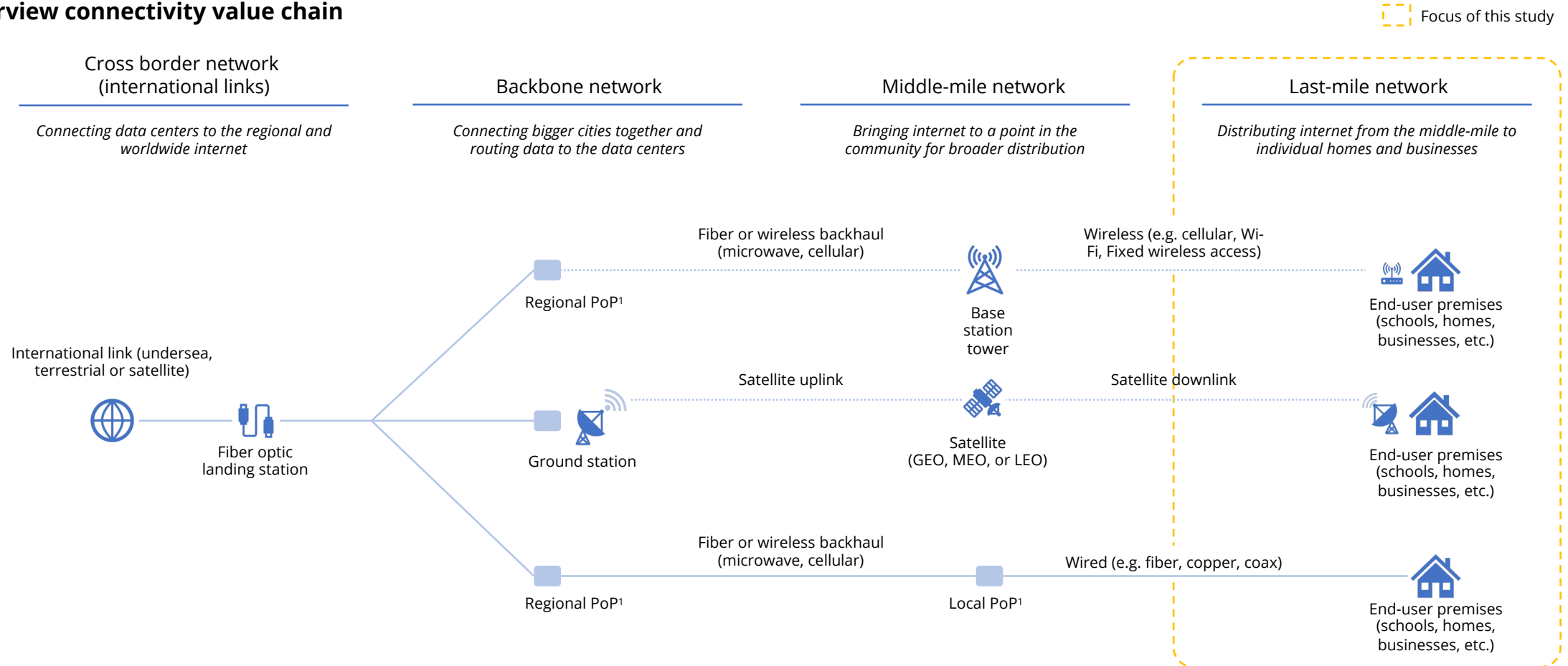
Overview of focus countries

	EAC		ECOWAS				SADC		
Country	Kenya	Rwanda	Nigeria	Sierra Leone	Benin	South Africa	Botswana	Malawi	Zimbabwe
Population (millions)	56.8	13.8	219.5	8.4	13.0	61.1	2.5	20.5	15.5
• Population per km^2	97	571	246	122	122	50	5	222	43
• Rural Population (% of total)	72%	82%	47%	57%	51%	32%	28%	82%	68%
GNI per capita ($PPP) [1]	5.680	2.730	5.650	1.900	4.020	15.570	17.590	1.700	2.460
Mobile Connectivity Index 2022 [2]	51	42	52	35	40	67	56	34	38
4G network coverage (% of population)	97%	99%	81%	49%	46%	98%	91%	70%	40%
Households with internet access (%)	18%	9%	8%	14%	5%	77%	63%	10%	50%
Internet use (% of population)	29%	30%	55%	18%	34%	72%	73%	24%	35%
Direct access to submarine cables	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*

Note: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production; 2) The GSMA Mobile Connectivity Index measures the performance of countries against key enablers of mobile internet adoption on a range of 0 to 100, with a higher score representing stronger performance
Source: ITU, GSMA Mobile Connectivity Index 2022, OECD, World Population Review

Scope | Connectivity value chain

The focus of the school connectivity market assessment is on last-mile connectivity solutions

Overview connectivity value chain

Cross border network (international links)	Backbone network	Middle-mile network	Last-mile network
Connecting data centers to the regional and worldwide internet	*Connecting bigger cities together and routing data to the data centers*	*Bringing internet to a point in the community for broader distribution*	*Distributing internet from the middle-mile to individual homes and businesses*

Fiber or wireless backhaul (microwave, cellular)

Wireless (e.g. cellular, Wi-Fi, Fixed wireless access)

Regional PoP[1]

Base station tower

End-user premises (schools, homes, businesses, etc.)

International link (undersea, terrestrial or satellite)

Satellite uplink

Satellite downlink

Fiber optic landing station

Ground station

Satellite (GEO, MEO, or LEO)

End-user premises (schools, homes, businesses, etc.)

Fiber or wireless backhaul (microwave, cellular)

Wired (e.g. fiber, copper, coax)

Regional PoP[1]

Local PoP[1]

End-user premises (schools, homes, businesses, etc.)

Note: 1) PoP stands for point-of-presence, which is a physical location at which two or more networks or communication devices share a connection
Sources: Adapted from ITU & Giga sources

Scope | Last-mile connectivity technologies

The focus is on Fiber, 4G/5G, Fixed Wireless Access and Satellite technologies for achieving future-proof and meaningful school connectivity

Legend:
- 🟩 Most suitable technology
- ⬜ Discarded[1]

	Fixed		Wireless			Satellite	
	Copper / coaxial	Fiber	2G/3G	4G/5G (Mobile cellular)	Fixed Wireless Access (FWA)	GEO	LEO
Key characteristics							
Investment costs	Medium to high	Medium to high	Medium	Medium	Low to medium	Low (for end-user terminals)	Low (for end-user terminals)
Recurring costs	Low to medium	Low to medium	Medium to high	Medium to high	Low	High	High
Quality (Speed of Service)	Copper: up to 200 Mbps Coaxial: up to 1,000 Mbps	100 – 1,000 Mbps	Up to 42 Mbps	Up to 1,000 Mbps	20 – 1,000 Mbps	5 – 150 Mbps	25 – 220 Mbps
Required infrastructure	Tower, poles, cabinets, network equipment	Subterranean duct work or tower & poles (overhead), cabinets, network equipment	Towers, radio equipment	Towers, radio equipment	Towers, radio equipment	Ground station, satellite, antenna	Ground station, satellite, antenna
Scalability	Requires existing middle-network; last-mile investment costs increases with distance	Requires existing middle-network; last-mile investment costs increases with distance	Requires existing middle-mile infrastructure; high scalability of last-mile connectivity	Requires existing middle-mile infrastructure; high scalability of last-mile connectivity	Requires existing middle-mile infrastructure; high scalability of last-mile connectivity	No dependence on local middle-mile infrastructure, high scalability of last-mile connectivity	No dependence on local middle-mile infrastructure, high scalability of last-mile connectivity
Other considerations	Right of way (access rights of landowners)	Right of way (access rights of landowners)	Requires spectrum licenses	Requires spectrum licenses	Requires line-of-sight	Signal affected by weather, lower quality compared to other options (high latency)	Increased electricity consumption compared to GEO
Suitability for school connectivity							
Urban	Discarded since fiber offers a better cost/quality trade-off (less costly, more energy efficient, higher quality)	High, high-quality connectivity solution	Not considered adequate for meaningful school connectivity because of quality	High, lower-cost connectivity solution	Medium, as FWA requires line-of-sight	Low, costs are higher than for fiber/wireless	Low, costs are higher than for fiber/wireless
Semi-urban / semi-rural		Medium, as investment scales with distance		High, suitable for semi-urban areas	High, offering lower-cost connectivity solution	Low, wireless is more cost effective	Low, wireless is more cost effective
Rural & remote		Low, as investment scales with distance		Low, due to low business viability to deploy tower	Medium, as requires many individual point-to-point connections	High, no dependence on existing local middle-mile	High, no dependence on existing local middle-mile

Note: 1) These connectivity solutions have been discarded as they are not considered to be capable of providing meaningful school connectivity that is sustainable for the long term (as per the 20 Mbps target as established by Giga) and other solutions are preferred; Sources: ITU, Giga, interviews, Deloitte analysis

Definitions | Market dimensions & market levers

The market assessment is based on UNICEF's approach to influencing markets, where markets are assessed on 7 market dimensions and can be influenced through 4 market-shaping levers

UNICEF's 7 Market Dimensions

Dimension	Desired situation
Acceptability	Products are culturally appropriate and well-adapted for low-income settings
Affordability	Prices are low enough to meet government's ability & willingness to pay
Availability	Sufficient volumes of appropriate connectivity solutions are available and easily accessible
Competition	There is a competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)
Delivery	Products & services are delivered reliably, cost effectively and on time
Funding security	Market players have sufficient access to finance
Quality	Products meet quality standards

UNICEF's 4 Market-shaping Levers
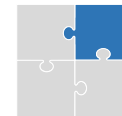
Increase market information: helping businesses assess the market potential and identify market opportunities, through demand forecasting and information communication
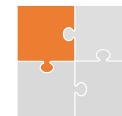
Reduce transaction costs: lowering the cost of delivering products & services through pooled procurement (resulting in greater economies of scale), variant optimization (resulting in streamlined demand) and/or harmonizing quality standards (lowering barriers to entry)

Balance supplier & buyer risks: making contracts more attractive or feasible through special contracts with non-standard terms (e.g., financing structures)
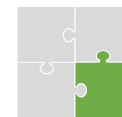
Improve access to finance & technology: supporting suppliers with gaining access to finance & technology through local industry engagement and supplier financing

Sources: Giga, UNICEF

3 **Overarching insights from assessment**
Barriers, market shortcomings & recommended actions
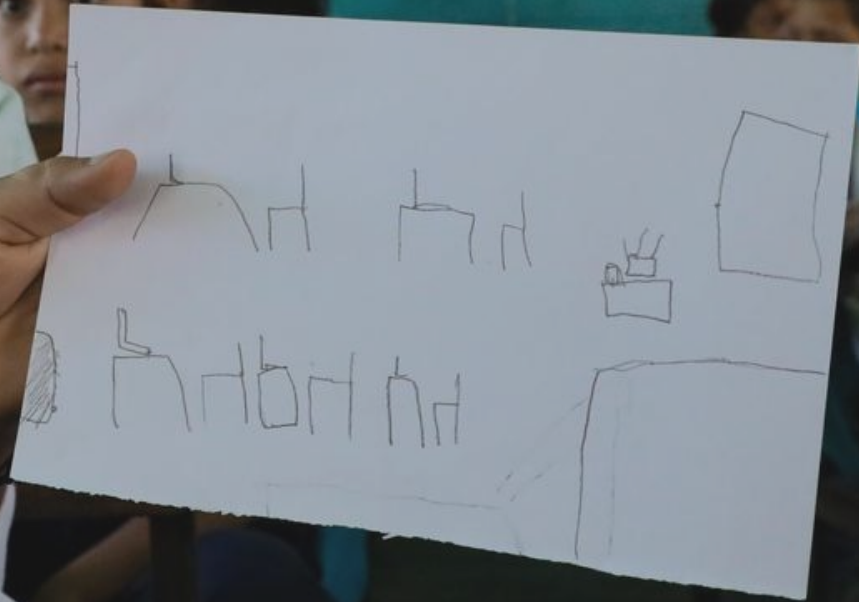
Overview

The assessment is built bottom-up from a country-level assessment of the connectivity market in the 9 focus countries, into regional syntheses and an overarching overview

Overview of the market assessment

1 Country-level market assessments

For each of the **9 focus countries**, a combination of desk research and interviews (21 in total*) provide insights in the identified **market shortcomings and root causes** for each country, structured by UNICEF's 7 market dimensions[1]
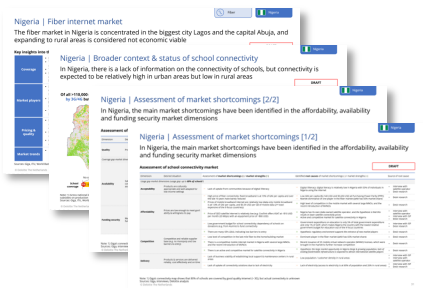
2 Regional assessment & possible solutions

The country-level insights are brought together in a **regional assessment** for each of the 3 regions: **EAC, ECOWAS and SADC**. Based on the market assessment, **possible actions** for how Giga can help address the market shortcomings are put forward, linked to UNICEF's 4 market-shaping levers[2]
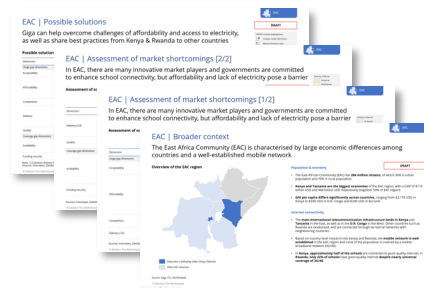
3 Overarching insights & catalogue of recommended actions

Lastly, the **overarching insights** provide a summary of the identified **barriers**, **market shortcomings & root causes** and a **catalogue of recommended actions**
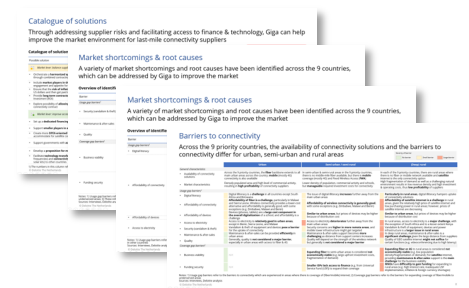
Synthesis

Synthesis

** Please note: the market assessment reflects the **perspective of connectivity suppliers** as retrieved through interviews, complemented with desk research. The insights have been validated with subject matter experts from UNICEF, ITU and Deloitte, but have not been confirmed with governments or schools*

Notes: 1) Acceptability, affordability, availability, competition, delivery, funding security and quality; 2) Increase market information, reduce transaction costs, balance supplier & buyer risks and improve access to finance & technology

Barriers to school connectivity

The availability of connectivity solutions and the barriers to school connectivity[1] vary across the 9 focus countries and differ for urban, semi-urban and rural areas

Severity of barrier

| | No barrier | Small barrier | Large barrier |
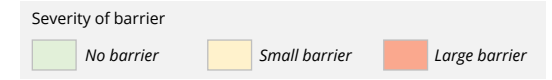
	Urban	Semi-urban / semi-rural	Rural & remote
General characteristics			
• Availability of connectivity solutions	Across the 9 focus countries, the **fiber** backbone extends to all main urban areas across the country; **mobile** (mostly 4G) connectivity is also available	In semi-urban & semi-rural areas in the 9 focus countries, there is often no middle-mile fiber available, but there is **mobile** coverage (3G/4G) and Fixed Wireless Access (**FWA**)	In each of the 9 focus countries, there are rural areas where there is often no fiber or mobile network available and **satellite** internet is perceived as the most viable connectivity option
• Market characteristics	Densely populated area and high level of commercial activity, resulting in **high profitability** of connectivity suppliers	Lower density of population, commercial activity and schools, but **manageable** required investment costs for connectivity	High fragmentation of demand as well as a challenging natural environment results in low revenue density and high investment & operating costs, thus **low profitability** of suppliers
Usage gap barriers[2]			
• Digital literacy	Digital illiteracy is a **challenge** in all countries except South Africa and Botswana	The issue of digital illiteracy **increases** further away from the main urban areas	**Particularly in rural & remote areas**, digital illiteracy hampers uptake of connectivity solutions
• Affordability of connectivity	**Affordability of fiber is a challenge**, particularly in Malawi and Sierra Leone. Wireless connectivity provides a lower-cost alternative and affordability is generally good, with some exceptions (e.g. Zimbabwe, Malawi and Benin)	**Affordability of wireless connectivity is generally good**, with some exceptions (e.g. Zimbabwe, Malawi and Benin)	**Affordability of satellite internet is a challenge** in rural & remote areas, given the relatively high price of satellite internet and low purchasing power in rural areas; however, prices of satellite internet are decreasing
• Affordability of devices	Devices (phones, tablets) are a **large cost component in the overall digitalization** of a school, and affordability is a challenge	**Similar to urban areas**, but prices of devices may be higher because of distribution cost	**Similar to urban areas**, but prices of devices may be higher because of distribution cost
• Access to electricity	Access to electricity is **relatively good in urban areas**, except in Benin, Sierra Leone, and Malawi	Access to electricity **deteriorates** further away from the main urban areas	In rural areas, access to electricity is a **major challenge**, with the exception of South Africa and to a lesser extent Kenya
• Security (vandalism & theft)	Vandalism & theft of equipment and devices **pose a barrier** for the uptake of connectivity	Security concerns are **higher in more remote areas**, and mobile tower infrastructure might get targeted	Vandalism & theft of equipment, devices and power infrastructure is a **larger issue in rural areas**
• Maintenance & after-sales	Maintenance & after-sales can be provided **efficiently** in urban areas	Maintenance & after-sales support becomes **more challenging** as distance from support centers increases	In rural & remote areas, maintenance & after-sales is a **significant challenge** given the large distance from suppliers
• Quality	Generally, quality is **not considered a major barrier**, especially in urban areas with access to fiber & 4G	Quality will depend on the strength of the wireless network but generally is **not considered a major barrier**	Quality of GEO satellite internet **might not suffice** for certain functions (e.g. videoconferencing due to high latency)
Coverage gap barriers[3]			
• Business viability	*N/A*	**Expanding fiber** to semi-urban areas is considered **not economically viable** (e.g. large upfront investment costs, fragmentation of demand)	**Expanding fiber or 4G** to rural & remote areas is considered **not economically viable** (e.g. low population density/fragmentation of demand). For **satellite** internet, providing **maintenance & after-sales** support is the **main challenge** for the business viability
• Funding security	*N/A*	**Smaller ISPs lack access to finance** (e.g. from Universal Service Fund (USF)) to expand their coverage	**MNOs** have **difficulty to gain funding** for expanding to rural & remote areas (e.g. high interest rate, inadequate USF implementation, inflation & foreign currency shortages)

Notes: 1) The barriers have been identified in the context of school connectivity, but may also be applicable to other segments of the connectivity market in the 9 focus countries; 2) Usage gap barriers refer to the barriers to connectivity which are experienced in areas where there is coverage of (fiber/mobile (>3G)) internet; 3) Coverage gap barriers refer to the barriers for expanding coverage of fiber/mobile (>3G) to underserved areas;
Sources: Interviews, Deloitte analysis

Market shortcomings & root causes

A variety of market shortcomings and root causes have been identified across the 9 countries, which can be addressed by Giga to improve the market

Overview of identified market shortcomings & root causes[1] (1/2)

Barrier	Market shortcoming		Root causes	Applicable countries[3]
Usage gap barriers[2]				
• Digital literacy	• Suppliers experience a lack of uptake due to digital illiteracy	1	• Suppliers experience hesitance from schools & teachers to transition to digital learning	Kenya, South Africa
		2	• Low internet penetration rate resulting in low familiarity	Kenya, Rwanda, Sierra Leone, Benin, Malawi
• Affordability of connectivity	• Price of connectivity is high	3	• High cost of first-mile / middle-mile bandwidth (wholesale internet prices) for landlocked countries having no direct access to international connectivity	Botswana, Malawi, Zimbabwe
		4	• High cost of first-mile / middle-mile bandwidth (wholesale internet prices) due to limited competition in the first-mile	Sierra Leone, Benin, Malawi
		5	• High cost of first-mile / middle-mile bandwidth because of lack of in-country data centers or Internet Exchange Points (IXP)	Botswana
		6	• High cost of networking equipment (e.g. import duties, inflation, lack of foreign currency/unfavorable exchange rates)	Sierra Leone, Malawi, Zimbabwe
		7	• High cost of infrastructure development & maintenance	Botswana
		8	• High cost for maintenance & after-sales support to customers	Botswana, Sierra Leone, Malawi
		9	• High cost of licenses & spectrum (e.g. scarcity of spectrum, lack of foreign currency (license fees in US dollars))	Kenya, Malawi
		10	• High inflation undermining profitability on longer-term contracts	Sierra Leone
		11	• Limited competition resulting in high supplier power & higher prices (e.g. due to gov't regulations, lack of available spectrum)	Kenya, Rwanda, Sierra Leone, Benin, Zimbabwe
	• Low available government budget for school connectivity	12	• Low GNI per capita which is reflected in government budgets	Rwanda, Sierra Leone, Malawi, Zimbabwe
		13	• Need for more advocacy on school connectivity in the public agenda	Nigeria, Kenya
		14	• Volatility of the yearly available government budget (for school connectivity)	Malawi
• Affordability of devices	• Price of devices is high	15	• High cost of devices (e.g. import duties, inflation, lack of foreign currency)	Kenya, Sierra Leone, Malawi, Zimbabwe
• Access to electricity	• Lack of electricity limits the uptake of connectivity, particularly in rural areas	16	• Lack of electricity infrastructure	Rwanda, Sierra Leone, Benin, Malawi, Botswana
		17	• Electricity needs to be paid in US dollars and there is a lack of foreign currency or unfavorable exchange rate resulting in high cost	Zimbabwe
		18	• Inadequate structure of schools which limits the possibility of deploying rooftop solar panels	Sierra Leone
		19	• Low reliability of electricity infrastructure	South Africa

Notes: 1) The market assessment reflects the perspective of connectivity suppliers as retrieved through interviews, complemented with desk research. The insights have been validated with subject matter experts from UNICEF, ITU and Deloitte, but have not been confirmed with governments or schools; 2) Usage gap barriers refer to the barriers to connectivity which are experienced in areas where there is coverage of (fiber/mobile) internet; 3) These refer to countries where the root cause has been identified, but they may also apply in other countries; Sources: Interviews, Deloitte analysis

Market shortcomings & root causes

A variety of market shortcomings and root causes have been identified across the 9 countries, which can be addressed by Giga to improve the market

Overview of identified market shortcomings & root causes[1] (2/2)

Barrier	Market shortcoming		Root causes	Applicable countries[4]
Usage gap barriers[2]				
• Security (vandalism & theft)	• Theft & vandalism pose a barrier for the uptake of connectivity	20	• Theft or vandalism of equipment, devices & energy infrastructure	Kenya, Nigeria, Sierra Leone, South Africa
	• Security concerns	21	• In some countries there are areas with security concerns (e.g. terrorism threat) which result in inability to do installation & maintenance, or a high cost of doing so (due to security measures)	Kenya, Nigeria
• Maintenance & after-sales	Challenge of providing maintenance & after-sales support in rural areas	22	• Large distance from main support centers (resulting in high costs for allowances and fuel)	Sierra Leone, Botswana
		23	• Difficult landscape (e.g. mountainous terrain) & lack of general road infrastructure	Sierra Leone
		24	• Security concerns (e.g. terrorism threat) pose a barrier for providing adequate support	Kenya
• Quality	• Low quality of connectivity	25	• Lack of business viability to invest in high-quality network	Botswana, Malawi
		26	• Low income levels resulting in preference for low-cost low-quality options (e.g. unlicensed frequencies)	Kenya, Rwanda
Coverage gap barriers[3]				
• Business viability	• Lack of profitability in rural areas	27	• Low revenue density (low population density) and difficulty to achieve economies of scale	Kenya, Sierra Leone, Botswana, Zimbabwe
		28	• Lack of demand from rural areas (e.g. low disposal income)	Kenya, Sierra Leone, Zimbabwe
		29	• Lack of existing middle-mile fiber/mobile infrastructure	Nigeria, Sierra Leone, Malawi, Zimbabwe
		30	• Inability to deploy certain connectivity solutions because of the landscape (e.g. FWA requires line-of-sight, which is not feasible in mountainous areas)	Sierra Leone
		31	• High costs of infrastructure development (e.g. difficult landscape, lack of general road infrastructure)	Kenya, Sierra Leone, Malawi, Zimbabwe
		32	• High cost of installation, maintenance & after-sales support	Sierra Leone, Malawi
• Funding security	• Lack of access to finance by market players	33	• Areas of opportunity for a more effective implementation of the USF	Nigeria, Malawi
		34	• High cost of capital (high interest rate)	Kenya, Nigeria, Sierra Leone, Malawi, Zimbabwe
		35	• Lack of foreign currency / unfavorable exchange rates and investment contracts require to be paid in US dollars	Zimbabwe
		36	• Lack of access to finance for smaller players (difficulty to access USF funding or development aid)	Kenya, Nigeria
		37	• Lack of access to long-term (development) funding to cover the recurring cost of connectivity	Sierra Leone

Notes: 1) Please note, the market assessment reflects the perspective of connectivity suppliers as retrieved through interviews, complemented with desk research. The insights have been validated with subject matter experts from UNICEF, ITU and Deloitte, but have not been confirmed with governments or schools; 2) Usage gap barriers refer to the barriers to connectivity which are experienced in areas where there is coverage of (fiber/mobile) internet; 3) Coverage gap barriers refer to the barriers for expanding coverage of fiber/mobile to underserved areas; 4) These refer to countries where the root cause has been identified, but they may also apply in other countries; Sources: Interviews, Deloitte analysis

Catalogue of recommended actions

Increasing market information can help suppliers identify market opportunities, and can help lower the cost of school connectivity

Catalogue of recommended actions (1/3)

Recommended action	Explanation of how the action can address identified market shortcomings	Root causes addressed[1]
Market lever: increase market information		
• Include the **proximity of other potential customers** (town hall, health clinic, etc.) in **Giga's connectivity map** of schools (e.g. as part of a score of the attractiveness of a school)	• Information on potential other customers around schools can encourage infrastructure investments into underserved areas	**27, 28**
• Include the **proximity of existing telecommunication infrastructure** in **Giga's connectivity map**, to help suppliers assess the difficulty to connect	• Information on existing infrastructure helps suppliers assess the required investment to connect schools, thereby lowering risk	**29, 31**
• Include **access to electricity** and the **proximity of schools/communities to electricity infrastructure** in Giga's connectivity map	• As access to electricity is an enabling requirement for connectivity, this helps suppliers & government assess which schools can be connected more easily	**16**
• Include the **quality of the (physical) structure of schools** in **Giga's connectivity map** to help suppliers assess the feasibility of installing solar panels alongside connectivity equipment	• In areas where there is no electricity, connectivity needs to be provided in combination with solar panels; however, the structure of schools need to be able to hold rooftop solar panels	**18**
• Publish **information on electricity projects/RFPs,** such that connectivity providers can piggyback	• Publishing information about new electricity projects can help suppliers identify new business opportunities (as electricity is an enabling requirement for connectivity)	**16**
• Support governments in **sharing their long-term plans** of **school connectivity projects**	• Increasing market information of upcoming school connectivity projects enable market players to spot business opportunities and plan accordingly	**12, 13, 14**
• Create a **dashboard with prices for school procurement contracts** to help governments benchmark what an appropriate price is (could be a sub-indicator in ITU's ICT prices dashboard)	• An international benchmark can help governments assess what a suitable price is to pay for school connectivity (based on some key characteristics (e.g. size of schools, distance from existing infrastructure etc.), facilitating cost efficiency in case of low available government budgets	**12, 13**
• **Track the quality of school internet** and **support governments in enforcement of service-level agreements** as specified in school connectivity contracts	• Tracking of quality of internet can help governments enforce the quality requirements as specified in school contracts (service-level agreements)	**25, 26**
• **Share best practices (**e.g. from Rwanda) on **bulk bandwidth purchasing agreements** with other countries	• Some landlocked countries (e.g. Rwanda) have successfully established long-term bulk purchase agreements to bring down cost of bandwidth	**3**
• **Sharing of best practices** on **training of communities** for **local support & maintenance,** particularly for satellite technology (less complex than other connectivity technologies)	• Maintenance and after-sales support is considered a high cost component for rural areas; sharing of best practice trainings can help lower the costs	**8, 22, 23, 24**
• Create an **overview of relevant initiatives** that focus on school connectivity to **help suppliers spot opportunities** for partnerships or funding	• An overview of relevant initiatives can help market players (particularly small ISPs) to engage in partnerships and access funding	**36**

Note: 1) The numbers in this column refer to the identified root causes as presented on slides 9 & 10
Sources: Interviews, workshop with UNICEF & ITU, Deloitte analysis

Catalogue of recommended actions

Transaction costs can be lowered through pooled procurement of last-mile connectivity as well as through national initiatives to reduce first- & middle-mile connectivity costs

Catalogue of recommended actions (2/3)

Recommended action	Explanation of how the action can address identified market shortcomings	Root causes addressed[1]
Market lever: reduce transaction costs		
• Look for opportunities for **pooled procurement of last-mile school connectivity** to bring down prices	• Bringing together multiple schools in one procurement contract can bring economies of scale and better return on investment of suppliers, by reducing overhead of procurement processes, enable bulk procurement of network equipment and more efficient roll-out & maintenance • It is recommended to consider the characteristics of the different connectivity technologies and existing infrastructure by pooling schools which can be served efficiently with the same type of connectivity solution, to enhance economies of scale and to account for supplier characteristics (e.g. licenses, capabilities, existing infrastructure)	**6, 7, 8**
• Look for opportunities for **cross-country pooled procurement of satellite school connectivity**	• As for satellite internet, cross-country pooled procurement might even be possible to fully utilize economies of scale as there is less dependency on existing infrastructure and footprint of existing market players. Differences in government procurement processes, licensing regimes, suppliers' network of partners for maintenance & support and supplier's ground station infrastructure should be considered	**6, 8**
• Look for opportunities for **pooled procurement** of last-mile connectivity **with other public organizations** within **communities** (e.g. town hall, health center, police station)	• Pooled procurement as a community of which the school is a part of improves the return on investment of supplier infrastructure investments	**6, 8, 27**
• Look for opportunities for **pooled procurement of devices** to bring down prices	• Access to affordable devices is a prequisite for connectivity; pooled procurement brings economies of scale and reduces price per device	**15**
• Explore **bulk procurement of bandwidth** to bring down prices, particularly for landlocked countries	• Assisting governments (particularly of landlocked countries) in making long-term agreements for international bandwidth capacity can lower the costs of wholesale connectivity prices (e.g. best practice of Rwanda)	**3, 4**
• Explore opportunity to build local **data centers for education content** to reduce peering costs	• Local (in-country) data centers can reduce the cost of peering data internationally; Giga can support with assessing the business case	**5**
• Promote regulatory requirements to **enhance competition** in the last-mile (e.g. **open access** middle-mile infrastructure, requirements for the **sharing of unused frequencies**)	• Giga can advocate for regulations to enhance competition in the last-mile, which could reduce prices of last-mile connectivity solutions	**11**
• Explore **possibilities to reduce reliance on a single first-mile operator** (potentially by advocating for the entrance of new infrastructure players)	• The reliance on a single backbone operator may in some countries lead to high wholesale prices; advocating for a new entrant could help increase competition, resulting in lower wholesale prices	**4**

Note: 1) The numbers in this column refer to the identified root causes as presented on slides 9 & 10
Sources: Interviews, workshop with UNICEF & ITU, Deloitte analysis

Catalogue of recommended actions

Through addressing supplier risks and facilitating access to finance & technology, Giga can help improve the market environment for last-mile connectivity suppliers

**Catalogue of recommended actions (3/3)**

Recommended action	Explanation of how the action can address identified market shortcomings	Root causes addressed[1]
Market lever: balance supplier & buyer risk		
• Orchestrate an **integrated approach to connectivity**, including electricity, devices and training through combined contracting	• Electricity, devices and training are key enabling requirements for connectivity; through combined contracting, this enlarges the market of school connectivity (as more schools can be included)	**1, 2, 15, 16**
• Include **market players in the planning of school connectivity initiatives**, to increase supplier engagement and appetite for school connectivity and to ensure effective & efficient roll-out	• Market players express their desire to be included in the planning of school connectivity, to jointly assess the required quality & solution	**7, 29, 30, 31**
• Ensure that the **risk of inflation is well-managed** in connectivity contracts (e.g. agree on price in US dollars and then get paid in the equivalent value of the local currency at the time of delivery)	• Inflation can make connectivity contracts unprofitable; adequate price indexation or contracting in US Dollars can address this risk	**10**
• Provide **long-term contracts** (5 to 10 years) to ISP's to reduce their risk and ensure Return on Investment (ROI)	• Longer-term contracts reduce supplier risk, and enables suppliers to make investments based on the perspective of longer-term revenues	**7, 31**
• Explore possibility of **allowing market players to include monetization models** as part of school connectivity contract	• Allowing market players to include monetization models (e.g. advertisement videos of local businesses, paid public Wi-Fi) can increase profitability and reduce prices for schools	**12, 13**
Market lever: improve access to finance & technology		
• Set up a **dedicated financing vehicle** to provide **low-interest loans** for middle-mile connectivity	• In countries with high interest rates, financing infrastructure development is a challenge (particularly for smaller players)	**33, 34, 35**
• Support **smaller players in accessing funding** from the Universal Service Fund, development aid and private sector financing	• Smaller players experience difficulties in accessing funding; supporting them through these processes enable them to engage in school contracts	**36**
• Create more **OPEX-oriented financing vehicles** to cover the recurring costs of connectivity (e.g. to accommodate for satellite connectivity)	• Suppliers indicate that most (development) funding is focused on CAPEX investments; there is a need for OPEX-oriented financing	**37**
• Support governments with **accessing development funding** earmarked for school connectivity	• In some countries with low government budgets, school connectivity may be considered a luxury and other investments are prioritized if there is no external development funding specifically for school connectivity	**12, 13, 14, 33**
• Develop a **proposition for monetizing connectivity by schools** (e.g. paid public Wi-Fi)	• Innovative monetization models can enable cost sharing by schools with the community, increasing affordability of connectivity	**12, 13**
• Facilitate **knowledge transfer** of **low-cost connectivity solutions** (e.g. FWA using unlicensed frequencies) and **connectivity solutions that combine electricity** (e,g. satellite connectivity with solar kits) to other countries	• Facilitating knowledge transfer internationally can help the adoption of novel school connectivity solutions	**9, 11, 12, 13, 16, 31**

Note: 1) The numbers in this column refer to the identified root causes as presented on slides 9 & 10
Sources: Interviews, workshop with UNICEF & ITU, Deloitte analysis
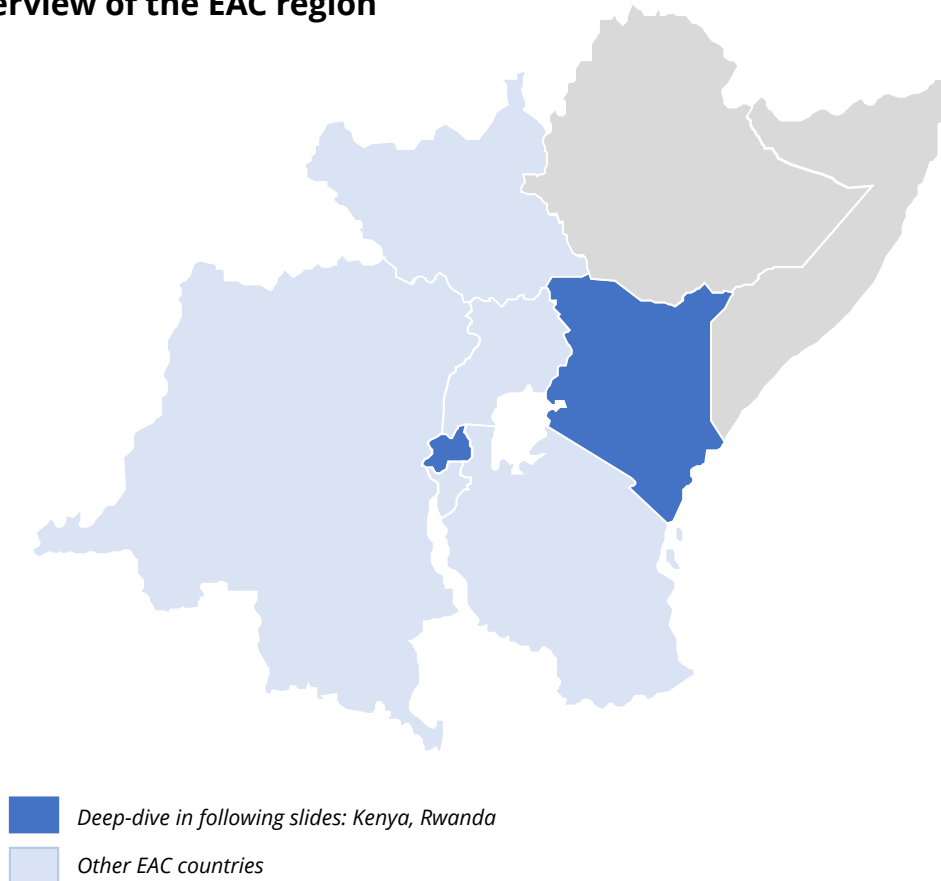
4 **EAC region**
Market assessment & recommended actions
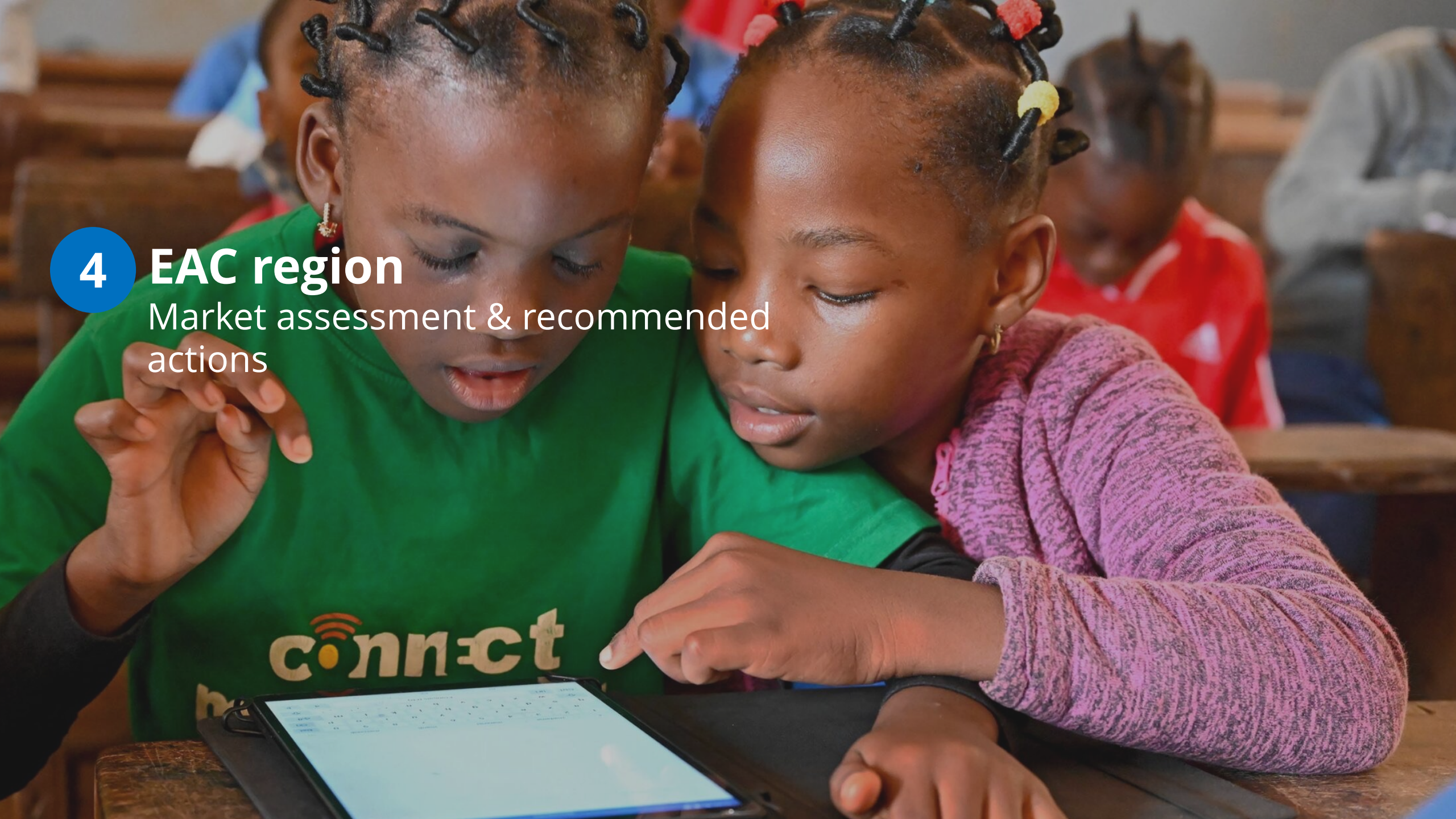
EAC | Broader context

The East Africa Community (EAC) is characterised by large economic differences among countries and a well-established mobile network

Overview of the EAC region

Deep-dive in following slides: Kenya, Rwanda

Other EAC countries

Population & economy

- The East African Community (EAC) has **284 million citizens**, of which 30% is urban population and 70% is rural population

- **Kenya and Tanzania are the biggest economies** of the EAC region, with a GDP of $110 billion USD and $68 billion USD respectively (together 59% of EAC region)

- **GNI per capita differs significantly across countries**, ranging from $2,170 USD in Kenya to $590 USD in D.R. Congo and $240 USD in Burundi

Internet connectivity

- The **main international telecommunication infrastructure lands in Kenya** and **Tanzania** in the East, as well as in the **D.R. Congo** in the West. Other countries such as Rwanda are landlocked, and are connected through terrestrial networks with neighbouring countries

- Based on country-level research into Kenya and Rwanda, the **mobile network is well-established** in the EAC region and most of the population is covered by a mobile broadband network (3G/4G)

- In **Kenya**, **approximately half of the schools** are connected to good quality internet; in **Rwanda, only 22% of schools** have good quality internet **despite nearly universal coverage of 3G/4G**

Source: Giga, ITU, World Bank

EAC | Assessment of market shortcomings [1/2]

In EAC, there are many innovative market players and governments are committed to enhance school connectivity, but affordability and lack of electricity pose a barrier

Severity of barrier

No barrier	
Small barrier	
Large barrier	

Assessment of school connectivity market

Dimension	Regional summary per theme		Kenya		Rwanda
Usage gap[1] dimensions	*% schools that are covered but not connected:*		~47%		~76%
Acceptability	**Digital illiteracy**: **suppliers experience a lack of demand** from communities & schools due to digital illiteracy; teachers are being trained on ICT skills to facilitate the uptake		Suppliers experience a **lack of uptake** from communities because of digital illiteracy and **lack of demand** (suppliers have the perception that not all teachers are willing to transition to digital learning)		Digital illiteracy is a **challenge in Rwanda** (low internet penetration), but government programs focused on school connectivity **include training of teachers on ICT skills**
Affordability	**Price of connectivity:** price is **relatively low** in the EAC region relative to ECOWAS and SADC regions; governments seem to be collaborating successfully to engage in long-term agreements and bring down the cost of connectivity		Price of connectivity is **relatively low** in Kenya; furthermore, there are market players who focus specifically on **providing low-cost connectivity** in **semi-urban and rural areas** (Poa! Internet, Mawingu)		Price of connectivity is **relatively low in Rwanda,** especially given the landlocked nature; the government has successfully made **interventions to bring down costs** (e.g. **long-term bulk bandwidth agreements** with Kenya & Tanzania)
	Price of devices: cost of the devices makes up a **significant share of the total costs** required to successfully implement digital learning		The **price of devices is high** (indicated that devices cover 50% of costs of a school's digital transformation vs. 15-20% for connectivity)		Price of devices are expected to be high in Rwanda as well; however, the **government** is making funding available to **provide devices to teachers and students** across the country
	Governmental budget: affordability of connectivity is a challenge given a relatively low GNI per capita (as reflected in the available government budget)[2]		**Relatively low government budget available** for school connectivity (relatively low GNI per capita)[2]		**Low government budget available** for school connectivity (low GNI per capita)[2]; despite significant commitment from the government, there is a dependence on external funding
Competition	**Level of competition**: although in the mobile connectivity market there are **large dominant players** in both Kenya and Rwanda, in Kenya there is a larger number of ISPs (incl. **several innovative players**)		**Limited competition in the mobile connectivity market**, with the dominance of one market player; there is however a **large number of ISPs** and **several innovative players**		**Limited competition in the mobile connectivity** market; the **4G infrastructure & wholesale market** used to be a **monopoly**, but this is about to come to an end, which will boost competition
Delivery *(1/2)*	**Access to electricity**: access to electricity is a **major barrier** to connectivity, particularly in Rwanda		**Although access to electricity is relatively good** in Kenya compared to other countries, it is still considered a major **challenge**		Access to electricity is a **major barrier** in Rwanda, with only 49% of population (38% in rural areas) having access to electricity

Notes: 1) The 'usage gap' is defined as the difference between the percentage of schools with good-quality coverage (>3G) and the percentage of schools that are actually connected to good quality connectivity (> 3G); 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Interviews, Deloitte analysis

EAC | Assessment of market shortcomings [2/2]

In EAC, there are many innovative market players and governments are committed to enhance school connectivity, but affordability and lack of electricity pose a barrier

Severity of barrier
- No barrier
- Small barrier
- Large barrier

Assessment of school connectivity market

Dimension	Regional summary per theme	Kenya	Rwanda
Delivery *(2/2)*	**Security:** theft of equipment & devices as well as security risks are a concern which pose a barrier for the uptake of connectivity	**Theft of equipment & devices** is a challenge, particularly in rural areas; there are also **security concerns** in some areas of Kenya	No market shortcoming identified
	Maintenance & after-sales support: In Kenya, maintenance & after-sales support is considered a barrier for uptake in rural areas and in areas where there are security risks	**Costs for maintenance** are considered **high**, particularly in rural areas and in areas where there are security risks (e.g. near Somali border)	No market shortcoming identified
Quality	**Quality:** Despite the large coverage of 3G/4G network, many consumers & schools seem to choose for lower-cost lower-quality options	Quality of fixed and mobile broadband is **low** in Kenya; the innovative **low-cost connectivity solutions** often also have **lower quality**	Although there is nearly universal coverage of 3G/4G internet, a significant share of schools are **connected to lower quality internet**; the quality of fixed broadband is relatively high in Rwanda
Coverage gap[1] dimensions	*% schools that are not covered:*	~7%	~2%
Availability	**Business viability of investment in rural areas:** There is a well-established 3G/4G network in Kenya and Rwanda; however, market players do experience a lack of profitability in rural areas	There is **relatively good coverage of the 3G/4G network;** however, market players experience a **lack of profitability** of rural areas (e.g. lack of revenue density, high cost of deployment & maintenance)	Rwanda has achieved **nearly universal coverage of 3G/4G (98% of schools)**
	Availability of new solutions: Kenya and Rwanda can be considered front-runners in terms of innovation, with several market players using novel connectivity solutions to connect underserved areas	**Several market players** (e.g. Poa! Internet, Mawingu) are exploring **low-cost connectivity solutions for rural areas** (e.g. using unlicensed frequencies, monetization models, sharing of infrastructure); **LEO satellite internet** has also become available in Kenya	**LEO satellite internet** has become available in Rwanda, and the government is collaborating with market players to make LEO satellite internet available for schools
Funding security	**Access to finance:** Smaller players experience difficulties in gaining access to Universal Service Fund or development funding, which limits their ability to finance investments into rural areas	There is a **lack of access to finance** for **smaller players**, as smaller players have difficulties gaining access to Universal Service Fund or development funding	No market shortcoming identified

Note: 1) The 'coverage gap' is defined as the percentage of schools that are not covered by a good-quality (>3G) network
Sources: Interviews, Deloitte analysis

EAC | Recommended actions

Giga can help overcome challenges of affordability and access to electricity, as well as share best practices from Kenya & Rwanda to other countries

UNICEF's market-shaping levers
- Increase market information
- Reduce transaction costs
- Balance supplier & buyer risks
- Improve access to finance & technology

Possible actions to strengthen the school connectivity market

N/A : no relevant action identified for Giga

Dimension	Common themes for the region[1]	Applicable countries	What can **Giga** do to address the identified market shortcomings?	Relevant **market-shaping levers**
Usage gap dimensions		Kenya Rwanda		
Acceptability	Digital illiteracy	Kenya, Rwanda	• Orchestrate an **integrated approach to connectivity**, including electricity, devices and training through combined contracting	
Affordability	Price of connectivity	Kenya, Rwanda	• Facilitate **knowledge transfer** of low-cost connectivity solutions from Kenya to other countries • Share **best practices** from Rwanda on bulk bandwidth purchasing agreements with other countries	
	Price of devices	Kenya, Rwanda	• Look for opportunities for **pooled procurement of devices** to bring down prices • **Include the procurement of devices** in the connectivity procurement process	
	Government budget for school connectivity	Kenya, Rwanda	• Support governments with **accessing development funding** earmarked for school connectivity • Develop a **proposition for monetizing connectivity by schools** (e.g. paid public Wi-Fi)	
Competition	Level of competition	Kenya, Rwanda	• Include **market players in the planning of school connectivity initiatives**, to increase supplier engagement and appetite for school connectivity and to ensure effective & efficient roll-out	
Delivery	Access to electricity	Kenya, Rwanda	• Include **proximity of schools/communities to electricity infrastructure** in Giga's connectivity map • Publish **information on electricity projects/RFPs,** such that connectivity providers can piggyback	
	Security (vandalism & theft)		• *N/A*	
	Maintenance & after-sales support	Kenya, Rwanda	• Sharing of best practices on **training of communities** for **local support & maintenance**	
Quality	Quality of connectivity	Kenya	• **Track the quality of school internet** and **support governments in enforcement of service-level agreements** as specified in school connectivity contracts	
Coverage gap dimensions				
Availability	Business viability for investing in connectivity in rural areas	Kenya	• Include the **proximity of other potential customers** (town hall, health clinic, etc.) in **Giga's connectivity map** of schools (e.g. as part of a score of the attractiveness of a school)	
	Availability of new solutions for rural areas (e.g. new technologies, community networks)	Kenya, Rwanda	• Facilitate **knowledge transfer** of **low-cost connectivity solutions** from Kenya to other countries • Share **best practices** from Rwanda on the **pooled procurement of LEO satellite internet** for schools	
Funding security	Access to finance by market players	Kenya	• Set up a **dedicated financing vehicle** to provide **low-interest loans** for middle-mile connectivity • Support **smaller players in accessing funding** from the Universal Service Fund or development aid	

Note: 1) Common themes have been identified through bottom-up analysis of the common market shortcomings & root causes that have been identified across countries
Sources: Interviews, Deloitte analysis

Kenya | Assessment of market shortcomings [1/2]

In Kenya, the main market shortcomings have been identified in the acceptability, affordability, delivery and quality market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~47% of schools[1])				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Lack of uptake from communities because of digital illiteracy and lack of demand (suppliers have the perception that not all teachers are willing to transition to digital learning)	− Digital illiteracy; digital literacy is low in Kenya with 29% of individuals in Kenya using the internet − Suppliers experience hesitance from schools & teachers to switch to digital learning; for administration, they may use their own mobile data or go to a nearby cyber café	• Interview with African infrastructure provider • Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	+ Price of mobile connectivity is relatively low in Kenya (at 3% of GNI per capita, and on average $0,59 USD per GB of mobile data)	+ There are several data centers in Kenya, which lowers the cost of connectivity + *Hypothesis: it is expected that the direct access to international submarine cable infrastructure, the stable regulatory environment and high level of innovation in the country results in favorable prices [2]*	• Interview with African infrastructure provider • Desk research
		+ There are market players who can provide low-cost connectivity in semi-urban and rural areas	+ Through using unlicensed frequencies, market players (e.g. Poa! Internet, Mawingu) can provide low-cost Fixed-Wireless Access (FWA) connectivity in semi-urban and rural areas (~$10 USD per month for 4 Mbps) + Market players (e.g. Poa! Internet & Google) are exploring novel laser technology for low-cost high-quality connectivity in semi-urban areas + Market players (e.g. Poa! Internet) are exploring innovative monetization models to connect underserved areas, enabling cost sharing within the community	• Interview with ISP • Interview with African infrastructure provider
		− The price of devices is high (a market player indicates that about 50% of a school's digital transformation costs is in devices, and connectivity is only 15-20%)	− *Hypothesis: no root cause has been identified, but expect that devices need to be imported and that there are limited low-cost options available [2]*	• Interview with African infrastructure provider
		− Relatively low government budget for school connectivity [3]	− Relatively low GNI per capita ($2,170 USD and $5,680 USD at PPP) − A market player indicated that they experience a lack of political will to increase school connectivity	• Interview with African infrastructure provider • Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	− Limited competition in the mobile connectivity segment	− Dominance of one market player with a 66% market share (Safaricom) − Licensing and spectrum costs could be a barrier for new entrants	• Interview with MNO • Desk research
		+ There is significant competition in the fixed connectivity market, and players recognize the market opportunity of school connectivity	+ There are multiple fixed network operators and a large number of ISPs (387) + Some market players recognize the market opportunity of schools (e.g. 'there is no bigger opportunity for us, there is no company that has 15,000 sites')	• Interview with African infrastructure provider
		+ There is a large number of active ISPs, which includes innovative players	+ There is large number of ISPs active in Kenya (387) + There are innovative players active in the market (e.g. Poa! Internet, Mawingu)	• Desk research
Delivery *(1/2)*	Products & services are delivered reliably, cost effectively and on time	− Lack of uptake of connectivity solutions due to lack of electricity, although access to electricity is relatively good in Kenya (2nd highest access to electricity out of the 9 assessed countries)	− Lack of electricity (access to electricity is at 77% of population and 68% in rural areas) − Gaining access to electricity has more of a priority than gaining access to connectivity	• Interview with ISP • Desk research

Notes: 1) Giga's Kenya opportunity brief states that the coverage gap is ~7% of population (it is assumed that the same percentage applies to schools), and that 54% of schools are not connected (so usage gap is calculated as 54 – 7 = 47%); 2) Within the scope of this study we could not validate this hypothesis and further research is required; 3) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Giga, interviews, Deloitte analysis;

Kenya | Assessment of market shortcomings [2/2]

In Kenya, the main market shortcomings have been identified in the acceptability, affordability, delivery and quality market dimensions

**Assessment of school connectivity market**

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Delivery *(2/2)*	Products & services are delivered reliably, cost effectively and on time	+ Market players have developed technologies to help overcome the challenge of access to electricity	+ Market players (e.g. Mawingu) deploy solar-powered radio towers to provide Fixed Wireless Access (FWA), to overcome the challenge of access to electricity	• Interview with African infrastructure provider
		− There is the risk of disruptions, particularly in rural areas	− Theft is challenge, particularly in rural areas (e.g. FWA equipment and devices) − There are security risks in some parts of Kenya (e.g. near border with Somalia)	• Interview with ISP • Interview with MNO
Quality	Products meet quality standards	− Quality of fixed and mobile broadband is low in Kenya, with Kenya ranking 158th out of 181 countries for fixed broadband and 104th out of 141 countries for mobile broadband by Ookla's Speedtest Global Index	− *Hypothesis: the limited competition in the mobile market as well as the focus on providing low-cost connectivity is expected to result in reduced quality of internet [2]*	• Desk research
		− Low-cost connectivity solutions often have lower quality	− The quality of low-cost connectivity solutions (e.g. FWA using unlicensed frequencies) is around 4 Mbps which is not considered meaningful connectivity	• Interview with ISP
Coverage gap market dimensions (coverage gap: ~7% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	+ Good coverage of mobile 3G/4G network (~93% of population are covered); and availability of connectivity solutions across urban, semi-urban and rural areas	+ Market players (e.g. Safaricom) deploy cellular technology in urban areas, microwave (FWA) technology in semi-urban areas and GEO satellite internet in remote areas	• Interview with MNO
		+ Market players are exploring innovative technologies & propositions to make low-cost connectivity available to rural areas	+ Market players (e.g. Poa! Internet) are exploring innovative monetization models to connect underserved areas, and share the costs within the community + Market players (e.g. Mawingu) is using unlicensed frequencies (TV White Space) and sharing of infrastructure of MNOs to provide FWA connectivity to rural areas + Market players (e.g. Safaricom & AST SpaceMobile, Starlink) are deploying LEO satellite internet	• Interview with ISP • Interview with MNO • Interview with development aid organization
		− Lack of profitability of fiber & mobile connectivity in rural areas	− Lack of revenue density in rural areas − Lack of demand from rural communities (limited disposable income and other priorities (e.g. electricity, food security)) − Deploying fiber or mobile is too expensive for rural areas, particularly in mountainous areas − Some connectivity solutions (Fixed Wireless Access) require line-of-sight which is a challenge in rural (mountainous) areas − There are security risks in some parts of Kenya (e.g. near border with Somalia) − There are high costs for maintenance in rural areas and in high-security risk areas − Achieving economies of scale is difficult as the best connectivity solution depends on the circumstances (e.g. existing infrastructure)	• Interview with ISP • Interview with MNO
Funding security	Market players have sufficient funding security	− Lack of access to finance for smaller players	− Smaller players experience difficulties with accessing Universal Service Fund (USF) funding, given the extensive process and requirements for proposals − Relatively high interest rate (10.5%)	• Interview with ISP

Notes: 1) Giga's Kenya opportunity brief states that the coverage gap is ~7% of population (it is assumed that the same percentage applies to schools); 2) Within the scope of this study we could not validate this hypothesis and further research is required; Sources: Giga, interviews, Deloitte analysis

# Kenya | Broader context & status of school connectivity

More than half of schools in Kenya are not connected to the internet, but the government is committed to connect all schools by 2030 as per their National Broadband Strategy

Out of a total of 43,000 schools,
23,300 still need to be connected
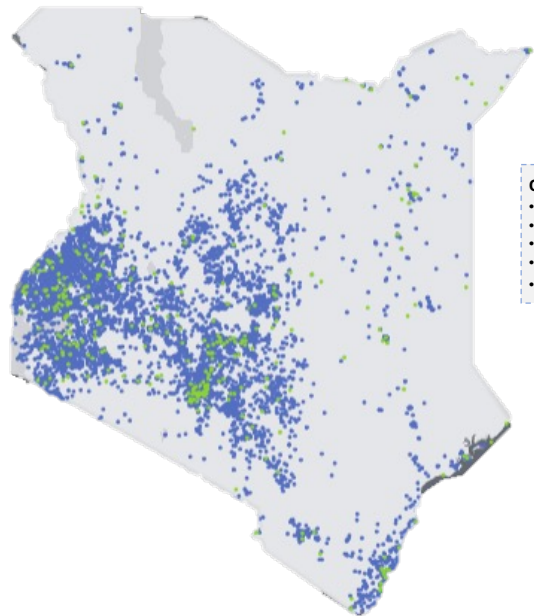
Overview
- Population: **56.8 million**
- Pop. density: **97 inhab. / km²**
- Urban/rural split: **38%/72%**
- GNI/capita: **2,170 USD**
- GNI/capita (PPP[1]): **5,680 USD**

No connectivity   3G/4G

| School connectivity[2] | 54% | 46% |
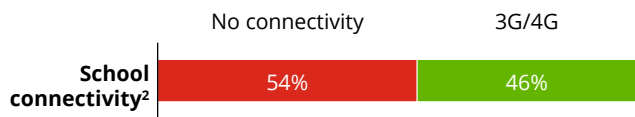
Government support for school connectivity
- The government adopted the **National Broadband Strategy** which aims for **100% connectivity** for all schools in 2030
- The EU launched a **Digital Economy Package** for Kenya, which will provide funding for **internet for 1,300 schools** in underserved areas

Electricity
- Access to electricity can be a **barrier** for connectivity

Total	77%	24%
Urban	98%	3%
Rural	68%	32%

% of population with access to electricity
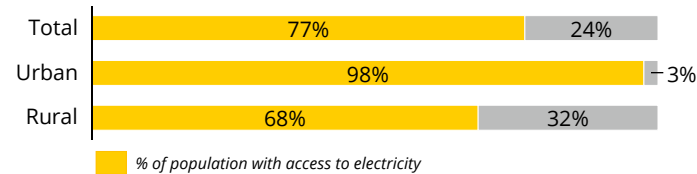
Digital literacy
- Kenya has a digital literacy score of **4.2** on the Wiley Digital Skills Gap Index[3], which ranks the country **2nd out of 26** Sub-Saharan African countries
- Digital literacy is relatively low in Kenya; **29% of the population** in Kenya is using the internet

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Key takeaways

- **Affordability:** The government has set ambitious goals for school connectivity, but the **overall budget is relatively low** given the relatively low GNI per capita[4]

- **Delivery: Lack of electricity** prevents uptake of connectivity solutions, especially **in rural areas**, although electricity coverage is relatively good compared to other countries in Africa

- **Acceptability: Digital illiteracy** prevents uptake of internet in schools

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Kenya | Fiber internet market

The market for fiber internet is quite fragmented with four main providers, but uptake amongst the population is low and prices are high compared to the GNI per capita

Key insights into the fiber internet market

Coverage	• **Five fiber optic international submarine cables land in Kenya**. This international bandwidth is further transported through the **National Optic Fiber Backbone Infrastructure** (NOFBI), which spans over **6,400 km** and touches **all 47 counties** • The population with a **fixed internet** connection is **below 2%**
Market players	• There is significant competition in the fixed connectivity market, with **many Internet Service Providers (ISPs) (387)** • In terms of subscriptions, **Safaricom is leading** in the fixed market with a market share of **36%**, followed by Faiba (24%), Wananchi (22%), and Poa! Internet (15%)
Pricing & quality	• The price for fixed internet service has gone down in the past years (from ~40% to now 17% of GNI per capita), but still is **significantly above Broadband Commission's target of 2% of GNI per capita** • Price of fixed broadband is **$1,76 per Mbps per month** in Kenya, scoring **average** compared to the 9 other assessed countries • **Quality** of fixed internet is **relatively low** in Kenya, ranking **158th out of 181** in terms of fixed broadband quality in Ookla's Speedtest Global Index
Market trends	• **Market players recognize the market opportunity** of school connectivity, given that it involves connecting so many sites

— Fiber backbone

Fixed internet subscriptions (2023)

- 36% Safaricom
- 24% Faiba
- 22% Wanainchi
- 15% Poa Internet
- 4% Others

Broadband prices as % of GNI per capita¹
— Fixed
— Mobile

40%

20%

17%

0%

3%

2014 2016 2018 2020 2022

" There is no bigger opportunity for us; there is no company that has 15000 sites. To connect all of these schools is a strategic pillar for us.
- Infrastructure provider "

Key takeaways
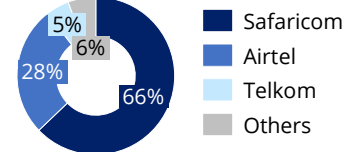
+ **Competition:** there is a **large number of ISPs**, resulting in significant competition

+ **Affordability: prices** for fixed internet are **average** but **still significantly above Broadband Commission's target of 2% of GNI per capita**

+ **Competition:** certain market players indicate that they **recognize the market opportunity** of connecting schools in Kenya

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Company websites, ITU, Cable.co.uk, CIO Africa, Techweez, Ookla, Interviews, Deloitte analysis

Kenya | Wireless internet market

Although there is limited competition in the mobile internet market, affordability is relatively good in Kenya

Key insights into the wireless internet market

Coverage	• **Around 93%** of the population have good **mobile broadband coverage** (3G/4G)
Market players	• There are **three major Mobile Network Operators**: Safaricom, Airtel Kenya and Telkom Kenya. These **players also own most of the tower infrastructure** • The mobile internet market is **dominated by Safaricom** with a market share of 66% of subscriptions, followed by Airtel (28%) and Telkom (5%) • Besides the MNOs, there are market players (e.g. **Poa! Internet, Mawingu**) that provide **Fixed-Wireless Access (FWA)** connectivity in semi-urban and rural areas
Pricing & quality	• **Price** of mobile connectivity is at **3% of GNI per capita**, and on average **$0,59 USD per GB of mobile data** which is considered to be **relatively affordable** • **Innovative players** like Mawingu and Poa! Internet provide low-cost connectivity solution (**~$10 USD per month for 4 Mbps**) • Kenya's median mobile speed is **22 Mbps download and 9 Mbps upload**, which ranks Kenya 104th out of 141 countries
Market trends	• **Safaricom announced** the **activation of 5G** in with planned expansion to 150 sites across nine towns in 2023 • **Alphabet** is working with **Liquid Telecom** on **delivering internet by using lasers** through its **'Taara' project** • **Poa! Internet** is exploring **innovative monetization models** to connect underserved areas, enabling cost sharing within the community

● 3G/4G coverage

Mobile internet subscriptions (2022)

- Safaricom 66%
- Airtel 28%
- Telkom 5%
- Others 6%

> The main MNOs are not entering the Fixed Wireless Access (FWA) market, because their main play is mobile and fiber, while we are in FWA. You pay 1500 shilling (*~$10 USD*) for 4 Mbps.
> — **ISP**

GSMA *August 2022*

5G gets boost in Kenya with successful spectrum assignment

Key takeaways

+ **Availability: high** mobile **coverage** across the country and population

− **Competition:** there is a **dominant mobile** operator, which result in **increased prices** for customers

+ **Affordability:** the **price** of mobile connectivity is **relatively low** in Kenya

+ **Affordability:** some innovative market players can **provide low-cost connectivity** in semi-urban and rural areas

− **Quality:** Kenya **ranks low** amongst other countries in terms of **mobile broadband speed**

Sources: Giga, ITU, GSMA, Communications Authority of Kenya, Cable.co.uk, Ookla, Company websites, ITU, Interviews, Deloitte analysis

Kenya | Satellite internet market

The satellite internet market in Kenya is active with new market players joining and established market players developing new offerings

Key insights into the satellite internet market

Coverage
- Kenya is covered by **GEO/VSAT** satellites and Starlink's **LEO satellites**

> *"Remote areas we will not do with fiber, but we will do satellite. Satellite we don't use for backhaul anymore, but for us it is a last-mile technology.*
> **- Infrastructure provider**

Market players
- In 2021 **five companies** were licensed to **operate in the satellite internet market** in Kenya, including Globalstar and Viasat Kenya
- Since July 2023, Starlink has started its operations in Kenya, providing LEO satellite internet
- Kenya is facing **challenges** with regards to **technical know-how** in the industry which **slowed down the growth** of this industry

Globalstar · Viasat · STARLINK

Pricing & quality
- A **monthly subscription** for Starlink is **$42 USD** and a **one-off price for equipment and shipping** of **~$600 USD**, **offering high-speed and low latency internet** [1]

> *"We are launching LEO satellite service together with our partner. It is still in testing phase, but it is a promising technology.*
> **- MNO**

Market trends
- **Starlink** started their operations in Kenya and partnered with Karibu Connect as a first authorized reseller
- Following Starlink, **Safaricom** is set to **launch LEO satellite internet services** through a partnership with **AST SpaceMobile**

SPACE IN AFRICA — *July 2023* Safaricom Partners with AST SpaceMobile to Compete with Starlink's Presence in Kenya

Key takeaways
- **Availability: GEO satellite internet** is available in Kenya and **LEO satellite internet** has also recently become available
- **Competition**: **several active market players** in the satellite internet market
- **Affordability**: satellite internet is **relatively expensive** compared to other connectivity options
- **Quality: LEO satellite** offers a high-quality connectivity solution for areas where there is no fiber or mobile coverage

Kenya | Enabling environment

Access to finance is a challenge in Kenya, particularly for smaller players; the many regulatory changes may also pose a challenge for existing or new market players

Regulations

- **Licenses to operate** in the telecommunication market in Kenya are **issued by the Communications Authority** (CA)
- The government has initiated a range of pro-business reforms over the last few years, including regulations on starting businesses and obtaining access to electricity
- **The Finance Act** has also seen various reforms over the past years (2019, 2020, 2023), **introducing new taxes**, including a **Digital Service Tax**. Some sources indicate that the oscillation between business reforms and **conflicting taxation policies** raise uncertainty over the long-term plans for improving the investment climate
- In 2023 the government **reversed** a rule in Kenya's National ICT policy that required ICT firms **to have at least 30% substantive Kenyan ownership to be licensed**

> " The Kenyan regulator charges 1% of gross revenue: 0.5% to Universal Service Fund (USF) for marginalized areas and 0.5% to sustain themselves. "
>
> — - ISP

G4 Kenya's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 4: 'Integrated regulation'** [1]

Access to finance

- The 'PPP Act 2021' **seeks to expand opportunities for Public-Private Partnerships in Kenya**. Despite these measures, **Foreign Direct Investments (FDI) is still recovering** from the COVID-19 pandemic. **Communications and Media** is considered one of the **leading sectors** in terms of FDI in Kenya

> " The government should make the USF funds more accessible for smaller players. Currently often 200-page proposals need to be submitted to get access, and that is not feasible for smaller ISPs with limited resources. "
>
> — - ISP

Access to finance indicators

- $ Exchange rate to USD: **0.0066** (2023)
- Government Debt to GDP (% of GDP): **67.3%** (2022)
- Interest rate: **10.5%** (2023)
- Domestic Credit to private sector (% of GDP)[2]: **31.5%** (2022)

Key takeaways

- **Competition**: oscillation in **regulations for digital services and investments** may raise uncertainty for (international) new entrants

- **Funding security:** it is **difficult** for **smaller players** to **access the Universal Service Fund**

- **Funding security: interest rate** is **relatively high** (10.5%), which may hamper infrastructure investments

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation;
2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, World Bank Development Indicators, Trading Economics, International Trade Administration, UNCTAD's Investment Report 2022, Investment Monitor, Crunchbase, OECD, University of Oxford, Interviews, Deloitte analysis

Rwanda | Assessment of market shortcomings [1/2]

In Rwanda, the main market shortcomings have been identified in the affordability, competition and delivery market dimensions

Assessment of school connectivity market[1]

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~76% of schools[2])				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Lack of uptake from communities because of digital illiteracy	− Digital illiteracy; digital literacy is relatively low in Rwanda with 30% of individuals in Rwanda using the internet + The 'One Laptop per Child (OLPC)' program of the Rwanda government includes training of teachers	• Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	+ Price of mobile connectivity is relatively low in Rwanda (at 3% of GNI per capita, and on average $0,55 USD per GB of mobile data)	+ The government of Rwanda has made interventions to bring down cost of bandwidth; it has used development finance to make long-term agreements in terms of bandwidth demand with neighboring countries + Rwanda is a densely populated country which makes providing connectivity relatively profitable, and enables providers to provide connectivity at lower costs	• Interview with African infrastructure provider • Desk research
		+ Price of fixed broadband is relatively low in terms of cost per Mbps per month ($0.51 USD), although the price of a fixed broadband package is generally not affordable (at 42% of GNI per capita)	+ The government of Rwanda has made interventions to bring down cost of bandwidth; it has used development finance to make long-term agreements in terms of bandwidth demand with neighboring countries (Kenya, Tanzania); despite being landlocked, these bulk purchases has greatly expanded Rwanda's international bandwidth and resulted in some of the lowest wholesale prices in Africa + *Hypothesis: fixed broadband is expected to be geared towards serving enterprises in the main urban areas rather than consumers, which explains the high cost of broadband packages despite the relatively good price of broadband in Mbps per month [3]*	• Desk research
		− Low government budget for school connectivity [4]	− Low GNI per capita ($930 USD and $2,730 USD at Purchasing Power Parity (PPP))	• Desk research
		+ Significant commitment from government to increase school connectivity	+ There are various government programs for improving school connectivity (e.g. School Connectivity Program, One Laptop per Child (OLPC) program) + The government is interested in exploring opportunities to lower tax on internet connectivity in underserved areas	• Interview with development aid organization • Desk research
		+ As for devices, the Rwanda government is committed to providing devices to teachers and students	+ The Rwandan government has implemented the One Laptop per Child (OLPC) program, which has distributed over 200,000 laptops in >900 schools	• Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	− Limited competition in the mobile connectivity segment	− Dominance of one market player with a 66% market share of 4G subscriptions (MTN) and one other major player (Airtel)	• Desk research
		− There is a monopoly in the 4G infrastructure & wholesale market. However, this is about to come to an end, which will boost competition in the 4G market	− The 4G infrastructure market used to be fully controlled by Korea Telecom Rwanda Networks (KTRN), but in July 2023 the Utilities Regulatory Authority (RURA) has modified the license of KTRN to allow other companies to deploy 4G networks	• Desk research
		+ The national fiber optic backbone provides open access to operators	+ The government has rolled out a national fiber backbone across all 30 districts, and provides open access to all operators at cost-based prices	• Desk research

Notes: 1) Please note that during the study we have not been able to conduct interviews with suppliers from Rwanda to validate the assessment; 2) Giga's connectivity map shows that 98% of schools are covered by good quality internet (> 3G), but only 22% of schools are connected to good quality connectivity; 3) Within the scope of this study we could not validate this hypothesis and further research is required; 4) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as % of GDP; Sources: Giga, interviews, Deloitte analysis

Rwanda | Assessment of market shortcomings [2/2]

In Rwanda, the main market shortcomings have been identified in the affordability, competition and delivery market dimensions

Assessment of school connectivity market[1]

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Delivery	Products & services are delivered reliably, cost effectively and on time	− Lack of uptake of connectivity solutions due to lack of electricity	− Lack of electricity (access to electricity is at 49% of population and 38% in rural areas)	• Desk research
Quality	Products meet quality standards	− Although there is nearly universal coverage of >3G internet (98% of schools), a significant share of schools are connected to lower quality internet (33% are connected to < 5 Mbps internet)	− *Hypothesis: the limited competition in the 4G infrastructure market has potentially led to MNOs preference of providing 2G/3G connectivity (higher margins for MNOs) and therefore to higher prices of 4G [3]*	• Desk research
		+ Quality of fixed broadband is relatively high in Rwanda, with Rwanda ranking 113th out of 181 countries	+ *Hypothesis: the government of Rwanda has made long-term agreements in terms of bandwidth demand with neighboring countries (Kenya, Tanzania), which might have helped improve quality of internet [3]*	• Desk research
Coverage gap market dimensions (coverage gap: ~2% of schools[2])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	+ Rwanda has achieved nearly universal coverage of 3G/4G (98% of schools)	+ Rwanda is a densely populated country (571 inhabitants per km2), which increases the business case for developing connectivity infrastructure	• Desk research
		+ LEO satellite internet has become available in Rwanda, and the government is collaborating with market players to make LEO satellite internet available for schools	+ Through the government's 'School Connectivity Program', 500 schools across the country will be connected to LEO satellite internet in collaboration with Starlink	• Desk research
Funding security	Market players have sufficient funding security	− *Hypothesis: similar to other countries, it is expected that access to finance is a challenge for smaller players [3]*	− *Hypothesis: smaller players are expected to have difficulties with accessing Universal Service Fund (USF) or development aid funding [3]* − Relatively high interest rate (7.5%)	• Desk research

Notes: 1) Please note that during the study we have not been able to conduct interviews with suppliers from Rwanda to validate the assessment; 2) Giga's connectivity map shows that 98% of schools are covered by good quality internet (> 3G); 3) Within the scope of this study we could not validate this hypothesis and further research is required;
Sources: Giga, interviews, Deloitte analysis

Rwanda | Broader context & status of school connectivity

Only 22% of schools in Rwanda have meaningful connectivity, with access to electricity and digital literacy posing barriers for expanding connectivity

Although 55% of schools are connected, only 22% of schools have a meaningful internet connection (3G/4G)

Overview
- Population: **13.8 million**
- Pop. density: **571 inhab. / km²**
- Urban/rural split: **12%/82%**
- GNI/capita: **$930 USD**
- GNI/capita (PPP[1]): **2,730 USD**

No connectivity   2G[2] 3G/4G Data unavailable

School connectivity	40.0%	32.8%	21.7%	5.6%
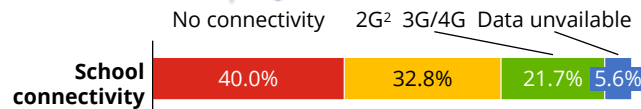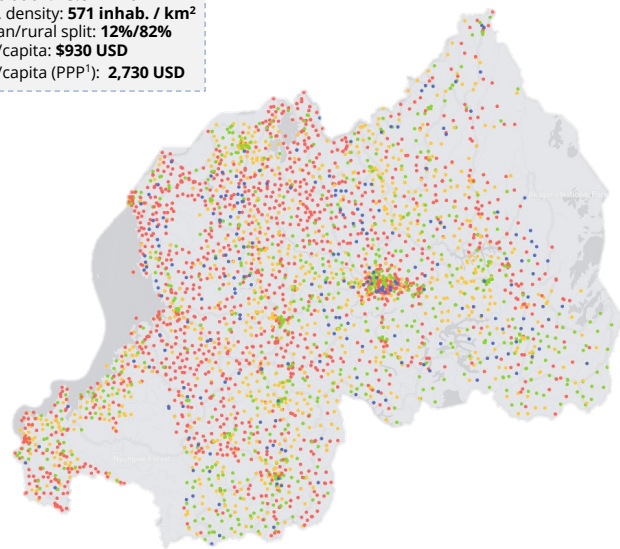
### Government support for school connectivity

- The Rwandan government has implemented the **One Laptop per Child (OLPC) program**, which has distributed over 200,000 laptops to primary school students across the country. This program helps to create a culture of technology and innovation from a young age
- In March 2023, **government ministers visited** the first **school** that was **connected** to the **internet via Starlink**

Electricity

- Access to electricity is **major barrier**, particularly in rural areas

Total	49%	51%
Urban	98%	2%
Rural	38%	62%

% of population with access to electricity
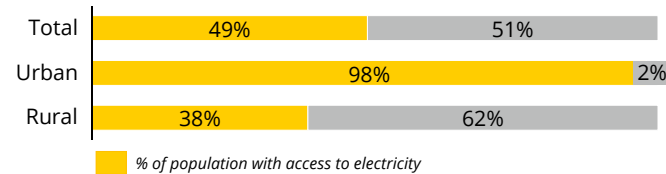
Digital literacy

- **Rwanda** has a **score of 4.5** on the Wiley 'Digital Skills Gap Index', which ranks Rwanda **4th out of 26** countries in **Sub-Saharan Africa**
- Digital literacy is relatively low in Rwanda: **30%** of the population in Rwanda **used the internet** in 2021

Key takeaways

+ **Affordability:** the **government** is **committed** to **providing ICT** and **high-speed internet** to schools

+ **Acceptability:** although **digital literacy** is relatively low in Rwanda, the **OLPC program includes training of teachers**

− **Affordability**: although the government is committed to expanding connectivity, **available budget** is expected to be **low** given the relatively low GNI per capita [2]

− **Delivery: lack of electricity** in rural areas increases costs for internet connectivity solutions

Notes: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production; 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP;
Sources: Giga, BCG, GSMA, WorldBank, Leonecom, Sierraloaded, Deloitte analysis
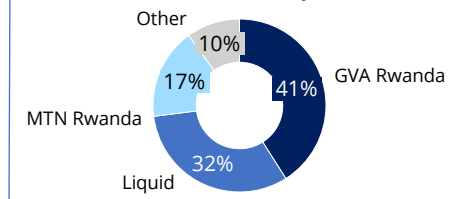
Rwanda | Fiber internet market

The government of Rwanda has made interventions to bring down cost of bandwidth; however, affordability of fiber remains a challenge

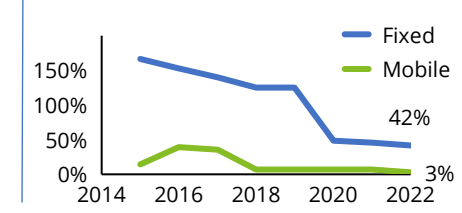**Key insights into the fiber internet market**

Coverage	• Given the **landlocked character** of Rwanda, the **government** deployed initiatives to **procure undersea fiber optic cable capacity** in Kenya and Tanzania • Rwanda has invested in **expanding its fiber network**, spanning over **6,000 km** since 2019. Nearly all schools are within a 30 km range of the fiber network. • Additionally, there are **several thousand kilometres** of **fiber deployed by other (private) operators** as a base for fixed and mobile internet • **Less than 1%** of Rwandans have **a fixed internet connection**
Market players	• The main Fixed Network Operators include **GVA Rwanda, Liquid Telecom Rwanda and MTN Rwanda** • **GVA Rwanda** is the **market leader** in terms of fixed broadband subscriptions **(41%)** followed by Liquid Telecom (32%) and MTN Rwanda (17%)
Pricing & quality	• **Bulk purchases** by the government greatly **expanded** Rwanda's international bandwidth capacity with some of the **lowest wholesale prices** in Africa • Price of fixed broadband is **relatively low ($0.51 USD per Mbps per month)**, although the price of a fixed **broadband package** is generally **not affordable (at 42% of GNI per capita)** • According to the Ookla speedtest, Rwanda has a **download speed of 34 Mbps** and **upload speed of 10 Mbps**, which ranks Rwanda **113th out of 181** countries
Market trends	• The World Bank Group has approved **$100 million** to help the Government of Rwanda **increase access and adoption of digital services** including broadband

> " Rwanda has made certain interventions to bring down the costs of bandwidth. They have used development finance to make long-term commitments. "
>
> **- Infrastructure provider**

Fixed broadband subscriptions (2023)

Other 10%
GVA Rwanda 41%
MTN Rwanda 17%
Liquid 32%

Broadband prices as % of GNI per capita[1]

- Fixed
- Mobile

150%
100%
50%
0%
2014 2016 2018 2020 2022
Fixed: 42%
Mobile: 3%

THE WORLD BANK

December 2021

World Bank Provides $100 Million to Accelerate Rwanda's Digital Transformation

Key takeaways

+ **Availability:** the fiber network **spans most of the country** and international bandwidth is available

− **Affordability:** despite **successful government interventions** to bring down costs, **affordability of fixed broadband** remains a **challenge**

+ **Competition:** there are **multiple larger FNOs** competing in the market

+ **Quality:** quality of fixed broadband is relatively high in Rwanda

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Giga, ITU, Rwanda Utilities Regulatory Authority, UN-OHRLLS, Ookla, Rwanda Today, ISP, Cable.co.uk, Interviews, Deloitte analysis

Rwanda | Wireless internet market

There is a well-established 4G network in Rwanda, and mobile connectivity is relatively affordable; however, competition is limited

Key insights into the wireless internet market

Coverage	• The **3G/4G network** in Rwanda covers **98% of schools**, and the **4G network covers 97% of population**
Market players	• The 4G infrastructure market used to be fully owned by **Korea Telecom Rwanda Networks (KTRN)**, but in July 2023 the Utilities Regulatory Authority (RURA) has modified the license of KTRN to **allow other companies to deploy 4G networks** • **MTN** is the **market leader** in the 4G market with **66%** of subscriptions. **Airtel** is another significant player with 21% of subscriptions. The **remaining 13%** of 4G subscriptions is covered by **18 different ISPs**
Pricing & quality	• **Price of mobile connectivity** is **relatively low** in Rwanda (at 3% of GNI per capita, and on average $0,55 USD per GB of mobile data) • The **opening of the 4G infrastructure market**, is **expected to reduce the cost of wholesale 4G** which will also reduce consumer prices • The speed of mobile broadband in Rwanda is average with **27 Mbps down- and 8 Mbps upload speed**
Market trends	• The government of Rwanda is preparing to **pilot 5G internet** by the end of 2023. The government is establishing 5G related infrastructure as part of the **revised National Broadband Policy and Strategy** from October 2022. The government aims to have a total of **60 5G sites in operation by 2025**

School coverage

No coverage   2G   3G/4G   Data unavailable

2%   98%   0%

0%

Market share 4G subscribers (2022)

Others 13%
Airtel 21%
66% MTN

Connecting Africa

July 2023

Korea Telecom Rwanda Networks loses 4G infrastructure monopoly

The New Times   *February 2023*

Rwanda set to pilot 5G internet

Key takeaways

+ **Availability:** Rwanda has achieved **nearly universal coverage of 3G/4G** (98% of schools are covered)

− **Competition:** dominance of one market player with a 66% market share of 4G subscriptions (MTN); the 4G infrastructure market used to be a monopoly, but this has recently been changed

+ **Affordability:** the **price of mobile connectivity** is **relatively low** in Rwanda and is **near the target of 2% of GNI per capita**

Sources: Giga, ITU, Rwanda Ministry of ICT & Innovation, Connecting Africa, Cable.co.uk, Ookla, The New Times, Interviews, Deloitte analysis

Rwanda | Satellite internet market

LEO satellite internet has become available in Rwanda and the government is collaborating with market players to make LEO satellite internet available to schools

Key insights into the satellite internet market

Coverage	• Rwanda is **covered** by Starlink's **LEO satellites** and by **GEO/VSAT satellites**	SPACE IN AFRICA *February 2023* SpaceX's Starlink Licensed in Rwanda
Market players	• Several providers **offer GEO/VSAT** internet (**Vizocom, Ntvsat and Globaltt**) • In early 2023, **Starlink** entered the market in Rwanda as currently the **only provider** of **LEO satellite internet** • The **Rwandan Space Agency** (RSA) indicates that Starlink's **services** have the potential to **increase the competitiveness** in the **broadband services sector**	VIZOCOM GLOBALTT STARLINK n|TVsat
Pricing & quality	• The Minister of ICT and Innovation states that the **Starlink's LEO internet** is about **three times faster than** the **available products** on the Rwandan market at almost the **same price point** • Price of Starlink satellite internet is around **$39 USD per month** with a **one-off equipment & shipping price of ~$460 USD** [1]	The New Times *February 2023* **Starlink internet is fast and affordable, ICT Minister says**
Market trends	• The Rwanda Space Agency (RSA) has announced that **Starlink has been licensed** to provide **internet services** to Rwanda • The Ministry of ICT and Innovation plans to **pilot** the **internet services** from **Starlink's satellite** technology in **500 Rwandan schools**; the **first 50 schools** have already been provided Starlink internet	The New Times *February 2023* **Starlink internet to be piloted in 500 schools**

Key takeaways

+ **Availability: LEO satellite internet** has become available in Rwanda, and the government is collaborating with market players to make LEO satellite internet **available for schools**

+ **Affordability & Quality:** first signals indicate that **LEO satellite** internet is **competitive with other connectivity solutions**

− **Competition: Starlink** currently is the **only company offering LEO satellite services**

Note: 1) Prices based on online available information on residential subscription price (source: Starlink Insider) and these have not been verified for school connectivity
Sources: Company websites, The New Times, Starlink Insider, Rwanda Space Agency, Interviews, Deloitte analysis

Rwanda | Enabling environment

The government is focused on improving prices in the telecommunications market and encourage foreign direct investment into the Rwanda economy

Regulations

- The Government of Rwanda is aiming to **improve competition** among **internet service providers** to **lower the costs** for Rwandans. One such initiative is the establishment of the **Rwanda Internet Exchange Point** (RIXP), which allows local ISPs to **exchange internet traffic within the country**, rather than routing it through international networks

- **Taxes and regulatory fees** also play a role in determining internet prices in Rwanda. ISPs are subject to various taxes and levies, including a value-added **tax (VAT) of 18% on internet services**, as well as **regulatory fees** imposed by the Rwanda Utilities Regulatory Authority (RURA). These **costs** are often **passed on to consumers** in the form of higher prices for internet access

- The **Ministry of ICT** (MINICT) addresses national priorities relating to **economic growth** and **poverty reduction through** policies and programs related to information, **technology, communication** and **innovation** as well as **citizen's empowerment**

G4   Rwanda's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 4: 'Integrate regulation'** [1]

Access to finance

- **Foreign Direct Investments** (FDI) have been **on the rise** after a moderate dip during the COVID-19 pandemic and exceeding the investments from before the pandemic. The **FDI** in **2022** stood at around **400 million USD**, coming from 150 million USD in 2020.

- The **Rwandan Investment Code** calls for **equal treatment** for both **foreigners and nationals** in certain operations, free transfer of funds, and compensation in cases of expropriation. This makes Rwanda an **interesting economy** for **foreign investors and companies**

Access to finance indicators

$ Exchange rate to USD: **0.00081**

   Government Debt to GDP (% of GDP): **67.5%** (2022)

   Interest rate: **7.5%** (2023)

   Domestic Credit to private sector (% of GDP)[2]: **22.5%** (2022)

Key takeaways

- **+ Affordability:** the establishment of the **Rwanda Internet Exchange Point** has helped to **reduce the cost of internet** and improve the overall quality of internet services in Rwanda

- **− Affordability: taxes** and **regulatory fees** are **passed onto consumers**

- **− Funding security:** there is a **relatively high interest rate (7.5%),** which may hamper investments

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, World Bank Development Indicators, Trading Economics, interviews, Deloitte analysis

5 **ECOWAS region**
Market assessment & recommended actions

ECOWAS | Broader context

Countries among the ECOWAS region show major differences in economic performance, and despite relatively high internet coverage the majority of schools are not connected

Overview of the ECOWAS region
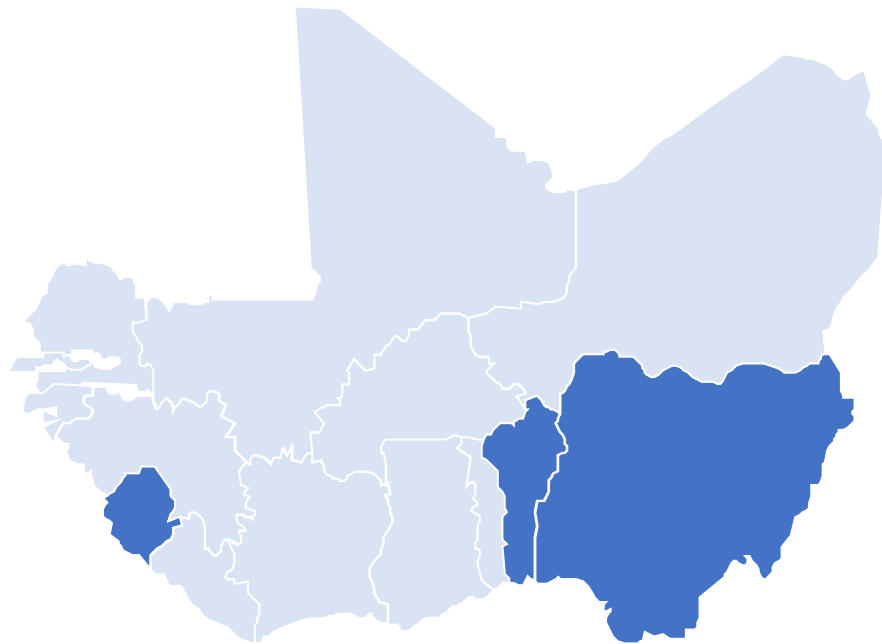
■ *Deep-dive in following slides: Nigeria, Benin, Sierra Leone*

□ *Other ECOWAS countries*

Population & economy

- The Economic Community of Western African States (ECOWAS) comprises fifteen member states and has around **414 million citizens**, of which roughly 47% is urban population and 53% is rural population

- **Nigeria is the biggest economy** in the ECOWAS region, with a GDP of $477 billion USD (roughly 63% of ECOWAS region)

- **GNI per capita differs significantly across countries**, ranging from $2,620 USD in Côte d'Ivoire to $510 USD in Sierra Leone

Internet connectivity

- **Several submarine cables carrying international broadband land in the ECOWAS-region** including landings of the Africa Coast to Europe (ACE) in nearly all coastal countries in the region and the West African Cable Systems (WACS) with landings in Nigeria, Togo, Ghana, Côte d'Ivoire and Cabo Verde. Other countries such as Burkina Faso, Mali and Niger, are landlocked, and are connected through terrestrial networks with neighbouring countries

- **The coverage of 3G and 4G internet is relatively high** with over 80% of the population covered

- Despite the coverage in these countries, **the majority of schools, specifically in Sierra Leone and Benin, are still not connected to the internet**

Source: ECOWAS, OECD, the World Bank, International Monetary Fund, GSMA

ECOWAS | Assessment of market shortcomings [1/2]

In ECOWAS, the affordability of connectivity is a major barrier across the region alongside the challenge of a lack of electricity and access to finance

Severity of barrier

🟩	*No barrier*
🟨	*Small barrier*
🟧	*Large barrier*

Assessment of school connectivity market

Dimension	Regional summary per theme		Nigeria		Sierra Leone		Benin
Usage gap[1] dimensions	*% schools that are covered but not connected:*	🟧	Up to 80%	🟧	~55%	🟧	Up to 83%
Acceptability	**Digital illiteracy:** digital literacy is a barrier to adopting school connectivity, especially in Sierra Leone and Benin	🟨	**Digital literacy is moderate** in Nigeria (55% of individuals using the internet)	🟧	**Digital literacy is low** in Sierra Leone (18% of individuals using the internet)	🟧	**Digital literacy is relatively low** in Benin (34% of individuals using the internet)
Affordability	**Price of connectivity:** prices are relatively low in Nigeria; in Sierra Leone and Benin the affordability of connectivity is however a challenge	🟩	Although price of fixed of broadband is relatively high, prices of mobile and satellite connectivity are **relatively low in Nigeria**	🟨	**Price is high for fixed** broadband (e.g. lack of access to affordable funding, reliance on single first-mile operator), **but relatively low for mobile** broadband	🟧	**Prices of fiber & mobile connectivity are high,** despite government efforts to reduce prices through price controls
	Prices of devices: price of devices is a challenge in Sierra Leone; it is unclear to what extent this is the case in Nigeria & Benin	🟨	No market shortcoming identified, but **expected to be a challenge** given the **high inflation**	🟧	**Price is high** (high inflation resulting in unfavorable exchange rates for equipment procured abroad)	🟩	No market shortcoming identified
	Government budget: whereas in Sierra Leone there is significant commitment from the government to increase school connectivity, in Nigeria & Benin there seems to be less government priority for school connectivity[2]	🟧	**Low government budget** for school connectivity (only 5% of government expenditure and only 1% of GDP goes to education)[2]	🟨	**Low government budget** available[2], but **significant commitment & share of gov't expenditures** to increase school connectivity as well as **good collaboration** among stakeholders	🟨	**Relatively low government budget** for school connectivity[2]; no dedicated initiative to improve school connectivity in Benin has been identified
Competition	**Competition:** the level of competition varies from a highly competitive market in Nigeria to the limited competition in Sierra Leone & Benin	🟨	There is a **competitive mobile & satellite market** (many ISPs, several MNOs and MVNOs, various satellite players); in the fiber market however there is limited competition	🟧	**Limited competition** in the mobile connectivity market and **reliance on one private sector first-mile (backbone) operator**	🟧	**Limited competition** in the mobile connectivity market, although recently a **new MNO has been introduced** to the market to increase competition; **reliance on one backbone operator**
Delivery (1/2)	**Access to electricity:** lack of electricity is a significant challenge across the region, but particularly in Sierra Leone & Benin	🟨	**Lack of electricity is a challenge** (access to electricity is at 60% of population and only 26% in rural areas)	🟧	**Lack of electricity is a major challenge** (access to electricity is at 28% of population and only 5% in rural areas)	🟧	**Lack of electricity is a major challenge** (access to electricity is at 42% of population and only 18% in rural areas)

Notes: 1) The 'usage gap' is defined as the difference between the percentage of schools with good-quality coverage (>3G) and the percentage of schools that are actually connected to good quality connectivity (> 3G); 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Interviews, Deloitte analysis

ECOWAS | Assessment of market shortcomings [2/2]

In ECOWAS, the affordability of connectivity is a major barrier across the region alongside the challenge of a lack of electricity and access to finance
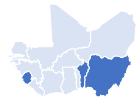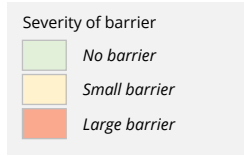
Severity of barrier

🟩	*No barrier*
🟨	*Small barrier*
🟧	*Large barrier*

Assessment of school connectivity market

Dimension	Regional summary per theme	Nigeria	Sierra Leone	Benin
Delivery *(2/2)*	**Security:** vandalism & theft is a concern in Nigeria & Sierra Leone; it is unclear to what extent this is the case in Benin	Vandalism & theft is a **concern, particularly in rural areas**	Vandalism & theft is a **concern, particularly in rural areas**	No market shortcoming identified
	Maintenance & after-sales support: providing maintenance and support is a challenge in rural areas given the low population density, challenging landscape (e.g. mountains) and lack of general road infrastructure	**Lack of business viability** of establishing local support & maintenance centers in rural areas	**High cost of maintenance & support** due to several factors (mountainous landscape, electricity & security challenges)	No market shortcoming identified, but cost of maintenance & support is expected to be a **challenge for rural areas**
Quality	**Quality:** quality of internet is generally low, but seems to be slightly better in Benin	**Fixed** internet is of **low quality, but mobile** connectivity has **relatively good quality**	Quality is **low**, but this is **not considered one of the major barriers** in Sierra Leone	**Quality of internet is relatively good** in Benin
Coverage gap[1] dimensions	*% schools that are not covered:*	~20%	~43%	~17%
Availability	**Business viability of investment in rural areas:** in Nigeria & Benin, there is a large coverage of the 4G network; in Sierra Leone however the network coverage lags behind	**Large coverage of 4G**, and **significant commitment from the government** to further expand coverage to rural areas as reflected in regulations	**Low profitability in rural areas** (e.g. low purchasing power, lack of electricity) and **high cost of infrastructure** (e.g. mountainous areas)	**Large coverage of 4G** and market players are investing in remote areas
	Availability of new solutions: market players are developing solutions to address the challenge of electricity; LEO satellite internet may also bring new opportunities in the ECOWAS region, but affordability might be a barrier for uptake	Availability of companies that can provide **satellite connectivity** with **renewable power generation** and **training of communities**; availability of **LEO satellite internet**	**LEO satellite internet** is expected to become available in 2024, but **affordability is expected to be a barrier**	Market players have identified **solutions that address the challenge of electricity** (mobile towers with solar panels)
Funding security	**Access to finance:** in Nigeria & Sierra Leone, access to finance is a major challenge; the access to finance in Benin seems to be better	**Lack of access to finance**, particularly for smaller players (perception of unsuccessful implementation of Universal Service Fund, high interest rate)	**Lack of long-term development funding** for connectivity to cover the recurring costs of connectivity; and high interest rate and inflation	Access to finance of market players is expected to be **relatively good**, given the relatively low interest rate

Note: 1) The 'coverage gap' is defined as the percentage of schools that are not covered by a good-quality (>3G) network
Sources: Interviews, Deloitte analysis

ECOWAS | Recommended actions

Giga can help improve affordability of connectivity and facilitate access to funding

UNICEF's market-shaping levers
- Increase market information
- Reduce transaction costs
- Balance supplier & buyer risks
- Improve access to finance & technology

Possible actions to strengthen the school connectivity market

N/A : no relevant action identified for Giga

Dimension	Common theme[1]	Applicable countries (Nigeria, SL, Benin)	What can **Giga** do to address the identified market shortcomings?	Relevant **market-shaping levers**
Usage gap dimensions				
Acceptability	Digital illiteracy	Nigeria, SL, Benin	• Orchestrate an **integrated approach to connectivity**, including electricity, devices and training through combined contracting	
Affordability	Price of connectivity	SL, Benin	• Ensure that the **risk of inflation is well-managed** in connectivity contracts (e.g. agree on price in US dollars and then get paid in the equivalent value of the local currency at the time of delivery)	
	Price of devices	Nigeria, SL, Benin	• Look for opportunities for **pooled procurement of devices** to bring down prices • **Include the procurement of devices** in the connectivity procurement process	
	Government budget for school connectivity	Nigeria, SL, Benin	• Support governments with **accessing development funding** earmarked for school connectivity • Develop a **proposition for monetizing connectivity by schools** (e.g. paid public Wi-Fi)	
Competition	Level of competition	SL, Benin	• Explore **possibilities to reduce reliance on a single first-mile operator** (potentially by advocating for the entrance of new infrastructure players (e.g. Liquid Technologies))	
Delivery	Access to electricity	Nigeria, SL, Benin	• Orchestrate an **integrated approach to connectivity**, including electricity • Facilitate **knowledge transfer**, showcasing propositions like satellite connectivity with solar kits	
	Security (vandalism & theft)		• *N/A*	
	Maintenance & after-sales support	Nigeria, SL, Benin	• Sharing of best practices on **training of communities** for **local support & maintenance**	
Quality	Quality of connectivity		• *N/A*	
Coverage gap dimensions				
Availability	Business viability for investing in connectivity in rural areas	SL	• Include the **proximity of other potential customers** (town hall, health clinic, etc.) and the **structure of schools** in Giga's **connectivity map** of schools (e.g. as part of a school's score)	
	Availability of new solutions for rural areas (e.g. new technologies, community networks)	Nigeria, SL, Benin	• Facilitate **knowledge transfer**, showcasing propositions like satellite connectivity with solar kits • Look for opportunities for (cross-country) **pooled procurement** for LEO satellite internet	
Funding security	Access to finance by market players	Nigeria, SL, Benin	• Set up a **dedicated financing vehicle** to provide **low-interest loans** for middle-mile connectivity • Create more **OPEX-oriented financing vehicles** to cover the recurring costs of connectivity	

Note: 1) Common themes have been identified through bottom-up analysis of the common market shortcomings & root causes that have been identified across countries
Sources: Interviews, Deloitte analysis

Nigeria | Assessment of market shortcomings [1/2]

In Nigeria, the main market shortcomings have been identified in the affordability, availability and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
*Usage gap market dimensions (usage gap: up to **80% of schools**[1])*				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Lack of uptake from communities because of digital illiteracy (suppliers have the perception that not all teachers are willing to transition to digital learning)	− Digital illiteracy; digital literacy is relatively low in Nigeria with 55% of individuals in Nigeria using the internet	• Interview with satellite operator • Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− High price of fiber connectivity; fixed broadband is at 19% of GNI per capita and over the last 10 years have barely reduced	− Low GNI per capita ($2,140 USD and $5,650 USD at Purchasing Power Parity (PPP)) − Market dominance of one player in the fiber market (ipNX has 65% market share)	• Desk research
		+ Prices of mobile broadband internet are relatively low (data-only mobile broadband is at 1.8% of GNI per capita, and $0.39 USD per GB of mobile data (2nd least expensive of the 9 focus countries))	+ High level of competition in the mobile market with several large MNOs, and the recent introduction of MVNOs	• Desk research
		+ Price of GEO satellite internet is relatively low (e.g. Coollink offers VSAT at ~$10 USD per month (20 Mbps) with an equipment price of ~$80 USD)	+ Nigeria has its own state-owned satellite operator, and *the hypothesis is that this results in lower satellite connectivity prices* [2] + Active and competitive market for satellite connectivity in Nigeria	• Interview with satellite operator • Interview with ISP • Desk research
		− Low government budget for school connectivity[3]; dependency of schools on donations (e.g. from Alumni) to fund connectivity	− Government expenditure on education is only 5% of total government expenditure and only 1% of GDP, which makes Nigeria the country with the lowest relative government budget for education out of the 9 focus countries − Suppliers perceive that internet connectivity is considered a 'luxury' and that there is a lack of adequate funding for school connectivity by the government	• Interview with ISP • Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	+ There are many ISPs (264), indicating low barriers to entry	+ *Hypothesis: regulatory environment supports the entrance of new market players* [2]	• Desk research
		− Low level of competition in the last-mile fiber-to-the-home/building market	− Dominant player in the fiber market (ipNX has 65% market share)	• Desk research
		+ There is a competitive mobile internet market in Nigeria with several large MNOs, and the recent introduction of MVNOs	+ Recent issuance of 25 mobile virtual network operator (MVNO) licenses, which were brought in the market to further increase competition	• Desk research
		+ There is an active and competitive market for satellite connectivity in Nigeria	+ *Hypothesis: the large market opportunity in Nigeria (large & growing population, lack of existing fixed/mobile infrastructure) is expected to attract international satellite players* [2]	• Desk research
Delivery	Products & services are delivered reliably, cost effectively and on time	− Lack of business viability of establishing local support & maintenance centers in rural areas	− Low population / customer density in rural areas	• Interview with ISP • Interview with satellite operator
		− Lack of uptake of connectivity solutions due to lack of electricity	− Lack of electricity (access to electricity is at 60% of population and 26% in rural areas)	• Interview with ISP • Desk research

Notes: 1) Giga's connectivity map shows that 80% of schools are covered by good quality internet (> 3G), but actual connectivity is unknown; 2) Within the scope of this study we could not validate this hypothesis and further research is required; 3) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Giga, interviews, Deloitte analysis

Nigeria | Assessment of market shortcomings [2/2]

In Nigeria, the main market shortcomings have been identified in the affordability, availability and funding security market dimensions

**Assessment of school connectivity market**

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Quality	Products meet quality standards	− Quality of fixed broadband is relatively low in Nigeria, with Nigeria ranking 142nd out of 181 countries by Ookla's Speedtest Global Index	− *Hypothesis: low penetration of fiber connectivity and low level of competition in the fiber-to-the-home/building market [2]*	• Desk research
		+ Quality of mobile broadband is relatively high compared to other countries in the region, with Nigeria ranking 85th out of 141 countries by Ookla's Speedtest Index	+ *Hypothesis: high level of competition in the mobile market may result in good-quality mobile broadband [2]*	• Desk research
Coverage gap market dimensions (coverage gap: ~20% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	− Lack of business viability for last-mile fiber & mobile connectivity in rural areas	− Lack of existing middle-mile fiber/mobile infrastructure due to low profitability (high investment & operating costs (e.g. maintenance & support) and low revenue density)	• Interview with ISP • Interview with satellite operator
		− Lack of business viability for satellite connectivity in rural areas	− Lack of electricity (in rural areas only ~26% of population have access) − Theft and vandalism affecting connectivity infrastructure	• Interview with ISP • Interview with satellite operator
		+ Significant government commitment to improve connectivity in rural areas	+ The national regulator (NCC) has a specific department for broadband penetration in rural areas + Furthermore, the government launched a National Broadband Plan improve coverage & quality of connectivity by 2025 + Nigeria's licensing requirements require MNOs to expand their coverage across all regions of the country	• Interview with ISP • Desk research
		+ Availability of a suitable connectivity solution for schools in rural areas	+ Availability of companies that can provide GEO satellite with renewable power generation and training of communities + Availability of LEO satellite internet (Starlink)	• Interview with ISP • Desk research
Funding security	Market players have sufficient funding security	− Lack of access to finance for MNOs to deploy infrastructure in rural areas	− Private finance providers prefer financing connectivity for urban areas (better risk/return profile) − Government funding is limited − High cost of capital (interest rate of 18.75%)	• Interview with ISP • Deloitte desk research
		− Lack of access to finance for ISPs	− Perception of an unsuccessful implementation of the Universal Service Fund (USF) and difficulty to gain access to USF funding − Smaller ISPs are too small to gain access to development funding − High cost of capital (interest rate of 18.75%)	• Interview with ISP • Interview with African int'l infrastructure provider • Desk research

Notes: 1) Giga's connectivity map shows that 80% of schools are covered by good quality internet (> 3G); 2) Within the scope of this study we could not validate this hypothesis and further research is required;
Sources: Giga, interviews, Deloitte analysis

# Nigeria | Broader context & status of school connectivity

In Nigeria, there is a lack of information on the connectivity of schools, but connectivity is expected to be relatively high in urban areas but low in rural areas

Of all >110,000 schools, **80% of schools** are **covered by 3G/4G** but actual connectivity is unknown[1]
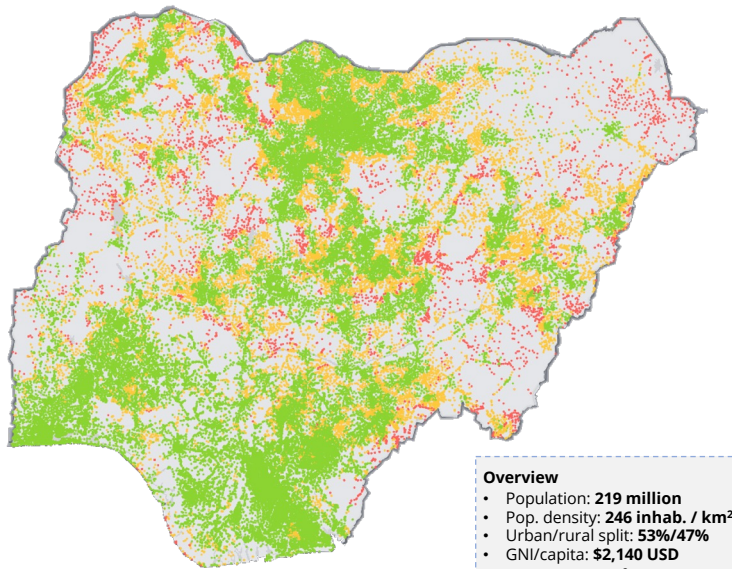
Overview
- Population: **219 million**
- Pop. density: **246 inhab. / km²**
- Urban/rural split: **53%/47%**
- GNI/capita: **$2,140 USD**
- GNI/capita (PPP[2]): **$5,560 USD**

School coverage

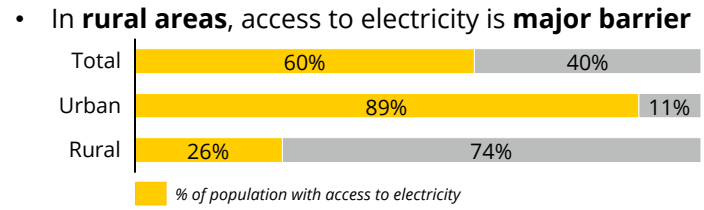| No coverage	2G	3G/4G	Data unavailable
4%	15%	80%	1%
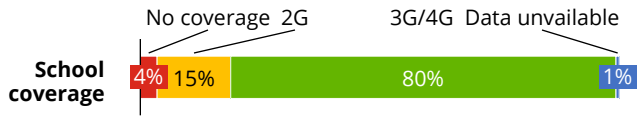
Government support for school connectivity

- In March 2022, the Ministry of Education launched the **Nigeria Learning Passport (NLP)** together with **UNICEF** and **Microsoft**. The NLP offers **digital learning resources** and is supported by **Airtel** and **IHS Towers** to connect more schools and provide **free access to the NLP** on Airtel devices
- In March 2023, the government approved the budget of N24.2 billion **(~$31 million USD)** to install **broadband internet** connections in **43 schools, 20 airports and 6 shopping malls**

Electricity

- In **rural areas**, access to electricity is **major barrier**

Total	60%	40%
Urban	89%	11%
Rural	26%	74%

☐ *% of population with access to electricity*

Digital literacy

- Digital literacy is average in Nigeria; **55% of individuals** in Nigeria are using the internet
- Nigeria scores a 3.6 on the Wiley 'Digital Skills Gap Index', **ranking 11th out of 26 countries** in Sub-Saharan Africa

Key takeaways

- **+ Affordability:** the government is making efforts to **improve school connectivity and digital education**, illustrated by the National Learning Passport (NLP) initiative

- **− Delivery:** while in urban areas there is relatively high access to electricity (~89% of population), **in rural areas there is a lack of access to electricity** (only ~26% of population have access)

- **− Acceptability:** there is a **lack of digital skills** with only 55% of individuals using the internet

Notes: 1) Status of school connectivity is unknown by Giga as Giga has not (yet) engaged with the government to obtain this data; 2) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production
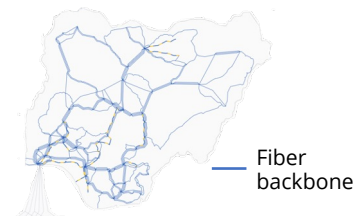Sources: Giga, ITU, World Bank, GSMA, Wiley, Deloitte analysis
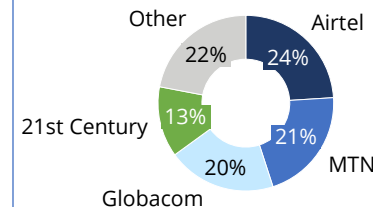
Nigeria | Fiber internet market

The fiber market in Nigeria is concentrated in the biggest city Lagos and the capital Abuja, and expanding to rural areas is considered not economic viable

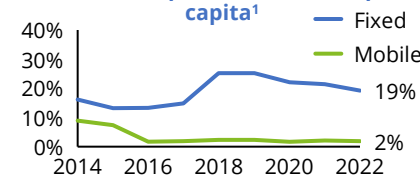**Key insights into the fiber internet market**

Coverage	• In Nigeria, there are **6 international submarine cables** entering in Lagos • **Total optical-fiber cable deployment** was **~96,000 km** (on-land fiber & submarine cable) across Nigeria by the end of 2022 • There are **<1 fixed broadband subscriptions per 100 inhabitants** • Investments in the fiber market focus on urban areas, and it is considered **too expensive** to **deploy fiber in rural areas** due to the low population density and high cost of maintenance
Market players	• In terms of **on-land fiber deployment**, the three main **MNOs Airtel, MTN** and **Globacom** account for a large share (~44,500 km, **65%**); besides the MNOs, the fixed network operator **21st Century** (~9,000 km, **13%**) is also a significant player • In terms of **Fiber-to-the-Home/Building subscriptions**, **ipNX is the market leader** with **64%** of the ~50,300 subscriptions. **MTN (11%)** and **Suburban Broadband (8%)** are other players in the fiber market • There is a **large number of Internet Service Providers (ISPs)** in Nigeria (264), but ISPs in Nigeria are **concentrated mostly in Lagos** and **Abuja**
Pricing & quality	• **Fixed broadband prices** in Nigeria relative to the **GNI per capita is at 19%** and have not reduced over the last years • Fiber broadband from ipNX is priced between **~$27 USD per month** (35 Mbps down, unlimited vol.) and **~$235 USD per month** (600 Mbps down, unlimited vol.) • **Quality of fixed broadband** is reported as 18 Mbps down, 12 Mbps up and latecy of 28ms, **ranking Nigeria 142th** in the Ookla Speedtest Global Index
Market trends	• The $428 million **backbone project (NICTIB II)**, financed by the Export-Import Bank of China, aims to develop **3,250 km of fiber across 19 states** (out of 36 states in Nigeria); the NICTIB II was **deemed 98% complete in Dec. 2022**

Fiber backbone

On-land fiber deployment 2022

- Other 22%
- Airtel 24%
- 21st Century 13%
- MTN 21%
- Globacom 20%

Broadband prices as % of GNI per capita[1]

- Fixed — 19%
- Mobile — 2%

(years: 2014, 2016, 2018, 2020, 2022; axis 0%–40%)

July 2023

NICTIB II: Fiber Optic Cable Infrastructure Brings Hope and Concerns to Communities, by Khadija Ishaq Bawas

Key takeaways

- **Availability:** investments in fiber in rural areas are **considered too expensive**, due to the low population density and high costs for maintenance
+ **Competition:** there are **many ISPs (264)**, indicating **low barriers to entry**
- **Affordability:** Over the last 10 years, prices of fixed broadband relative to GNI per capita have barely reduced, indicating that **affordability is a persistent challenge**
- **Quality:** fixed internet **seems to be relatively low** compared to other countries in the region

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Giga, ITU, World Bank, Submarine Cable Networks, Nigeria Communications Commission (NCC) Annual Report 2022, Economic Confidential, ipNX, Ookla, Interviews, Deloitte analysis
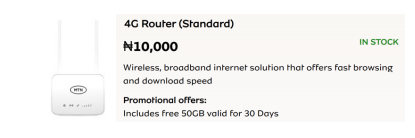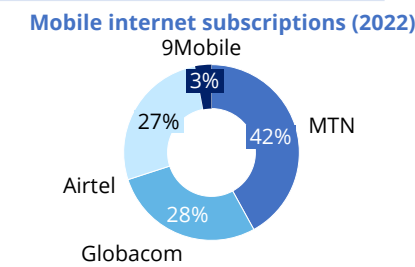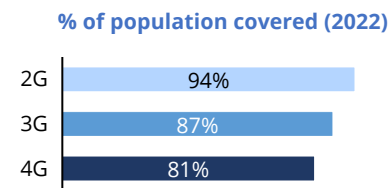
Nigeria | Wireless internet market

The mobile internet market in Nigeria is competitive and prices are relatively low, but most players lack economic incentive to expand their operations to rural areas

Key insights into the wireless internet market

Coverage	• In Nigeria, the **majority of schools (80%)** is **covered by 3G or 4G** • **>80% of population is covered by 4G** (LTE/WiMAX), 87% of population is covered by 3G and 94% of population is covered by 2G • Current **broadband penetration** stands at around **50% of population** • Like the fiber market, there is a **lack of economic incentive** for MNOs to expand their mobile infrastructure to remote areas
Market players	• In the **mobile internet market**, **MTN is the market leader** with 66 million subscriptions (**42% market share**) followed by **Globacom (28%), Airtel (27%)** and **9Mobile (3%)** • **Mafab Communications** is a **new player** which entered the market in 2021, focusing solely on **5G** • Besides the MNOs, there are also 'collocation & infrastructure sharing' companies that own **mobile towers**; in this segment, **IHS Nigeria** is the market leader **(48%)** followed by **Globacom (25%)** and **ATC Wireless Infrastructure (22%)**
Pricing & quality	• Prices of **mobile broadband** internet are **relatively** low; data-only mobile broadband is at 1.8% of GNI per capita, and $0.39 USD per GB of mobile data (2nd least expensive of the 9 focus countries) • **Quality of mobile broadband** is reported as 27 Mbps down, 12 Mbps up and latency of 32ms, **ranking Nigeria 85th** in the Ookla Speedtest Global Index
Market trends	• In October 2022, the **European Investment Bank** agreed to provide **€100 million in funding** to **MTN Nigeria** to support the expansion of its 4G network • In June 2023, the Nigeria Communications Commission (NCC) issued **25 mobile virtual network operator (MVNO)[2] licenses** to increase competition, reduce prices and improve network coverage in underserved areas • In June 2023, **Airtel** became the third operator to **launch 5G**, following earlier deployments of **MTN Nigeria** and newcomer **Mafab Communications**

% of population covered (2022)

2G	94%
3G	87%
4G	81%

Mobile internet subscriptions (2022)

- 9Mobile 3%
- MTN 42%
- Globacom 28%
- Airtel 27%

4G Router (Standard)
₦10,000 — IN STOCK
Wireless, broadband internet solution that offers fast browsing and download speed
Promotional offers:
Includes free 50GB valid for 30 Days

Oct. 2022 — Nigeria: EIB backs MTN Nigeria with €100m for high-speed network expansion

June 2023 — The Guardian: Nigeria begins MNVO operations, 25 firms get licences

June 2023 — total telecom: Airtel joins the 5G race in Nigeria

Key takeaways

− **Availability:** there is a **lack of economic incentive** for MNOs **to expand** their mobile infrastructure to **rural areas**

+ **Competition**: There is a **competitive mobile internet market** in Nigeria with several large MNOs, and the **recent introduction of MVNOs**

+ **Affordability:** Prices of **mobile broadband** internet are **relatively low** in Nigeria compared to other countries

+ **Quality seems to be relatively high** compared to other countries in the region

Sources: Giga, ITU, Nigeria Communications Commission (NCC) Annual Report 2022, Cable.co.uk, Vanguard, MTN, EIB, The Guardian, Total Telecom, Interviews, Deloitte analysis

Nigeria | Satellite internet market

There is an active and competitive satellite internet market in Nigeria, and satellite internet is offered at an affordable price point
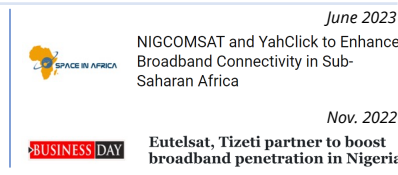
Key insights into the satellite internet market

Coverage	• There is an **active satellite market** in Nigeria, and **VSAT internet** is being used across the country • As of June 2023, **Starlink Nigeria** had a total **customer base of 6,756** in Nigeria • However, there are still several **challenges** for satellite internet in rural areas, including affordability, access to electricity, security, (digital) illiteracy and the provision of after-sales services
Market players	• There are many players active in the **satellite market** of Nigeria, ranging from state-owned satellite operator **NIGCOMSAT** to satellite internet providers such as **Yahclick, Avanti and Eutelsat** • Furthermore, there is the entrance of **LEO-satellite players such as Starlink** (which is available in Nigeria since January 2023 with Nigeria being the first African country to receive Starlink's service) and **Eutelsat OneWeb** • Additionally, there are ISPs such as **Coollink, Derive Communications** and **Tizeti** which partner up with satellite internet providers to service their customers with satellite connectivity
Pricing & quality	• Starlink's LEO connectivity was introduced to the Nigerian market at **$48 USD per month** with a **one-off equipment & shipping price** of **$380 USD** [1] • VSAT players such as Coollink on the other hand offer satellite internet as affordable as **~$10 USD per month** (20 Mbps) with an equipment price of **~$80 USD**
Market trends	• The Nigerian state-owned satellite operator **NIGCOMSAT** has recently **partnered with Yahclick**, to expand their GEO satellite footprint in Nigeria and beyond • Nigerian ISP **Tizeti** and **Eutelsat** have partnered to provide **GEO satellite internet** to underserved areas through a **public wi-fi hotspot service**, particularly in remote areas that are difficult to reach by terrestrial broadband infrastructure.

> " Our coverage is as wide as you need it; if there is no fiber infrastructure and you don't have mobile network access at your location, we can service you with VSAT connectivity. "
> **- ISP**

> " We differentiate from our competitors by focusing on government enterprises. Furthermore, we have a network of resellers across the country and can deploy & service customers in each state. "
> **- Satellite operator**

> " LEO satellite internet might be an option for private schools but at least for now is too expensive for public schools and GEO is preferred. "
> **- ISP**

June 2023
SPACE IN AFRICA
NIGCOMSAT and YahClick to Enhance Broadband Connectivity in Sub-Saharan Africa

Nov. 2022
BUSINESS DAY
Eutelsat, Tizeti partner to boost broadband penetration in Nigeria

Key takeaways

+ **Competition:** there is an **active** and **competitive** market for satellite connectivity in Nigeria

+ **Availability:** besides various **GEO satellite** internet providers, **LEO satellite internet** is also available in Nigeria

+ **Affordability: satellite connectivity** is at a **competitive price point** in Nigeria, with VSAT players offering satellite internet for as affordable as **~$10 USD per month**

Note: 1) Prices based on online available information on residential subscription price (source: Business Insider Africa) and these have not been verified for school connectivity
Sources: Business Insider Africa, Coollink, Space in Africa, Business Day, Interviews, Deloitte analysis

Nigeria | Enabling environment

There is significant commitment from the government to improve connectivity, but access to finance is a challenge, particularly for smaller players

Regulations

- In March 2020, Nigeria's **National Broadband Plan (2020-2025)** was launched with the aim to improve network coverage and quality. The target is to achieve download speeds of minimum 25 Mbps in urban areas and 10 Mbps in rural areas, with effective coverage available to >90% of population by 2025 at a price not more than 2% of median income / 1% of minimum wage
- MNOs who have reached a **5G license**, are under the **licensing requirements** from the Nigeria Communications Commission (NCC) required to expand their coverage to reach at least two states in each of the country's six main regions within two years

> " The government is making efforts through the Nigeria Communications Commission (NCC). They specifically have a department for broadband penetration in the rural areas. They are making efforts, and we have been involved in government projects to reach the unreachable "
> **- ISP**

> **G4** Nigeria's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 4: 'integrated regulation'** [1]

Access to finance

- **The interest rate in Nigeria is high** (**18.75%**), which poses a challenge for capital-heavy investments such as developing new connectivity infrastructure
- Nigeria has a **Universal Service Fund**, but it is **not considered to be successful up to now** as **limited funding has been provided**

> " Access to finance for smaller players is a big issue as they cannot access development funding. A good example is Nigeria, where there are lots of local licenses, but none of the smaller players have been able to raise $50-100 million to expand fiber in the region. "
> **- Infrastructure company**

Access to finance indicators

- $ Exchange rate to USD: **0.00013** USD (2023)
- Government Debt to GDP (% of GDP): **38%** (2022)
- Interest rate: **18.75%** (2023)
- Domestic Credit to private sector (% of GDP)[2]: **13.56%** (2021)

Key takeaways

- **+ Funding security: Nigeria** has a **well-established** telecommunications **market**, and **significant commitment** from the government to improve the coverage and quality of internet

- **– Funding security:** the **high interest rate** poses a challenge for capital-heavy investments such as connectivity infrastructure

- **– Funding security: smaller players** in particular **struggle to gain access to finance**, as smaller players often **cannot access development funding**

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, World Bank Development Indicators, Trading Economics, S&P Global, OECD, Nigeria Communications Commission (NCC) Annual Report 2022, Interviews, Deloitte analysis

Sierra Leone | Assessment of market shortcomings [1/2]

In Sierra Leone, the main market shortcomings have been identified in the affordability, delivery, availability and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
*Usage gap market dimensions (usage gap: **~55% of schools[1]**)*				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Lack of uptake from communities because of digital illiteracy	− Digital illiteracy; digital literacy is low in Sierra Leone with 18% of individuals in Sierra Leone using the internet	• Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− High price of fixed connectivity (at 38% of GNI per capita, and on average $5,56 USD per Mbps per month (3rd most expensive of the 9 focus countries))	− Cost of equipment is a major cost component, as equipment needs to be procured from abroad − High price of bandwidth due to unfavorable exchange rates and possibly due to the reliance on a single first-mile operator (Zoodlabs)	• Interview with MNO • Interview with ISP
		+ Relatively low price of mobile connectivity (at 3% of GNI per capita, and average price of $0.67 USD per GB)	+ *Hypothesis: no root cause has been identified, but low GNI per capita may incentivize MNOs to provide low-cost connectivity options [2]*	• Desk research
		− High price of devices	− Cost of equipment is a major cost component, as equipment needs to be procured from abroad (which is expensive given the high inflation)	• Interview with MNO • Desk research
		− Low government budget for school connectivity[3]	− Very low GNI per capita ($510 USD and $1,900 USD at Purchasing Power Parity (PPP))	• Desk research
		+ Significant commitment from the government to increasing school connectivity, and good collaboration between government, market players and other partners (e.g. Giga)	+ Government expenditure on education is 34% of total government expenditure and 9% of GDP, which makes Sierra Leone the country with the highest government budget for education out of the 9 focus countries + There is good collaboration between government, market players and other partners and several initiatives to improve connectivity (e.g. Giga, Metro Cable's (ISP) Connectivity for Good Initiative, Afcom's (ISP) One Access Initiative)	• Interview with MNO • Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	− Limited competition in the mobile connectivity market	− The mobile connectivity market is dominated by two players: Orange and Africell. This might result in limited competition and therefore higher prices	• Desk research
		− Reliance on a single first-mile operator, potentially leading to higher wholesale bandwidth prices	− There is one private sector operator who manages the first-mile in Sierra Leone (Zoodlabs), which potentially leads to higher wholesale bandwidth prices	• Interview with ISP • Desk research
		+ Although the fiber market is small (<1 fixed subscription per 100 people), there are 17 ISPs active in Sierra Leone of which several are focused on providing fiber in the main urban areas	+ There are 17 ISPs active in Sierra Leone of which several are focused on providing fiber in the main urban areas (e.g. Metro Cable, Afcom, Onlime, Michcom)	• Desk research
Delivery *(1/2)*	Products & services are delivered reliably, cost effectively and on time	− Lack of uptake of connectivity solutions due to lack of electricity and challenge of providing connectivity with electricity	− Lack of electricity (access to electricity is at 28% of population and only 5% in rural areas) − Structure of schools often require to be strengthened for the installation of rooftop solar panels (which adds to the costs)	• Interview with MNO • Desk research
		− Security of devices and solar panels is a challenge	− When communities do not feel ownership of the connectivity infrastructure and devices, there is the risk of vandalism and theft	• Interview with MNO

Notes: 1) Giga's connectivity map shows that 57% of schools are covered by good quality internet (> 3G), but only 1.5% of schools are connected to good quality connectivity; 2) Within the scope of this study we could not validate this hypothesis and further research is required; 3) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Giga, interviews, Deloitte analysis

Sierra Leone | Assessment of market shortcomings [2/2]

In Sierra Leone, the main market shortcomings have been identified in the affordability, delivery, availability and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Delivery *(2/2)*	Products & services are delivered reliably, cost effectively and on time	− High inflation undermines profitability of longer-term contracts, which challenges the ability of market players to adequately deliver on the contract	− High inflation (51% annual inflation rate in August 2023)	• Interview with MNO • Desk research
		+ There are market players which have gained experience with providing school connectivity, which potentially enables them to provide connectivity more effectively and efficiently in subsequent contracts	+ Through previous engagements with Giga, market players have gained experience with overcoming the challenges of providing school connectivity in rural areas	• Interview with MNO
Quality	Products meet quality standards	− Quality of fixed broadband is relatively low in Sierra Leone, with Sierra Leone ranking 145th out of 181 countries by Ookla's Speedtest Global Index	− *Hypothesis: it is expected that the low quality is the result of some of the market shortcomings identified in the other market dimensions, such as affordability and the lack of business viability of investing in telecommunication infrastructure [2]*	• Desk research
Coverage gap market dimensions (coverage gap: ~43% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	− Lack of business viability for investing in fiber & mobile connectivity (particularly in rural areas)	− Sierra Leone is a mountainous country, which poses a challenge for infrastructure development, particularly for solutions that require line-of-sight (e.g. Point-to-Point microwave) − Lack of electricity (access to electricity is at 28% of population and only 5% in rural areas) − Structure of schools often require to be strengthened for the installation of rooftop solar panels (which adds to the costs)	• Interview with MNO • Interview with ISP
		+ The National Fiber Optic Backbone Project has recently been completed (August 2023), spanning 14 of the 16 districts and connecting all major towns and cities in Sierra Leone , which is expected to positively impact fixed connectivity in urban areas	+ In 2019, a $30 million (USD) loan from the China Export-Import Bank was provided to Sierra Leone to finance its contract with Huawei for the development of the National Fiber Optic Backbone project	• Desk research
		+ In June 2023, Sierra Leone granted a license to Starlink; the entrance of Starlink could provide a viable alternative for rural connectivity, although affordability is expected to be a challenge	+ Sierra Leone has granted a license to Starlink, and Starlink is expected to start its operations in Sierra Leone in 2024 − Affordability of LEO satellite internet is expected to be a challenge in Sierra Leone because of low GNI per capita and low available government budget	• Interview with MNO • Desk research
Funding security	Market players have sufficient funding security	− Lack of long-term development funding for connectivity, to cover the recurring costs of connectivity	− Development funding is often for a limited period and focused on funding CAPEX-heavy investments − Government is not able to cover the funding requirements after the development funding period ends (due to low available government budget)	• Interview with MNO • Interview with ISP
		− Lack of access to finance for market players for infrastructure investments	− High cost of capital (interest rate of 21.3% (Sept. 2023)) − Private finance providers prefer financing connectivity for urban areas (better risk/return profile)	• Desk research

Notes: 1) Giga's connectivity map shows that 57% of schools are covered by good quality internet (> 3G); 2) Within the scope of this study we could not validate this hypothesis and further research is required
Sources: Giga, interviews, Deloitte analysis

Sierra Leone | Broader context & status of school connectivity

In Sierra Leone, only 1.5% of schools are connected, the government is committed to increase connectivity in schools, but digital illiteracy and lack of electricity access create barriers

Out of a total of 12,000 schools, **only 192 schools have reported to be connected**

Overview
- Population: **8.4 million**
- Pop. density: **122 inhab. / km²**
- Urban/rural split: **43%/57%**
- GNI/capita: **$510 USD**
- GNI/capita (PPP[1]): **1,900 USD**

School connectivity

| No connectivity	3G/4G
98.4%	1.5%
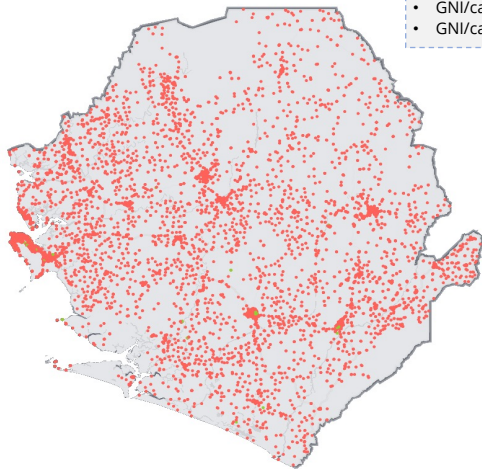
Government support for school connectivity
- **Government organizations** Ministry of Basic and Secondary School Education (MBSSE) and the Directorate of Science, Technology and Innovation (DSTI) collaborate to **ensure that schools are equipped with connectivity solutions**
- The government **partnered** with **WorldVision and ProFuturo** to **provide digital learning in schools**, and with **Giga** to **increase school connectivity**

Electricity
- Access to electricity is **major barrier**, particularly in rural areas

Total	28%	73%
Urban	57%	43%
Rural	5%	95%

% of population with access to electricity
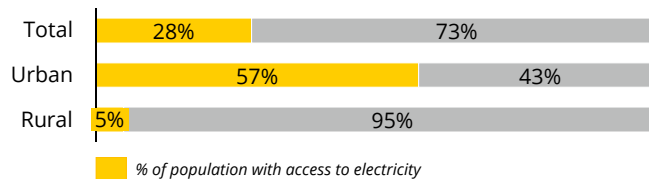
Digital literacy
- Digital literacy is **low** in Sierra Leone, with only **18%** of the population **using the internet** (least internet usage of the 9 assessed countries)

Key takeaways

+ **Affordability: significant commitment** from the government to increase school connectivity, and **good collaboration** between government, market players and other partners (e.g. Giga)

− **Affordability:** however, **government budget is low**, given the **very low GNI per capita** [2]

− **Delivery: access to electricity** in rural areas is a **major challenge**

− **Acceptability:** there is a **lack of digital literacy** which may hamper the uptake of school connectivity
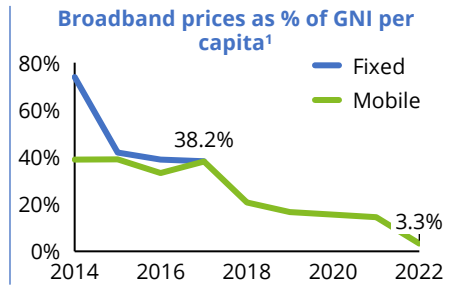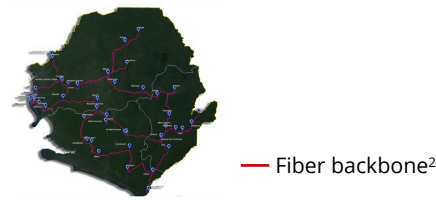
Notes: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production; 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP
Sources: Giga, BCG, GSMA, WorldBank, Leonecom, Sierraloaded, Deloitte analysis

Sierra Leone | Fiber internet market

Affordability of fixed broadband connectivity is a major challenge in Sierra Leone; with the reliance on a single first-mile operator as a possible root cause for high prices

Key insights into the fiber internet market

Coverage	• The **Africa Coast to Europe (ACE)** submarine cable lands in capital Freetown • In **August 2023**, Huawei handed over the completed **National Fiber Optic Backbone** to operator **Leonecom** • Although fiber coverage used to be low and **usage still is (<1%)**, the National Fiber Optic Backbone Project has recently been completed (August 2023), spanning **14 of the 16 districts** and connecting all major towns and cities in Sierra Leone
Market players	• The access point of the ACE submarine cable (first-mile) is managed by **ZoodLabs** • The National Fiber Optic Backbone is operated by **Leonecom** • There are **three Fixed Network Operators: Sierratel**, **Orange** and **Africell** • According to the latest registry of regulator NATCOM (2020), there were **17 Internet Service Providers (ISPs)** active in Sierra Leone (+ the MNOs who also act as ISPs)
Pricing & quality	• **High price of fixed connectivity**, which is priced at **38% of GNI per capita** and on average **$5,56 USD per Mbps per month** (3rd most expensive of the 9 focus countries) • The ISP K3Tele offers an **unlimited business internet connection** for **$399 USD** per month at **100 Mbps download speed** • According to the Ookla speedtest global index **download speed is 14 Mbps and upload is 8 Mbps**, which ranks the country **145th out of 181**
Market trends	• **Africell** received a **USD 100 million grant** from the United States Trade and Development Agency (USTDA) for a **feasibility study to expand fixed broadband network** in up to 32 cities and towns

— Fiber backbone[2]

Broadband prices as % of GNI per capita[1]

— Fixed
— Mobile

80%
60%
40% — 38.2%
20%
0% — 3.3%
2014 2016 2018 2020 2022

Key takeaways

− **Competition:** there is a **single first-mile operator** which potentially leads to **higher wholesale bandwidth prices**

+ **Competition:** Although the **fiber market is small,** there are **17 ISPs** which suggests **low barriers to entry**

− **Affordability: high price** of fixed connectivity (~38% of GNI per capita)

− **Quality: Relatively low quality** of fixed broadband internet

Notes: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita; 2) The coverage of the National Fiber Optic Backbone as retrieved from the Leonecom website

Sources: Giga, ITU, World Bank, Submarine Cable Networks, NATCOM Register of Licensed Telecom Operators in Sierra Leone (2020), NATCOM annual report (2019), Cable.co.uk, Interviews, Deloitte analysis
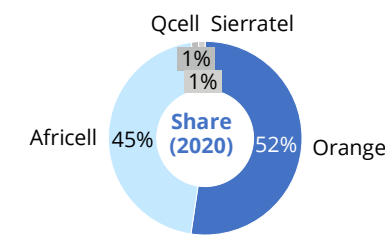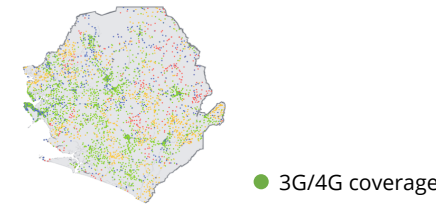
Sierra Leone | Wireless internet market

The mobile market in Sierra Leone is dominated by two major operators; affordability however has significantly improved over the last years

Key insights into the wireless internet market

Coverage	• Around **57%** of schools are covered by a **strong 3G or 4G network** • Sierra Leone **aims for 80% 3G/4G coverage by 2024** • There are **98 mobile cellular subscriptions** per 100 inhabitants

● 3G/4G coverage

Market players	• There are **four Mobile Network Operators**: Orange, Africell, Qcell and Sierratel • In the **mobile market, Orange** and **Africell** are the **market leaders** with 52% and 45% share respectively • **Sierratel's** network used to be based on CDMA technology, but recently launched its 4G network

Qcell Sierratel
1%
1%
Africell 45% **Share (2020)** 52% Orange

Pricing & quality	• **Affordability** of mobile connectivity has **significantly improved** over the last years, with now a **relatively low price** of mobile connectivity (at 3% of GNI per capita, and average price of $0.67 USD per GB) • **Orange** offers 4G mobile Wi-Fi at 10 Mbps (300 GB): ~$50 USD per month; **Africell** offers 4G mobile broadband at 10 Mbps (unlimited data): ~$70 USD per month • Providing connectivity in **rural areas** is considered a **major challenge,** given the **difficult terrain** (Sierra Leone is a mountainous country) resulting in **high costs**

" Sierra Leon is a mountainous country; this is one of the biggest showstoppers, especially for point-to-point microwave solutions
- MNO "

Market trends	• Africell has **received** the **country's first 5G spectrum** in 2022 • Orange is **trialing 5G service** for its subscribers in **Freetown**

africell *Nov. 2022*
Africell receives 5G spectrum in Sierra Leone

Key takeaways

− **Availability:** 3G/4G network coverage is low for schools as **only 57% of schools are covered**

− **Competition:** there is **limited competition** in the mobile market as **two providers** dominate the market

+ **Affordability:** Relatively low price of mobile connectivity (at 3% of GNI per capita, and average price of $0.67 USD per GB)

Sierra Leone | Satellite internet market

Satellite internet might provide a solution for the challenging terrain in Sierra Leone, but affordability is likely to be a challenge

Key insights into the satellite internet market

Coverage	• In Sierra Leone both **GEO/VSAT** and **LEO satellite internet** is **available** • Satellite internet offers the **potential to reach remote areas** without large additional capital investments of extending the middle-mile network (fixed or mobile) and **can be used in mountains and forests** (under the condition that a **line of sight** with the satellite can be established for GEO satellite internet)	**Example Eutelsat satellite coverage**
Market players	• A **variety of providers**, such as Vizocom, Globaltt and Ntvsat, **offer GEO/VSAT internet** in Sierra Leone • **Starlink** has been granted a license and will initiate the **LEO satellite internet** market in Sierra Leone	" Satellite internet is very expensive – we have Eutelsat and the costs are way higher than other solutions **- MNO** "
Pricing & quality	• Prices for GEO/VSAT satellite internet are estimated to range from **~$40-$150 USD per month** [1] • **Starlink has not announced prices** for its services in Sierra Leone, but it is likely that they will be **similar to prices in Nigeria** which are approximately $48 USD per month and $380 USD for the equipment & shipping	" It depends on the costs – if the costs are okay then I'm sure we will do a partnership with Starlink. **- MNO** "
Market trends	• In June 2023, Sierra Leone granted a **license to Starlink**; Sierra Leone is the **fifth African country** where **Starlink will operate**, after Nigeria, Mozambique, Rwanda and Mauritius	African BUSINESS *June 2023* Sierra Leone joins Elon Musk's Starlink satellite service

Key takeaways

+ **Availability:** satellite internet can offer a viable alternative to fiber & mobile in **mountainous areas** of Sierra Leone

− **Affordability: price of satellite internet** (GEO and LEO) are considered **high** compared to other connectivity solutions

+ **Availability: Starlink** recently received an **operating license** in Sierra Leone

Note: 1) Prices based on online available information on subscription price (source: TS2) and these have not been verified for school connectivity
Sources: African Business, Company websites, TS2, Interviews, Deloitte analysis

Sierra Leone | Enabling environment

The government is supportive of increasing connectivity across the country; however, access to affordable finance is a major obstacle for further investments in connectivity

Regulations

- In June 2022, a new law was passed to govern the telecommunications industry in Sierra Leone: the **National Communications Authority Act 2022**. The act provides the regulatory and licensing framework for telecommunication operators
- Network operators require a **telecommunication service authorization (license)** from the NatCA
- Key requirements for network operators include **mandatory coverage targets, universal access and quality targets** (minimum data speed, transparency of the conditions of the service level agreement and equal access to services)

> " The challenge is the sustainability of connectivity after the government projects have ended. Funding is required to cover the recurring costs, but because of inadequate management decisions, there is no money collected from schools and funding stops. "
>
> **- ISP**

G2 Sierra Leone's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 2: 'early open markets'** [1]

Access to finance

- **Interest rates in Sierra Leone are high** (**21%**) compared to other countries, which is a problem for capital-heavy investments such as developing new connectivity infrastructure
- Along with other ECOWAS countries, Sierra Leone established a **Universal Service Fund**, the UADF to **fund investments in ICT**

> " Cost of equipment is a major cost component. In Sierra Leone, the economy has fallen drastically, and because of inflation the cost of goods has gone threefold. This has jeopardized the profitability of our contracts.
>
> **- MNO** "

Access to finance indicators

$ Exchange rate to USD: **0.000051** (2023)

Government Debt to GDP (% of GDP): **98.8%** (2022)

Interest rate: **21.3%** (2023)

Domestic Credit to private sector (% of GDP)[2]: **0.00635%** (2022)

Key takeaways

- **Delivery: high inflation** affects the **profitability** of operators and their **ability** to meet contracts

- **Affordability: lack of long-term funding** that is available for school connectivity and to cover the recurring costs

- **Funding security:** high **cost of capital** due to high interest rates

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, World Bank Development Indicators, Trading Economics, Interviews, Deloitte analysis

Benin | Assessment of market shortcomings [1/2]

In Benin, the main market shortcomings have been identified in the affordability and delivery market dimensions

Assessment of school connectivity market[1]

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
*Usage gap market dimensions (usage gap: up to **83% of schools**[2])*				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	– Lack of uptake from communities because of digital illiteracy	– Digital illiteracy; digital literacy is relatively low in Benin with 34% of individuals in Benin using the internet	• Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	– Prices of fiber & mobile connectivity are high (fixed broadband is at 23% of GNI per capita, and mobile broadband is also expensive with $2.37 USD per GB of mobile data (most expensive of the 9 focus countries))	– *Hypothesis: the backbone is fully managed by state-owned company SBIN, which might result in increased wholesale prices [3]*	• Desk research
		+ The government is making efforts to decrease connectivity prices	+ The telecommunications regulator ARCEP imposes price controls that prevent companies from overcharging customers, which is based on an analysis of service production costs and allowable profit margin	• Desk research
		– Relatively low government budget for school connectivity [4]	– Relatively low GNI per capita ($1,400 USD and $4,020 USD at Purchasing Power Parity (PPP)) – No dedicated initiative from the government to connect schools has been identified	• Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	– There is a reliance on a single company in the first-mile (backbone), which may result in increased wholesale prices	– The backbone is fully managed by state-owned company SBIN	• Desk research
		– Limited competition in the mobile connectivity market, which might result in higher prices	– The mobile connectivity market is dominated by two players: MTN and Moov Africa.	• Desk research
		+ In 2022, Celtiis was introduced to the market to bring more competition in the mobile segment; Celtiis subsidiary of state-owned company SBIN	+ *Hypothesis: the dominance of MTN and Moov Africa is expected to have led to the government's decision to introduce Celtiis to the market (through state-owned company SBIN) [3]*	• Desk research
Delivery	Products & services are delivered reliably, cost effectively and on time	– There is a lack of information on the connectivity status of schools, which potentially hampers the identification of business opportunities for market players	– *Hypothesis: school connectivity is not tracked by the government; no dedicated initiative from the government to increase school connectivity has been identified [3]*	• Desk research
		– Lack of uptake of connectivity solutions due to lack of electricity	– Lack of electricity (access to electricity is at 42% of population and only 18% in rural areas)	• Desk research

Notes: 1) Please note that during the study we have not been able to conduct interviews with suppliers from Benin to validate the assessment; 2) Giga's connectivity map shows that 83% of schools are covered by good quality internet (> 3G); actual connectivity is unknown, but only 20 schools have reported to be connected to good quality internet; 3) Within the scope of this study we could not validate this hypothesis and further research is required; 4) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Giga, interviews, Deloitte analysis

Benin | Assessment of market shortcomings [2/2]

In Benin, the main market shortcomings have been identified in the affordability and delivery market dimensions

**Assessment of school connectivity market[1]**

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Quality	Products meet quality standards	+ Quality of fixed broadband is relatively good in Benin, with Benin ranking 133rd out of 181 countries by Ookla's Speedtest Global Index (3rd highest quality fixed internet of the 9 focus countries)	+ *Hypothesis: there are three submarine cables entering Benin in the South and a large part of the population is in the South [3]*	• Desk research
Coverage gap market dimensions (coverage gap: ~17% of schools[2])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	+ There is a well-established mobile network, with Around 84% of schools covered by a strong 4G network	+ *Hypothesis: this is expected to be the result of some of the other market strengths (e.g. relatively good access to finance) [3]*	• Desk research
		+ Market players are investing in remote areas (e.g. MTN and Ericsson announced a partnership in July 2023 to deploy 29 towers including renewable energy generation)	+ Market players have identified solutions that address the challenge of electricity (mobile towers with solar panels) + Market players show commitment to expanding mobile broadband access	• Desk research
Funding security	Market players have sufficient funding security	+ *Hypothesis: access to finance of market players is expected to be relatively good compared to other countries in the ECOWAS region, given the relatively low interest rate [3]*	+ Interest rate is relatively low in Benin (~5.3%) compared to other countries in the ECOWAS region	• Desk research

Notes: 1) Please note that during the study we have not been able to conduct interviews with suppliers from Benin to validate the assessment; 2) Giga's connectivity map shows that 83% of schools are covered by good quality internet (> 3G); 3) Within the scope of this study we could not validate this hypothesis and further research is required
Sources: Giga, interviews, Deloitte analysis

# Benin | Broader context & status of school connectivity

In Benin, there is a lack of information on the connectivity of schools, but connectivity is expected to be low due to challenges of affordability, electricity and digital literacy

Out of a total of 8,668 schools, only 20 schools have reported to be connected
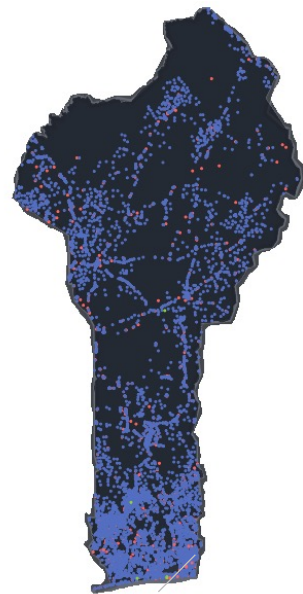
Overview
- Population: **13 million**
- Pop. density: **122 inhab. / km²**
- Urban/rural split: **51%/49%**
- GNI/capita: **$1,400 USD**
- GNI/capita (PPP[1]): **$4,020 USD**

School connectivity

| No connectivity	Data unavailable
10%	89%
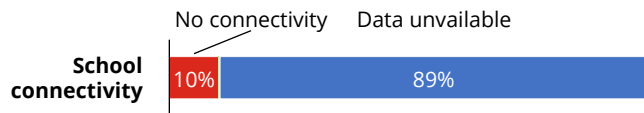
Government support for school connectivity
- In 2022, the **Beninese Education and Research Network (RBER)** was launched, connecting 10 universities and academic centers
- The *Agence des Systèmes d'Information et du Numérique* **(ASIN) has a dedicated initiative** to connect primary & secondary schools

Electricity
- Access to electricity is **major barrier**, particularly in rural areas

Total	42%	58%
Urban	67%	33%
Rural	18%	82%

■ *% of population with access to electricity*
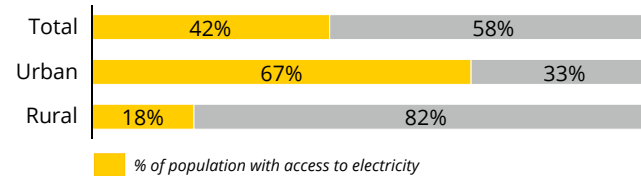
Digital literacy
- Digital literacy is relatively low in Benin; only **34% of individuals** in Benin are using the internet
- Benin scores a 3.2 on the Wiley 'Digital Skills Gap Index'[3], **ranking 14th out of 26 countries** in Sub-Saharan Africa

Key takeaways

- **Affordability:** the Benin population has **low purchasing power** considering GNI per capita[2] and there is at least **one dedicated initiative** from the government to connect schools to the internet

- **Access to electricity** is a major challenge in Benin, especially in rural areas

- **Acceptability**: there is a **lack of digital skills** with only 34% of individuals using the internet

Benin | Fiber internet market

State-owned company SBIN is the only fiber provider in Benin, and while fiber broadband could be a viable solution for urban areas, affordability is a challenge

Key insights into the fiber internet market

Coverage
- There are **three submarine cables** entering Benin in Cotonou: the SAT-3/WASC, ACE and West Africa cables
- The **fiber-optic backbone** of Benin covers >3,000 km and **86% of communes**
- **~50% of schools** in Benin are **located within 10 km** to the closest fiber node
- The **fixed market represents ~6%** of the total telecommunications market (incl. telephone), and there are **<1 fixed broadband subscriptions** per 100 inhabitants

— Fiber backbone

Market players
- There is **one** fixed network operator: **state-owned company SBIN.** SBIN manages the fiber-optic backbone and deploys fixed LTE and Fiber-to-the-Home
- Besides SBIN, there is **one other ISP** that offers fiber: **Isocel.** Isocel is however **only active in the Cotonou area** (south of Benin)

SBiN
Société Béninoise d'Infrastructures Numériques

Pricing & quality
- Fixed broadband prices are **expensive** relative to the gross national income (GNI) per capita (23%), which is an indicator for **high connectivity prices** for **schools**
- Fiber-to-the-Home from SBIN (through their Celtiis brand) and Isocel are priced between $**25 per month** (10 Mbps down, 3 Mbps up, unlimited volume) and **$65 USD per month** (50 Mbps down, 10-12 Mbps up, unlimited volume)
- The fixed broadband has a median **download speed of 21 Mbps** and an upload speed of 9 Mbps, which ranks the country **133rd out of 181**

Broadband prices as % of GNI per capita[1]

80%	
60%	Fixed
40%	Mobile
20%	23%
0%	6%
2014 2016 2018 2020 2022	

Market trends
- In October 2022, the Minister of Digital Transformation launched the **Beninese Education and Research Network (RBER).** The RBER connects **10 universities and academic centers** through deployment of **7 km of fiber** and **420 access points** with an internet speed of **1000 Mbps**

we are tech .africa
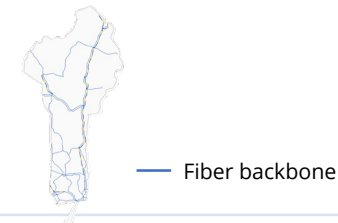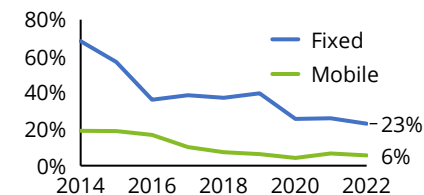
Oct. 2022

Benin interconnects ten universities, more to come

Key takeaways

- − **Availability:** while the fiber-optic backbone covers 86% of communes, **only 50% of schools** are located **within 10 km** from a **fiber node**
- − **Competition:** the backbone is **fully managed by state-owned company SBIN**, which might result in **increased wholesale prices** if there is no substantial investment from the government
- − **Affordability:** affordability of fiber connectivity is a challenge given **fixed broadband is 23% of GNI per capita**
- + **Quality:** Benin has the **third highest quality of fixed internet** of the nine focus countries

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Giga, ITU, World Bank, Submarine Cable Networks, ARCEP Benin annual report 2022, Celtiis, We Are Tech Africa, Interviews, Deloitte analysis

Benin | Wireless internet market

The mobile internet market is dominated by MTN Benin and Moov Africa, but the government introduced Celtiis to the market (subsidiary of state-owned SBIN) to bring more competition

Key insights into the wireless internet market

Coverage	• **93% of population** in Benin is covered by mobile broadband network • Around **84%** of schools are covered by a **strong 4G network** • There are **109 mobile cellular subscriptions** per 100 inhabitants • The coverage of the MNOs is **concentrated in the densely populated south** of Benin, but also covers the main towns & roads towards the North; **Moov Africa** seems to have the **largest geographical coverage**
Market players	• There are **three** MNOs in Benin: **Moov Africa**, **MTN Benin** and **Celtiis** • **MTN** is the **market leader** with a revenue market share of 68% (in 2022) • **Celtiis** is a subsidiary of state-owned SBIN and was **introduced to the market in 2022** to bring more competition in the mobile segment. Celtiis is **managed by Sonatel** (part of Orange) and offers fiber broadband and 4G LTE technologies
Pricing & quality	• **Price for mobile broadband** is expensive with **$2.37 USD per GB of mobile data** (**most expensive of the 9 focus countries**) • Mobile broadband is priced at **6% of GNI per capita,** which significantly exceeds Broadband Commission's target of 2% of GNI per capita
Market trends	• **Ericsson** and **MTN** announced a partnership to provide mobile broadband to **remote rural areas** that have limited or no connectivity. A total of 29 **mobile towers** will be deployed which will run on **100 percent solar and battery power** • As of January 2023, the telecom regulator ARCEP opened the 5G spectrum, granting mobile network operators the **possibility to deploy experimental 5G networks**. Since then, MTN Benin announced the launch of 5G

● 3G/4G coverage

Market share by revenue (2022)

Celtiis 0%
Moov 32%
MTN 68%
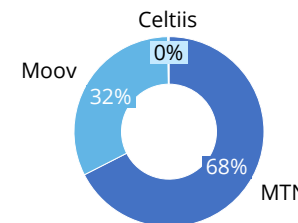
MTN *July 2023*
Ericsson and MTN connect remote areas with solar power in Benin

ARCEP *June 2023*
• Autorisation de l'expérimentation de la 5G au Bénin

Key takeaways

+ **Availability:** the **4G network covers** most of the population in Benin and **84% of schools** and market players are investing into solutions for remote areas
− **Competition:** MTN is the dominant market player with a **market share of 68%**
+ **Competition:** The **entrance of Celtiis** into the **mobile market** has brought more **competition**
+ **Availability:** mobile and infrastructure players are **partnering** to **provide mobile access using solar-powered towers in rural areas**
− **Affordability:** mobile broadband is cheaper than fixed broadband but still at **6% of GNI per capita**

Sources: Giga, ITU, GSMA, World Bank, ARCEP, CommsUpdate, Cable.co.uk, Ericsson, TechCabal, Deloitte analysis

Benin | Satellite internet market

The satellite internet market seems to be at a nascent stage in Benin; Starlink has however recently entered the market to provide LEO satellite connectivity

Key insights into the satellite internet market

Coverage	• **GEO/VSAT satellite** internet is **available** in Benin, but no information has been found to what extent it is being deployed and used • **Starlink launched** LEO satellite internet in Benin in **November 2023**
Market players	• There are several **international satellite ISPs** such as **BusinessCom, Vizocom and Spacecom** that offer GEO satellite services in Benin • With the launch of Starlink the company is the first provider of LEO satellite internet
Pricing & quality	• With the **entrance of Starlink**, the country will have access to high-speed and low latency satellite internet, with prices around **$55 USD per month** and **one-off equipment & shipping price of ~$700 USD**
Market trends	• **Starlink launched** LEO satellite internet in Benin in **November 2023**

Eutelsat's Konnect Ka-band coverage
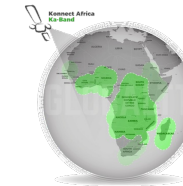
" We work with ISPs abroad to deliver satellite connectivity in the region. We have provided internet connectivity to a bank in Benin across its various sites. "
- Nigerian satellite operator

COMMS UPDATE   *November 2023*
Starlink launches satellite broadband service in Benin

Key takeaways

+ **Availability:** there are **various (international) GEO satellite internet service providers**, and **Starlink** has **recently been launched** in Benin

− **Affordability: affordability** of LEO satellite internet is **expected to be a challenge** given the higher price and low GNI per capita

Note: 1) Prices based on online available information on residential subscription price (source: Starlink Insider) and these have not been verified for school connectivity
Sources: Company websites, Connecting Africa, Starlink Insider, GlobalTT, Commsupdate, TS2, Deloitte analysis

Benin | Enabling environment

The government is making efforts to decrease connectivity prices, for instance by imposing price controls and supporting the industry by attracting private investments

Regulations

- The telecommunications regulator ARCEP imposes **price controls** that **prevent companies** from **overcharging customers**, which is based on an analysis of service production costs and allowable profit margin. Although affordability remains a challenge, this regulation has led to **lower prices in Benin** and has **eased access to internet**

- Benin has also implemented a **Digital Code,** which prescribes the **conditions** for **access**, **confidentiality** and **neutrality** in the telecommunications industry

- The **taxation system** for the ICT sector underwent **simplification** through the implementation of the finance law. This law standardized the GSM communications fee at a fixed rate of 10% of the monthly turnover so that the **operators** can **increase** their **investments** and **promote growth**

> G2 — Benin's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 2: 'early open markets'** [1]

Access to finance

- **Interest rates in Benin** are low compared to other ECOWAS countries, which is positive for capital-heavy investments such as developing new connectivity infrastructure
- Benin's government continues efforts to **attract private investment** and has raised EUR 1.5 billion on the Eurostox market and XOF 86 billion (USD 138 million) on the WAEMU financial market
- The Investment and Exports Promotion Agency works with **foreign companies** to **facilitate new investments** and brings down processing time for new business registrations and construction permits

> *Access to finance indicators*
>
> $ — Exchange rate to USD: **0.0016** (2023)
>
> — Government Debt to GDP (% of GDP): **53%** (2022)
>
> — Interest rate: **5.25%** (2023)
>
> — Domestic Credit to private sector (% of GDP)[2]: **17.1%** (2021)

Key takeaways

+ **Affordability:** the **government** has **imposed price controls** on telecommunication operators

+ **Funding security:** the **interest rate** in Benin **is low** compared to other assessed countries **(~5%)**, which is **positive for high-CAPEX investments** such as telecommunication infrastructure

+ **Funding security:** the government continues efforts to **attract (foreign) private investments** into its economy

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, World Bank Development Indicators, Worldbank, USA Buerau of Economic and Business Affairs, International Trade Administration, Trading Economics, S&P Global, OECD, University of Oxford, Interviews, Deloitte analysis
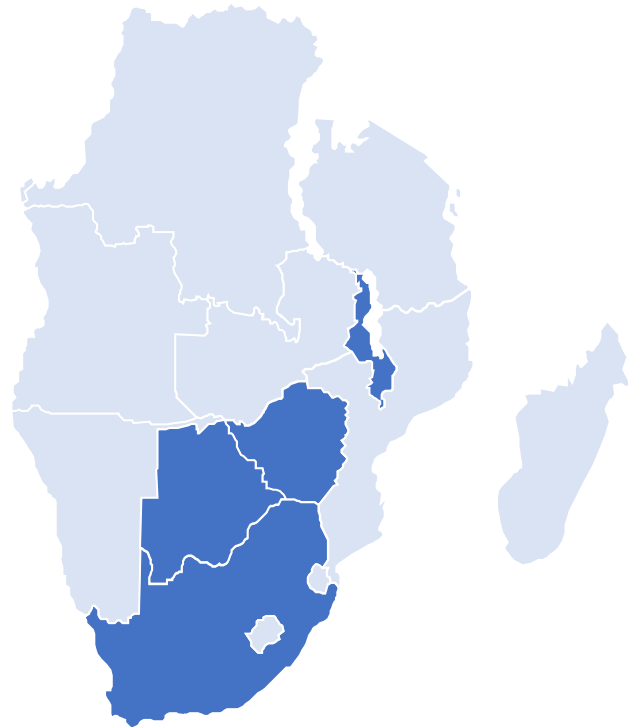
6 **SADC region**
Market assessment & recommended actions

SADC | Broader context

Countries among the Southern African Development Community show major differences in terms of economic performance and connectivity

Overview of the SADC region

■ *Deep-dive in following slides: South Africa, Malawi, Zimbabwe, Botswana*

□ *Other SADC countries*

Population & economy

- The Southern African Development Community (SADC) compromises sixteen member states and has around **345 million citizens**, of which roughly 45% is urban population and 55% is rural population

- **South Africa and Angola are the biggest economies of the SADC region**, with a GDP of $405 billion USD and $106 billion USD respectively (together 64% of SADC region)

- **GNI per capita differs significantly across countries**, ranging from $14,340 USD in the Seychelles to $640 USD in Malawi
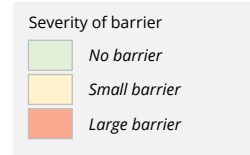
Internet connectivity

- **Several submarine cables carrying international broadband land in the SADC-region** including landings in the DRC, Angola, Namibia, Mozambique and several in South Africa. Other countries such as Botswana, Zimbabwe and Malawi, are landlocked, and are connected through terrestrial networks with neighbouring countries

- Based on country-level research into **Zimbabwe, South Africa, Malawi and Botswana**, there are significant differences between the connectivity among these countries with coverage of good quality internet (> 3G) reaching around 43% of the schools in Malawi, while South Africa is close to 100% coverage

- Even in areas with good-quality (> 3G) internet coverage, the **majority of schools in Botswana, Malawi and Zimbabwe are not connected** to good-quality internet

Sources: World Bank, International Monetary Fund, ISS, GSMA

SADC | Assessment of market shortcomings [1/2]

In SADC, there are major differences in the market shortcomings experienced in South Africa and Botswana versus Malawi and Zimbabwe

Severity of barrier
- No barrier
- Small barrier
- Large barrier

Assessment of school connectivity market

Dimension	Regional summary per theme	South Africa	Botswana	Malawi	Zimbabwe
Usage gap[1] dimensions	*% schools that are covered but not connected:*	~20%	~58%	~40%	~53%
Acceptability	**Digital illiteracy:** digital illiteracy is a barrier to connectivity, especially in Malawi & Zimbabwe	While digital literacy is **generally high**, but **some challenges in rural areas**	No challenges with digital literacy have been identified in Botswana	**Digital literacy is low** in Malawi (24% of individuals using the internet)	**Digital literacy is relatively low** in Zimbabwe (35% of individuals using the internet)
Affordability	**Price of connectivity:** high prices in Botswana, Malawi and Zimbabwe, and lack of access to foreign currency in Malawi & Zimbabwe	**Prices are good** and there are **reduced tariffs for schools**	**Price is high** (landlocked, sparse population, reliance on data centers abroad)	**Price is high** (landlocked, high equipment costs, lack of foreign currency)	**Price is high** (landlocked, high equipment costs, lack of foreign currency)
	Price of devices: affordability of devices is a barrier in Malawi & Zimbabwe	No market shortcoming identified	No market shortcoming identified	**Price is high** (government taxes/customs duties, lack of foreign currency)	**Price is high** (lack of foreign currency)
	Government budget: large differences in government budget available between South Africa & Botswana vs. Malawi & Zimbabwe[2]	**High GNI per capita** and **significant government commitment** to improve connectivity but **challenges with mismanagement** of government funding	**High GNI per capita** and **significant funding available** from the government to enhance connectivity, including for schools	**Low GNI per capita** and suppliers experience large fluctuation in gov't budget; **but gov't is committed** to improving school connectivity and **funding is becoming available**	**Low GNI per capita** which is reflected in **low available government budget**[2]
Competition	**Competition:** the level of competition is generally good; but in Zimbabwe the lack of available spectrum poses a barrier for new entrants	**High level of competition** among ISPs and satellite players; mobile market mainly consists of 3 major MNOs	Availability of **open access backbone** & middle-mile infrastructure, resulting in **competition among ISPs**; **entrants of new infrastructure players**	**Low level of competition** in the mobile connectivity market; **availability of open access backbone**	**Low level of competition** in the mobile connectivity market segment; **lack of availability of spectrum** for new entrants or community networks
Delivery *(1/2)*	**Access to electricity:** the lack of electricity is a challenge across the region, but particularly in Malawi & Zimbabwe	Although, access to electricity is **generally good**, the **reliability of electricity poses a challenge**	**Lack of access** to electricity **in rural areas** (only 25% of rural population have access)	**Lack of electricity is a major challenge** (access to electricity is at 14% of population and only 6% in rural areas)	**Lack of electricity is a major challenge** (access to electricity is at 49% of population and only 32% in rural areas)

Notes: 1) The 'usage gap' is defined as the difference between the percentage of schools with good-quality coverage (>3G) and the percentage of schools that are actually connected to good quality connectivity (> 3G); 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP; Sources: Interviews, Deloitte analysis

SADC | Assessment of market shortcomings [2/2]

In SADC, there are major differences in the market shortcomings experienced in South Africa and Botswana versus Malawi and Zimbabwe

Severity of barrier
- No barrier
- Small barrier
- Large barrier

Assessment of school connectivity market

Dimension	Regional summary per theme	South Africa	Botswana	Malawi	Zimbabwe
Delivery *(2/2)*	**Security:** across the region, vandalism & theft is a concern which complicates deployment in rural areas	Vandalism & theft is a **concern, particularly in rural areas**	Vandalism & theft is a **concern, particularly in rural areas**	Vandalism & theft is a **concern, particularly in rural areas**	Vandalism & theft is a **concern, particularly in rural areas;** and it is linked to the lack of electricity (theft of diesel generators)
	Maintenance & after-sales support: providing maintenance & support is a challenge in rural areas	**Low business viability** of establishing local support & maintenance centers in rural areas	**Lack of business viability** of establishing local support & maintenance centers in rural areas (**sparse population**)	**High cost of maintenance** for rural areas (e.g. **lack of general road infrastructure**)	**High cost of maintenance** for rural areas (e.g. **lack of general road infrastructure**)
Quality	**Quality:** quality is a barrier in Botswana; in Malawi & Zimbabwe quality is also low, but not one of the major barriers	Quality is **relatively high** in urban areas; however rural areas experience slower bandwidth	Quality is **very low**; however, the government is committed to enhancing quality	Quality is **low**, but this is **not considered one of the major barriers** in Malawi	Quality is **low**, but this is **not considered one of the major barriers** in Zimbabwe
Coverage gap¹ dimensions	*% schools that are not covered:*	<1%	~10%	~57%	~47%
Availability	**Business viability of investment in rural areas:** availability of connectivity in rural areas is low given the low business viability	Relatively **low profitability** in rural areas, **but almost all schools are covered** with good quality connectivity	Connectivity has been designated as a **basic amenity** and middle-mile is **100% government-funded**	**Low profitability in rural areas** (e.g. low purchasing power, lack of electricity)	**Low profitability in rural areas** (e.g. low purchasing power, lack of electricity, gov't price controls); **but there are investments in fiber**
	Availability of new solutions: LEO satellite internet is becoming available, with specifically high potential in Botswana; Malawi & Zimbabwe are also exploring other solutions	Availability of a **suitable LEO connectivity** solution is **imminent**	**LEO satellite internet** is **not yet available**; Starlink has applied for a license but is **pending approval**	Market players are exploring usage of **Fixed Wireless Access** and **TV White Space technology**; **LEO satellite internet** (through Starlink) has recently become available	Precedent of successful implementation of **community network**; **LEO satellite internet** is **becoming available** in 2024
Funding security	**Access to finance:** access to affordable finance is a major challenge for market players in Malawi & Zimbabwe	No market shortcoming identified	No market shortcoming identified; there is significant funding available from the government	**Lack of access to finance** for market players (high interest rate, lack of access to foreign currency, USF is only just being set up)	**Lack of access to finance** for market players (very high interest rate, lack of access to foreign currency, perception of unsuccessful implementation of USF)

Note: 1) The 'coverage gap' is defined as the percentage of schools that are not covered by a good-quality (>3G) network
Sources: Interviews, Deloitte analysis

SADC | Recommended actions

Giga can help bring connectivity prices down in Botswana, Malawi and Zimbabwe as well as orchestrate an integrated approach to connectivity

Possible actions to strengthen the school connectivity market

UNICEF's market-shaping levers
- Increase market information
- Reduce transaction costs
- Balance supplier & buyer risks
- Improve access to finance & technology

N/A : no relevant action identified for Giga

Dimension	Common theme[1]	Applicable countries				What can **Giga** do to address the identified market shortcomings?	Relevant **market-shaping levers**
		SA	BW	MW	ZW		
Usage gap dimensions							
Acceptability	Digital illiteracy	SA		MW	ZW	• Orchestrate an **integrated approach to connectivity**, including electricity, devices and training through combined contracting	
Affordability	Price of connectivity		BW	MW	ZW	• Explore **bulk procurement of bandwidth** to bring down prices, particularly for landlocked countries • Explore opportunity to build local **data centers for education content** to reduce peering costs	
	Price of devices			MW	ZW	• Look for opportunities for **pooled procurement of devices** to bring down prices • **Include the procurement of devices** in the connectivity procurement process	
	Government budget for school connectivity			MW	ZW	• Support governments with **accessing development funding** earmarked for school connectivity • Support governments in **sharing their long-term plans** of **school connectivity projects**	
Competition	Level of competition			MW	ZW	• Promote opportunities for **sharing unused frequencies** to improve competition and connectivity in rural areas	
Delivery	Access to electricity	SA	BW	MW	ZW	• Orchestrate an **integrated approach to connectivity**, including electricity • Facilitate **knowledge transfer**, showcasing propositions like satellite connectivity with solar kits	
	Security (vandalism & theft)			MW	ZW	• *N/A*	
	Maintenance & after-sales support	SA	BW	MW	ZW	• Sharing of best practices on **training of communities** for **local support & maintenance**, particularly for satellite technology (less complex than other connectivity technologies)	
Quality	Quality of connectivity		BW	MW	ZW	• **Track the quality of school internet** and **support gov't in enforcing service level agreements** • Look for opportunities for **pooled procurement** for LEO satellite internet	
Coverage gap dimensions							
Availability	Business viability for investing in connectivity in rural areas		BW	MW	ZW	• Include the **proximity of other potential customers** (town hall, health clinic, etc.) in **Giga's connectivity map** of schools (e.g. as part of a score of the attractiveness of a school)	
	Availability of new solutions for rural areas (e.g. new technologies, community networks)	SA	BW	MW	ZW	• Look for opportunities for (cross-country) **pooled procurement** for LEO satellite internet	
Funding security	Access to finance by market players			MW	ZW	• Set up a **dedicated financing vehicle** to provide **low-interest loans** for middle-mile connectivity • Create more **OPEX-oriented financing vehicles** to accommodate for satellite connectivity	

Note: 1) Common themes have been identified through bottom-up analysis of the common market shortcomings & root causes that have been identified across countries
Sources: Interviews, Deloitte analysis

South Africa | Assessment of market shortcomings [1/2]

In South Africa, the main market shortcomings have been identified in the acceptability, availability and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~20% of schools[1])				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Although digital literacy is relatively high in South Africa, the digital literacy of teachers is considered a challenge by suppliers, particularly in more rural areas	+ Digital literacy is relatively high in South Africa (72% of individuals are using the internet) − Digital literacy of teachers is considered one of the barriers for adopting connectivity, particularly in more rural areas	• Interview with SA industry expert • Deloitte desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− Unaffordability of a complete solution including electricity	− Peri-urban and rural areas lack basic infrastructure and will need comprehensive solution	• Interview with SA industry expert • Desk research
		+ Prices of school connectivity are lower due to government intervention	+ Department of Basic Education promulgated a tariff for South African schools; the 'E-Rate Tariff' prices grants 50% discount on data usage to public schools, technical vocational education and training colleges	• Desk research
		− Insufficient government funding to connect all schools	− Poor oversight (projects and funding) and inexperience of key stakeholders − Government funding is limited	• Interview with SA industry expert • Interview with SA Network operator
		+ Significant government commitment to improve connectivity in general and school connectivity specifically	+ Universal Service and Access Obligations mandates telecom operators, to connect a designated number of schools to the internet including institutions for persons with disabilities, within a five-year period + The 'SA Connect' initiative aims to increase broadband penetration and bring down data cost while providing broadband access to users at 100Mbps by 2030	• Interview with SA industry expert • Interview with SA Tower operator • Deloitte desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	+ Competitive environment keeping prices relatively low and driving innovation. The South African Internet Service Providers Association has more than 200 members, which gives a good indication of the size of the industry	+ *Hypothesis: regulatory environment supports the entrance of new market players [2]*	• Desk research
		− Low level of competition in the mobile internet market, dominated by Vodacom, MTN and Telkom	− These three operators have obtained significant market share due to first mover advantage and government support.	• Desk research
		− The fixed internet market in South Africa is relatively competitive, with a number of different ISPs offering a variety of services and packages. However, the market is still dominated by a few large players, such as Telkom and Vodacom.	− High cost of infrastructure. ISPs need to invest heavily in building and maintaining their networks. This can be a barrier to entry for new players	• Desk research
		+ The satellite internet market in South Africa is becoming increasingly competitive, potential new entrant Starlink looking to officially offer its services and Vodacom's partnering with Amazon	+ Offering high-speed internet access to even the most remote parts of the country. + Vodacom's partnership with Amazon is also expected to shake up the market, as it will allow the company to offer satellite internet services to its existing customers.	• Desk research

Notes: 1) Giga's connectivity map shows that 99.7% of schools are covered by good quality internet (> 3G), and from desk research it is estimated that max. 80% of schools are connected to good quality connectivity; 2) Within the scope of this study we could not validate this hypothesis and further research is required;
Sources: Giga, IOL, interviews, Deloitte analysis

South Africa | Assessment of market shortcomings [2/2]

In South Africa, the main market shortcomings have been identified in the acceptability, availability and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Delivery	Products & services are delivered reliably, cost effectively and on time	− Connectivity equipment currently does not cater for lack of electricity	− The addition of sustainable solutions or back-up generators add another layer of complexity and cost	• Interview with SA industry expert
		− Security is a concern by ISP's, deploying expensive infrastructure that may get stolen or vandalized	− The low-income areas, typically have high unemployment rates, and theft of connectivity and devices and energy supply is seen as a source of income	• Interview with SA industry expert
		− Lack of business viability of establishing local support & maintenance centers in rural areas	− Low population / customer density in rural areas − Poor road and power infrastructure impacts access to rural areas	• Interview with SA industry expert • Interview with SA Tower operator
Quality	Products meet quality standards	+ Quality of fixed broadband is relatively high compared to other countries in the region - South Africa ranks first in Africa in terms of download speed	+ *Hypothesis: 6 international submarine cables entering South Africa may result in good-quality fixed broadband [2]*	• Desk research
		+ Quality of mobile broadband is relatively high compared to other countries in the region - South Africa also ranks high in terms of download speed	+ A well-developed telecommunications infrastructure + A competitive ISP market	• Desk research
		− Although majority of schools do have mobile broadband coverage, it is either via 3G or LTE which is not ideal for teaching and learning.	− Poor or limited telecommunication infrastructure within rural areas − Poor road and power infrastructure impacts access to rural areas	• Desk research

Coverage gap market dimensions (coverage gap: <1% of schools[1])

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	− Lack of business cases viability for last-mile fiber & mobile connectivity in rural areas	− Lack of existing middle-mile fiber/mobile infrastructure	• Interview with SA industry expert • Interview with SA Tower operator
		− Risks in installing consumer premises equipment (wifi routers) at rural locations − Lack of business viability for satellite connectivity in rural areas	− Unstable electricity supply due to frequent scheduled power cuts − Theft and vandalism affecting connectivity infrastructure	• Interview with SA industry expert • Interview with SA Tower operator
		+ Availability of a suitable LEO connectivity solution for schools in rural areas imminent	+ Shorter installation time than fixed line or wireless (e.g. tower construction) + Prices of consumer premises equipment are dropping rapidly	• Interview with SA industry expert
Funding security	Market players have sufficient funding security	− There is room for improvement with regards to project management with connectivity projects	− Poor oversight (projects and funding) and inexperience of key stakeholders	• Interview with SA industry expert • Interview with SA Network operator

Notes: 1) Giga's connectivity map shows that 99.7% of schools are covered by good quality internet (> 3G); 2) Within the scope of this study we could not validate this hypothesis and further research is required
Sources: Giga, interviews, Deloitte analysis

South Africa | Broader context & status of school connectivity

School connectivity is relatively good in South Africa with around 80% of public schools being connected, but the stability of electricity and digital illiteracy form a barrier for further uptake

Out of a total of 32,925 schools, **only 0.1% schools are reported with no coverage**

Overview
- Population: **62 million**
- Pop. density: **50 inhab. / km²**
- Urban/rural split: **67%/33%**
- GNI/capita: **$6,780 USD**
- GNI/capita (PPP[1]): **$15,570 USD**

No or limited connectivity   Connected (3G/4G)

School connectivity[2]   20%   80%
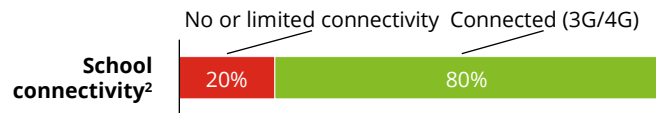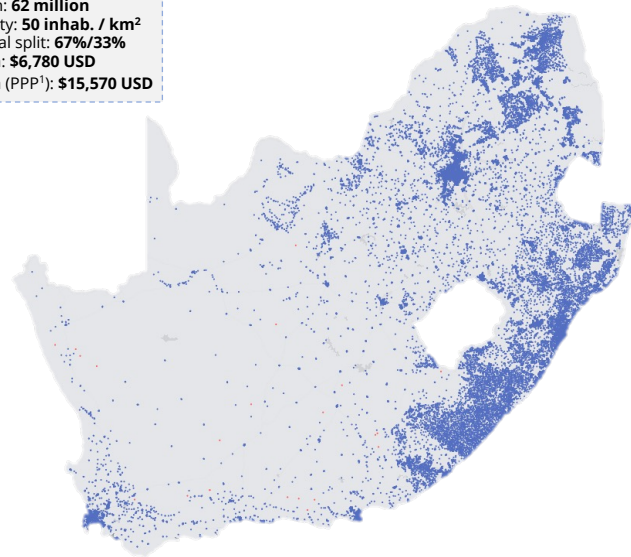
Government support for school connectivity
- In 2013, the South African government approved the SA Connect initiative, which aimed to connect 6,135 government facilities including schools
- The communications regulator, ICASA has mandated (through spectrum licenses) telecommunications companies to provide broadband services to 18,520 schools

Electricity
- Access to **stable** electricity supply is a **major barrier**

Total	89%	11%
Urban	94%	6%
Rural	84%	16%

% of population with access to electricity
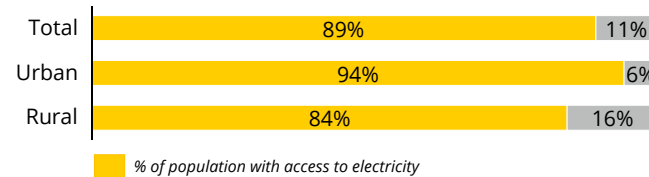
Digital literacy
- Digital literacy is relatively high in South Africa; with **72% of individuals** in South Africa using the internet
- South Africa scores a 4.4 on the Wiley 'Digital Skills Gap Index', **ranking 4th out of 26 countries** in Sub-Saharan Africa

Key takeaways

- **Affordability**: South African has the **most unequal** income equality in the world, with the poorest living of $2.15 per day

- **Affordability: dedicated initiatives from the government** have been stymied by limited funding

- **Delivery: stable electricity supply** is a major challenge due to constraints experienced at the national electricity provider Eskom

- **Acceptability:** there is a **gap of digital skills** with 28% of individuals not using the internet

Notes: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production; 2) Connectivity of schools as found through desk research (source: IOL (2023) 'Angie Motshekga says 80% of public schools have internet connectivity'); please note that this is not aligned with Giga's connectivity map, as data on connectivity per school is largely unavailable (blue colour)
Sources: Giga, ITU, World Bank, GSMA, IOL, Wiley, Deloitte analysis

South Africa | Fiber internet market

The fiber market is competitive in South Africa, and while fiber broadband could be a viable solution for urban areas, affordability is a challenge

Key insights into the fiber internet market

Coverage	• There are **eight submarine cables** entering South Africa: the SAT-3/WASC, SAFE, SAT-3/WASC, EASSy, METISS, Equiano, 2Africa and West Africa cables • The **fiber-optic backbone** in South Africa is extensive, with over 100,000 km of cables deployed • As of March 2023 South Africa has around **1.5 million households** with fiber-to-the-home (FTTH) connectivity • At the national level, about 90% of households do not have internet connection at home
Market players	• The **main** fixed network operators: **Vumatel, state co-owned company Openserve (Telkom), Metrofibre, Octotel, Frogfoot** • These fiber network operators (FNO's) own and manage their own fiber networks and provide **wholesale access** to other internet service providers (ISP's)
Pricing	• Having largely frozen prices since the Covid-19 pandemic, FNOs such as Telkom's Openserve, Vumatel and Frogfoot have begun raising the fees they charge ISPs for accessing their networks to bring them in line with inflation • Aggregate fixed internet prices are around **$17 USD per month** (20 Mbps down, 14 Mbps up, unlimited volume), but government subsidies through the E-Rate Tariff offer a 50% discount for schools.
Market trends	• Vodacom e-learning equips educators with mobile technology to improve classroom experience. Educators and learners will be able to access content and lesson plans remotely • Free internet for schools has partnered with Frogfoot, Vumatel and Octotel, offering fiber routers along with free data for school premises

Fiber backbone

20 Mbps Fiber prices of South African ISP's in USD

Vumatel	Openserve	MFN	Frogfoot
41	38	27	41

Mail&Guardian — *April 2023*
South Africa Investment Conference
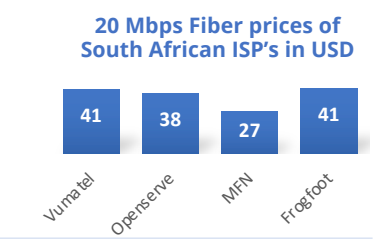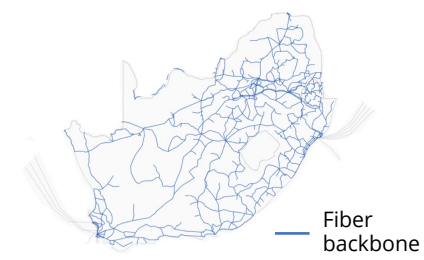
Key takeaways

+ **Availability:** the fiber-optic backbone covers over 100,000km

+ **Competition:** there are nine main FNO's **that own and operate their own network**, which contributes to healthy competition resulting in decreasing wholesale prices and increasing speeds

− **Affordability: affordability** of **fiber** connectivity is a challenge given the large low-income base in the country

Note: 1) Price per month based on retail prices from Orange and MTN for satellite internet and from MTN Benin and Moov for mobile internet
Sources: Giga, ITU, BusinessDay, GSMA, MyBroadband, ICASA, Interviews, Deloitte analysis
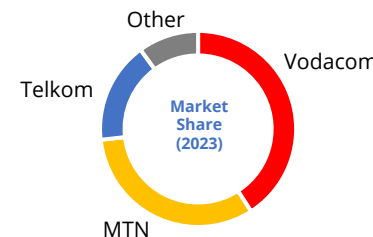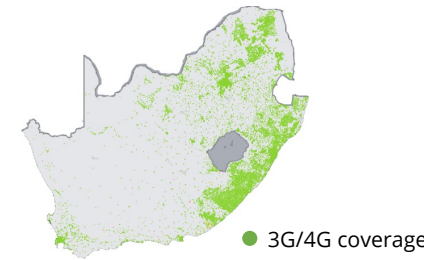
South Africa | Wireless internet market

Vodacom leads the mobile internet market with over 40% market share, while MTN has a denser network in the country

Key insights into the wireless internet market

Coverage	• National population **coverage for 3G stood at 100%** in South Africa, 4G/LTE stood at 98% and 5G stood at 20% in 2022. • In 2022, **6,088 schools were connected** to the internet based on universal service obligations imposed by ICASA. • The South African mobile market supported approximately **180 mobile cellular subscriptions** per 100 inhabitants, inflated by multiple SIMs and inactive SIMs. • In 2021, **69.4% of households nationally** had access to the internet using mobile devices. **Rural households made up 59.2%** nationally, accessing the internet through mobile devices in the same period.

● 3G/4G coverage

Market players	• South Africa's market is competitive, with at least three strong mobile network operators and several mobile virtual network operators (MVNOs) • **Vodacom** is the **market leader** with a market share of **~40%**, followed by **MTN** with **~32%**. • **Telkom**, the largest operator in South Africa in terms of turnover and reach, is 51% government owned (including the Public Investment Corporations 12% shareholding).

Other
Vodacom
Telkom
Market Share (2023)
MTN

Pricing	• Price of prepaid mobile internet is **$0.81-$1.09 USD for 100MB** and, **$33-$38 USD for 20,480MB** (34.71 Mbps down, 6.79 Mbps up)

> " If you look at urban areas, there is no reason not to have connectivity
> **- MNO** "

Market trends	• At present, **4G is heavily underutilised**, leaving operators with plenty of opportunity to migrate subscribers over to these higher value plans, which should support growth • The delayed spectrum auction in March 2022 raised over ZAR14.4bn (USD970.0mn) for ICASA (Independent Communication Authority of SA)

South Africa Telecommunications Report

BMI a FitchSolutions Company

The State of the ICT Sector Report in South Africa
MARCH 2023

ICASA INDEPENDENT COMMUNICATIONS AUTHORITY OF SOUTH AFRICA

Key takeaways

+ **Availability**: the **4G network covers 98% of the population** in South Africa, with **6,088 schools connected**

− **Competition: MTN and Vodacom** are the **dominant market players** with a combined **market share of over 70%**

− **Competition**: The mobile market is **strongly concentrated** between MTN and Vodacom, while smaller players Cell C and Telkom have struggled to grow their market shares significantly

Sources: Giga, GSMA, World Bank, MyBroadband, CommsUpdate, BMI, ICASA, Deloitte analysis

South Africa | Satellite internet market

GEO satellite internet is available in South Africa but LEO/MEO satellite internet is at a nascent stage, and satellite internet is considered more expensive than other connectivity options

Key insights into the satellite internet market

Coverage	• **GEO satellite internet is available** in South Africa. For example, Eutelsat's satellite coverage is present across South Africa through 128 high-power spot beams, and YahClick by HughesNet has satellite coverage present in most of South Africa, except the North-West Province • LEO/MEO Satellite internet is at a **nascent stage** in South Africa
Market players	• **Eutelsat** and **HughesNet** offer satellite Internet to home users in South Africa through several ISPs — including **DSL Telecom Connect, MorClick, and Vox**. • The entry of **Starlink** in South Africa can boost satellite internet access in the country. However, the company **has not obtained an operating license yet**
Pricing	• As satellite internet is **comparatively more expensive** than other internet solutions, it does not have any significant presence across schools in South Africa • Eutelsat offers **five different plans** with speeds ranging from 5 to 50 Mbps • Yahclick offers **two different plans** with speeds ranging from 10 to 20 Mbps
Market trends	• HughesNet offers **distance learning solutions** and internet connectivity for schools across the world • Internet Service Provider MorClick partnered with Yahclick, to provide **free internet to 15 schools in South Africa for three months**

> "LEO and MEO satellite solutions are great, but it is early days. There is not much regulations as well and there are political issues with having no ground stations in-country."
> **- Infrastructure provider**

EUTELSAT

HughesNet.

Price of GEO satellite vs. Fiber

$37 — Fiber (20Mbps)

$71 — GEO Satellite (20Mbps)
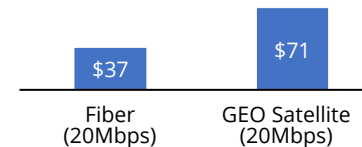
MYBROADBAND TRUSTED IN TECH — *March 2022*

MorClick – Satellite internet that changes lives

Key takeaways

– **Availability:** for **rural areas** with no access to fiber or mobile connectivity, there are **not a lot of options available**, given that the **LEO/MEO satellite internet market is still nascent**

– **Affordability**: GEO/VSAT Satellite is comparatively **more expensive than fixed broadband**

– **Quality:** the available Mbps varies **starts at 5 Mbps**, which is sufficient for meaningful connection, however Satellite internet often has **high latency**

Sources: Company websites, MyBroadband, interviews, Deloitte analysis

South Africa | Enabling environment

Multiple regulatory policies are in force to enhance internet access and drive down prices across the country, many of which focus specifically on school connectivity

Regulations

- **The Independent Communication Authority of South Africa**, an autonomous regulatory body responsible for overseeing and regulating the communications sector in South Africa, established under the ICASA Act

- **E-rate tariff**, grants 50% discount on data usage to public schools, technical vocational education and training colleges. They are eligible to benefit from this E-rate tariff allowing them to access the internet at a reduced rate. Certain educational websites may avail zero-rated benefits from telecom providers, allowing the users to view or download content from those sites for free

> " To make universal school connectivity happen, there needs to be a major policy initiative from the state authorities who are responsible for education, whether provincial or national. This needs some serious resources to make this happen.
> **- Infrastructure provider** "

G4 South Africa's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 4: 'integrated regulation'** [1]

Access to finance

- **Interest rates in South Africa** are low compared to other SADC countries, which is positive for capital-heavy investments such as developing new connectivity infrastructure;
- **Universal Service and Access Obligations** mandates telecom operators, to connect a designated number of schools to the internet including institutions for persons with disabilities, within a five-year period. This facilitates enhanced educational resources, online learning, and research opportunities

Access to finance indicators

Exchange rate to USD: **0.054** (2023)

Government Debt to GDP (% of GDP): **75%** (2022)

Interest rate: **8.25%** (2023)

Domestic Credit to private sector (% of GDP)[2]: **92.1%** (2022)

Key takeaways

+ **Affordability:** the government has imposed **price controls** on telecommunication operators

+ **Funding security:** the **interest rate in South Africa is relatively high**. The Central Bank has raised interest rates by a total of 475 basis points since November 2021, which is unfavorable for high-CAPEX investments such as telecommunication infrastructure

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD
Sources: ITU, World Bank Development Indicators, Trading Economics, S&P Global, OECD, University of Oxford, Interviews, Deloitte analysis

Botswana | Assessment of market shortcomings [1/2]

In Botswana, the main market shortcomings have been identified in the affordability, delivery and quality market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~58% of schools[1])				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	+ No challenges regarding digital literacy have been identified	+ Digital literacy is relatively high in Botswana (74% of individuals are using the internet)	• Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− Prices of fiber & mobile connectivity are relatively high (fixed broadband is at 10% of GNI per capita, and mobile broadband is also relatively expensive with $1.99 USD per GB of mobile data (3rd most expensive of the 9 focus countries))	− Very sparse population (4.5 inhabitants per km², being by far the least populated of the 9 focus countries), so large infrastructure investment & operating costs which need to be distributed over just a small population − Botswana is a landlocked country, resulting in higher cost of bandwidth − Lifespan of fiber/mobile telecommunication equipment is ~10 years, so besides the initial CAPEX investment, there are also significant operational expenditures − High cost of maintenance and high risk of disruptions given the large distance the fiber or mobile infrastructure must cover − Reliance on data centers abroad (e.g. South Africa) resulting in higher connectivity costs	• Interview with infrastructure provider • Desk research
		− Price of GEO internet is relatively high (e.g. ranging from $35 per month for 0.5 Mbps to $525 per month for 10 Mbps at GCSat, and starting at $150 per month at BTC)	− Satellite internet is expected to be affected by many of the affordability challenges above (e.g. high bandwidth costs, high cost of maintenance & after-sales support)	• Desk research
		+ The upcoming entry of Starlink into Botswana could bring an affordable high-quality connectivity solution to Botswana	+ Starlink has applied for a license in Botswana (October 2023); if approved, Starlink is expected to offer unlimited 150 Mbps internet at ~$47 USD per month on top of the one-off investment needed for installation	• Desk research
		+ Significant commitment and budget available from the government for connectivity for schools [2]	+ High GNI per capita ($7,350 USD and $17,590 USD at Purchasing Power Parity (PPP)) + There is significant commitment from the government for education (16% of government expenditure / 9% of Botswana GDP goes towards education, being the 3rd highest of the 9 focus countries)	• Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	+ Availability of open access backbone & middle-mile infrastructure, resulting in competition among ISPs	+ The state-owned infrastructure company BoFiNet only has a wholesale license and cannot serve customers directly as it does not have a retail license + BoFiNet provides open access to its infrastructure, serving multiple ISPs who then compete in the retail market	• Interview with infrastructure provider
		+ New players (e.g. Liquid Technologies) have entered the connectivity infrastructure market in Botswana, resulting in competition in the middle-mile segment	+ The government intentionally excited the market and welcomed new players	• Interview with infrastructure provider

Note:s 1) Giga's connectivity map shows that 90% of schools are covered by good quality internet (> 3G), but only 32% of schools are connected to good quality connectivity; 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP
Sources: Giga, interviews, Deloitte analysis

Botswana | Assessment of market shortcomings [2/2]

In Botswana, the main market shortcomings have been identified in the affordability, delivery and quality market dimensions

Assessment of school connectivity market

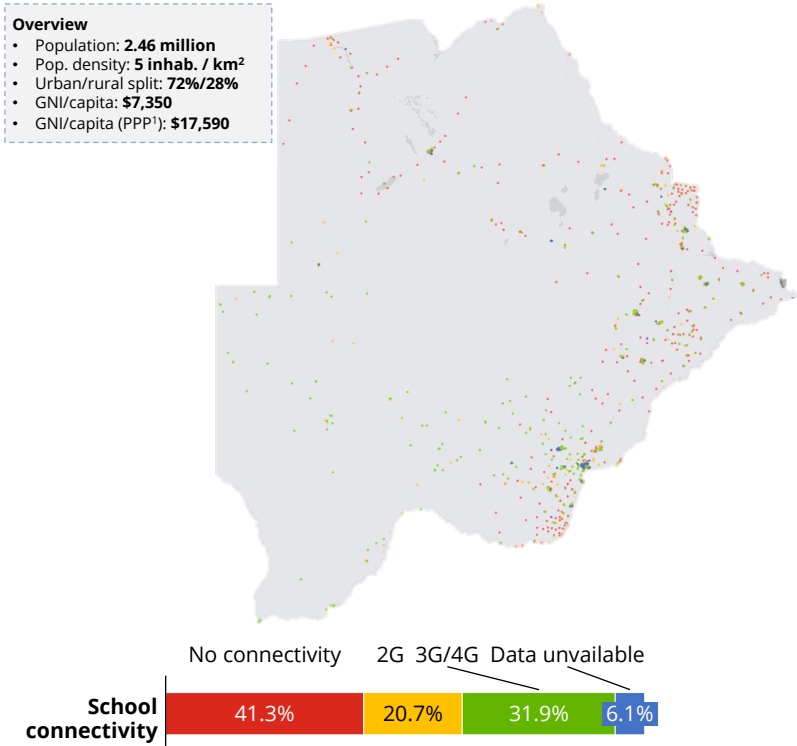| Dimension	Desired situation	Assessment of **market shortcomings (-) / market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Delivery	Products & services are delivered reliably, cost effectively and on time	− There is a high risk of disruptions given the large distance the fiber or mobile infrastructure must cover, and maintenance & security therefore is a challenge	− Very sparse population (4.5 inhabitants per km², being by far the least populated of the 9 focus countries), with telecommunication infrastructure having to cover long distances between villages	• Interview with infrastructure provider
		− Lack of uptake of connectivity solutions due to lack of electricity (particularly in rural areas)	− Lack of electricity, particularly in rural areas (access to electricity is at 74% of population and only 25% in rural areas)	• Desk research
		− Lack of business viability of establishing local support & maintenance centers in rural areas	− Very sparse population (4.5 inhabitants per km², being by far the least populated of the 9 focus countries), so relatively high costs of providing maintenance & support	• Satellite internet company • Desk research
Quality	Products meet quality standards	− Quality of fixed broadband is low in Botswana (median quality of 8 Mbps down, 7 Mbps up and 24 ms latency), with Botswana ranking 168th out of 181 countries by Ookla's Speedtest Global Index and ranking lowest of the 9 focus countries	− Lack of business viability of investing in telecommunication infrastructure due to the low population density	• Desk research
		+ Significant commitment of the government to provide high-quality connectivity	+ Under the new SmartBots government action plan, the government aims to provide minimum of 50 Mbps internet to all schools in villages of >500 people in Botswana	• Interview with infrastructure provider • Desk research
Coverage gap market dimensions (coverage gap: ~10% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	+ There is significant commitment from the government to make connectivity available across the country	+ In Botswana, connectivity has been designated as a basic amenity by the government, resulting in it being a requirement for all villages >500 people	• Interview with infrastructure provider
		+ Although there is currently no LEO satellite internet option available, if Starlink's license application is approved, this could bring an affordable high-quality connectivity solution to Botswana	+ Starlink has applied for a license in Botswana (October 2023); if approved, Starlink is expected to offer unlimited 150 Mbps internet at ~$48 USD per month	• Desk research
Funding security	Market players have sufficient funding security	+ There is significant funding available from the government to enhance connectivity, including for schools as part of its SmartBots action plan (with aim to connect all local government premises, including schools, to high-quality internet)	+ Government is funding 100% of the infrastructure deployment (through state-owned infrastructure provider BoFiNet)	• Interview with infrastructure provider • Desk research

Note: 1) Giga's connectivity map shows that 90% of schools are covered by good quality internet (> 3G)
Sources: Giga, interviews, Deloitte analysis

Botswana | Broader context & status of school connectivity

Around 32% of schools in Botswana have meaningful connectivity; the sparse population as well as a lack of electricity are identified as barriers to connectivity

Of all >1,000 schools, **44% of schools** **are connected to the internet**

Overview
- Population: **2.46 million**
- Pop. density: **5 inhab. / km²**
- Urban/rural split: **72%/28%**
- GNI/capita: **$7,350**
- GNI/capita (PPP[1]): **$17,590**

School connectivity

| No connectivity	2G	3G/4G	Data unavailable
41.3%	20.7%	31.9%	6.1%

Government support for school connectivity

- In 2019 BOCRA launched the **Schools Connectivity and Computerization Project**, which funded provision of broadband **internet connectivity** and **installation** of **computers** of 69 schools in **rural and remote villages**
- **SmartBots** program by the **government continuously** aims to **digitize the country** and **plans to connect 500 villages** to the internet
- **SmartBots** and **Giga** work together to **connect schools** to higher speed internet, which has so far benefited 400 schools

Electricity

- In **rural areas**, access to electricity is **major barrier**

Total	80%	20%
Urban	93%	7%
Rural	25%	75%

🟨 *% of population with access to electricity*
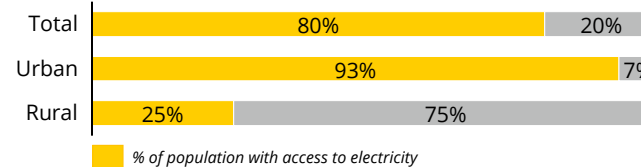
Digital literacy

- Digital literacy is high in Botswana; **74% of individuals** in Nigeria are **using** the **internet**
- Botswana scores a 4.2 on the Wiley 'Digital Skills Gap Index', **ranking 4th out of 26 countries** in Sub-Saharan Africa

Key takeaways

+ **Acceptability: Digital literacy** is **high**, and a large share of the population uses the internet

− **Delivery:** in **rural areas** there is a **lack of access to electricity** and very **low population density** increases price and risks of disruption, maintenance & security needs

+ **Affordability:** there is **clear commitment** from the government to **improve the internet connection** of villages

Botswana | Fiber internet market

The fiber market in Botswana is concentrated amongst three big players; the network covers most towns, but transit charges for international bandwidth are significant

Key insights into the fiber internet market

Coverage
- BoFiNet has strategically invested in the **WACs and EASSy subsea cables** to ensure international bandwidth coming into Botswana.
- Botswana has **redundant national fiber backbone** networks, that connect most parts of the country. The network spans over **10.000 km nation wide** and aims to cover all towns by 2025. **BoFiNet operates the network** and serves as a wholesaler to other internet providers

Market players
- Organizations are free to deploy backbone infrastructure, but the infrastructure has to be provided to other operators on **Open Access Network Principles**
- There are **three operators with public telecommunications operators licenses**: Mascom Wireless, Orange Botswana and Botswana Telecommunications Corporation (BTC)
- More than **40 ISPs** and **new players** have entered as a **result of government policies** and **open access backbone**

Pricing & quality
- Costs for connecting Botswana to the EASSy and WACS cable systems remain significant: **transit charges** through Namibia and South Africa constitute between **43% and 68% of the total cost for bandwidth** from the Botswana border
- **Slow speed** of 8 Mbps down, 7 Mbps up and 24 ms latency, with Botswana ranking **168th out of 181** countries by Ookla's Speedtest Global Index (ranking lowest out of 9 focus countries)

Market trends
- The **U.S. Trade and Development Agency** awarded a grant to BoFiNet for a **feasibility study** to support **equitable and affordable broadband internet access** to nearly a half million people in Botswana's **most rural and hardest-to-reach communities**
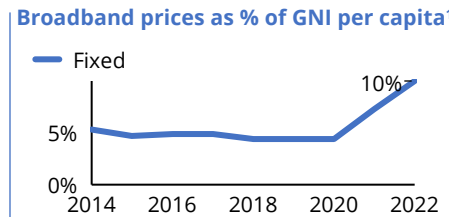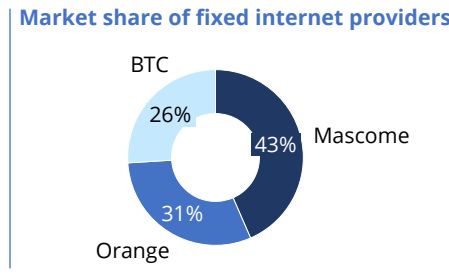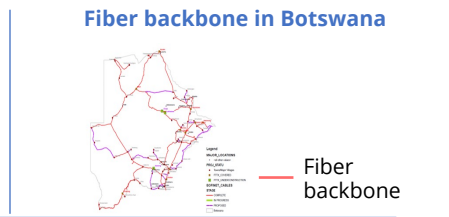
Fiber backbone in Botswana

Fiber backbone

Market share of fixed internet providers

BTC 26%
Mascome 43%
Orange 31%

Broadband prices as % of GNI per capita[1]

Fixed

10%, 5%, 0% — 2014 2016 2018 2020 2022

News

USTDA
U.S. TRADE AND DEVELOPMENT AGENCY

Key takeaways

- **Availability:** investments in fiber in rural areas are **considered too expensive**, due to the low population density and high costs for maintenance and security

+ **Competition:** Competition in the middle-mile segment **amongst ISPs**

- **Affordability: Price of fixed broadband** relative to GNI per capita has **increased,** potentially due to **high transmission costs** through SA and Namibia

- **Quality: quality of fixed broadband is low** in Botswana (ranking lowest out of 9 focus countries)

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita;
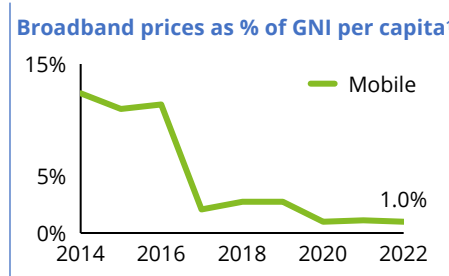Sources: BOCRA, USTDA, Worldbank, Ookla, ITU, Interviews, Deloitte Analysis
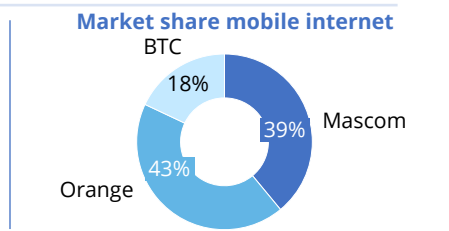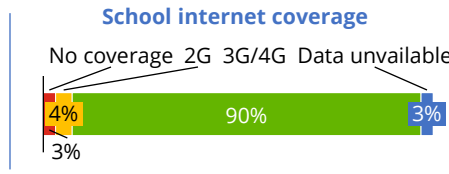
Botswana | Wireless internet market

The mobile internet market in Botswana is relatively competitive and affordability of mobile broadband is good

Key insights into the wireless internet market

Coverage	• Botswana has **strong mobile coverage**, following a good backbone infrastructure • **90% of schools** are in areas, which **are covered by 3G or 4G** Mobile internet • Overall, Botswana had 4.28 million **cellular mobile connections**, which is equivalent to **162% of the total population**	**School internet coverage** No coverage 2G 3G/4G Data unvailable 4% 90% 3% 3%
Market players	• **BTC, Orange and Mascom** are also the **main providers** for mobile phone services • As of November 2023 **Orange** has already launched **5G internet** for its customers and BTC plans to follow suit with optimising its 4G/ 5G network • There are at least **10 internet service providers** in Botswana	**Market share mobile internet** BTC 18% Mascom 39% Orange 43%
Pricing & quality	• The **price** of mobile subscriptions is **below the 2% of GNI per capita target** set by the Broadband Commission for the past few years • Mobile broadband costs **$1.99 USD per GB** • Connecting **smaller villages** (<500 inhabitants) to high-speed internet is considered **not economically viable** (no viable business case) • According to Ookla's Speedtest Global Index, the **median mobile internet connection speed** is 33 Mbps, which is more than **four times faster than median fixed internet** speed	**Broadband prices as % of GNI per capita**[1] 15% Mobile 5% 0% 2014 2016 2018 2020 2022 1.0%
Market trends	• **Orange** Botswana has **launched** the group's **first 5G network in Africa**. The new infrastructure covers 30% of the country's population, centered on greater Gaborone and Francistown, with other cities to follow in 2023. Despite these upgrades, the focus seems to remain on bigger cities, not including more rural areas of Botswana	**COMMS UPDATE** *November 2022* **Orange Botswana launches the group's first African 5G network**

Key takeaways

− **Availability: limited** availability in **rural areas** as the business case is low for connecting rural tows <5000 inhabitants

+ **Affordability:** mobile broadband is **affordable compared to the GNI** per capita

+ **Quality: mobile internet** connection speed **is faster** than fixed internet

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Giga, BOCRA, Reuters, Ookla, CommsUpdate, Interviews, Deloitte analysis

Botswana | Satellite internet market

There is a competitive satellite internet market in Botswana, but quality of the offered GEO satellite internet is relatively low

Key insights into the satellite internet market

BTC satellite coverage

Coverage	• The country has full **GEO satellite coverage** available via BTC VSAT Hub and Ku Band satellites • Satellite internet is **available everywhere** in the country
Market players	• According to BOCRA, there are **several players offering satellite internet connections**, for example, Lenong Communications, Zebranet, GCSAT and BTC, among others • **BTC targets remote areas**, businesses and schools directly and has recently bought **more capacity** on the AMOS-7 satellite from Spacecom to **improve its offer** for rural customers
Pricing & quality	• Price of GEO internet is relatively high (e.g. **ranging from $35 per month for 0.5 Mbps** to **$525 per month for 10 Mbps** at GCSat, and **starting at ~$60 per month** at BTC) [1] • Starlink is planning to provide LEO satellite internet for **$48 USD per month** (for 150 Mbps internet) [1], which would make a **relatively cheap & high-quality option**
Market trends	• According to Starlink's website, the **satellite internet service planned to launch in Botswana in Q3 2023.** This has now been adjusted to Q3 2024 since, according to the Botswana Communications & Regulatory Authority (BOCRA), **the company is yet to get the licensing** requirements needed to set up operations in Botswana.
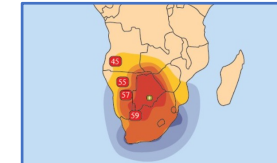
" The population distribution is a challenge – some villages are 100s of kilometers away from the nearest fiber node
- Infrastructure provider "

" The lifespan of telecom equipment is 7-10 years or 15 years if you push it, for 500 people it does not make economically sense
- Infrastructure provider "

September 2023
Starlink Has Not Received License To Operate In Botswana, Says BOCRA

Key takeaways

+ **Competition:** there are **several providers of GEO satellite internet**

+ **Availability:** GEO satellite internet is available, and **LEO internet is expected to become available soon**

− **Quality**: **quality of GEO satellite internet** is **relatively low** and offered speed is often too slow for a meaningful internet connection

Note: 1) Prices based on online available information (source: BOCRA for GEO/VSAT and Guardian Sun for Starlink) and these have not been verified for school connectivity
Sources: BOCRA, Guardian Sun, Amos-Spacecom, Interviews, Deloitte analysis

Botswana | Enabling environment

There is significant commitment from the government to improve connectivity

Regulations

- In 2019, the Botswana Communications Regulatory Authority (BOCRA) engaged with operators and **agreed to cut data prices by up to 46 %** making data prices competitive in the region
- Botswana Fiber Network (BoFiNet), the state-owned entity that provides wholesale national and international telecommunication infrastructure and services to the Botswana Telecommunications Corporation (BTC) **offered service providers Indefeasible Right of Use (IRU)** contracts for connectivity, **reducing prices** in some cases **to below $0.86** per Megabits per second (Mbps)

> " In Botswana, connectivity has been designated as a basic amenity by the government, resulting in it being a requirement for all villages with a population of over 500 people
>
> **- Infrastructure provider** "

> **G3** Botswana's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 3: "enabling investment & access'** [1]

Access to finance

- Botswana's financial system appears to be **mostly stable**, sound and **resilient to a wider range of shocks** relating to risks such as volatility in diamond prices, geo-political development and the tightening of global financial conditions
- The Botswana Pula, is the **strongest currencies in Southern Africa**, which **benefits** the **economic growth** of the country

> " Infrastructure providers have very small margins, and all equipment is procured from outside the continent.
>
> **- Infrastructure provider** "

Access to finance indicators

- Exchange rate to USD: **0.073**
- Government Debt to GDP (% of GDP): **26.1%** (2022)
- Interest rate: **2.65%** (2023)
- Domestic Credit to private sector (% of GDP)[2]: **29.76%** (2021)

Key takeaways

+ **Funding security:** The **government provides** funding **for connectivity and digitization** of local government premises, which includes schools

+ **Funding security:** Botswana has a **stable and relatively strong economy**, which facilitates investments

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: ITU, Trading Economics, XE, International Monetary Fund, Interviews, Deloitte analysis

Malawi | Assessment of market shortcomings [1/2]

In Malawi, the main market shortcomings have been identified in the affordability, availability, delivery and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~40% of schools[1])				
Acceptability	Products are culturally appropriate and well-adapted	− Lack of uptake from communities because of digital illiteracy (suppliers have the perception that not all teachers are willing to transition to digital learning)	− Digital illiteracy; digital literacy is low in Malawi with 24% of individuals in Malawi using the internet	• Interview with MNO • Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− High price of connectivity (price of fixed broadband is at 64% of GNI per capita, being the least affordable out of all 9 assessed countries; price of data-only mobile broadband is at 9% of GNI per capital, being the 2nd least affordable out of all 9 assessed countries)	− High price of bandwidth (given that Malawi is landlocked, given the low bandwidth usage of Malawi and the lack of long-term bandwidth agreements) − License fees need to be paid by market players to the regulator in US dollars, which is expensive given the shortage of foreign currency and high exchange rate − High cost of equipment (equipment needs to be imported from abroad and there are high custom duties) − High cost of maintenance for rural areas (given the large distance, resulting in higher cost for fuel and allowances) − Vandalism & theft resulting in increased costs, particularly in rural areas	• Interview with African int'l infrastructure provider • Interview with MNO • Interview with infrastructure provider
		− Lack of affordable devices	− The government charges high taxes on imported devices (17.5% VAT)	• Interview with MNO • Desk research
		− Affordability of (GEO/LEO) satellite internet is expected to be a challenge, given the price of satellite internet and low purchasing power	− Price of (LEO) satellite internet is relatively high (e.g. price of Starlink is ~$49 USD per month with installation cost of ~$580 USD)	• Interview with MNO • Desk research
		− Low government budget for school connectivity [2]	− Low GNI per capita ($640 USD and $1,700 USD at Purchasing Power Parity (PPP))	• Desk research
		+ Government is committed to improving school connectivity and funding is becoming available	+ The government is committed to digitalising education (Malawi 2063 strategy); through the 'Connect-A-School' initiative, Malawi aims to connect all schools by 2030	• Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	− Limited competition in the mobile connectivity market	− The mobile connectivity market is dominated by two players: Airtel and TNM. This might result in limited competition and therefore higher prices	• Desk research
		+ Availability of open access backbone & middle-mile infrastructure, resulting in competition among ISPs	+ Backbone operator Open Connect Limited provides an open access network to all market players	• Interview with infrastructure provider
Delivery	Products & services are delivered reliably, cost effectively and on time	− Lack of uptake of connectivity solutions due to lack of electricity	− There is a lack of electricity; access to electricity is at 14% of population, and only 6% in rural areas (lowest access to electricity out of all 9 assessed countries)	• Interview with MNO • Desk research
		− There is the risk of disruptions, particularly in rural areas	− Vandalism & theft is challenge, particularly in rural areas	• Interview with infrastructure provider

Notes: 1) Giga's connectivity map shows that 43% of schools are covered by good quality internet (> 3G), and from desk research it is estimated that 3% of schools are connected to good quality connectivity; 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP
Sources: Giga, interviews, Deloitte analysis

Malawi | Assessment of market shortcomings [2/2]

In Malawi, the main market shortcomings have been identified in the affordability, availability, delivery and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Quality	Products meet quality standards	− Quality of fixed broadband is relatively low in Malawi, with Malawi ranking 146th out of 181 countries by Ookla's Speedtest Global Index	− *Hypothesis: expect this is the result of some of the market shortcomings identified in the other market dimensions, such as the lack of business viability of investing in telecommunication infrastructure [2]*	• Desk research
		− Most of the country is covered by 2G or 3G mobile network, but the 4G network only covers the main urban areas	− *Hypothesis: expect this is the result of some of the market shortcomings identified in the other market dimensions, such as the lack of business viability of investing in telecommunication infrastructure [2]*	• Desk research
Coverage gap market dimensions (coverage gap: ~57% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	− Lack of business viability of expanding fiber or mobile connectivity to outside main urban areas	− Expanding outside of the main urban areas is not considered commercially attractive given the low population density and low ability to pay − Market players experience a lack of insight into where the demand is located (e.g. lack information on density and location of schools) − Access to funding for investments is a challenge for market players (e.g. Universal Service Fund is only just being set up, and there is a high interest rate (24%)) − High cost of equipment (equipment needs to be imported from abroad and there are high custom duties) − Lack of electricity (access to electricity is at only 6% in rural areas in Malawi) − Lack of general road infrastructure	• Interview with MNO • Interview with infrastructure provider
		+ Market players are exploring the use of new technologies such as Fixed Wireless Access and TV White Space, which could potentially lower the costs for connectivity	+ An infrastructure provider mentioned that they are looking into Fixed Wireless Access technologies for rural areas after having been inspired by Poa Internet in Kenya + An MNO mentioned that TV White Space technology has already been used in West-Malawi and that it resulted in lower connectivity costs	• Interview with infrastructure provider
		+ The entrance of LEO satellite internet in Malawi may provide a suitable connectivity solution in, although affordability remains a challenge	+ LEO satellite internet (through Starlink) has recently become available in Malawi (Aug. 2023), which may provide opportunities for connectivity in rural areas	• Desk research
Funding security	Market players have sufficient funding security	− Access to funding for investments is a challenge for market players	− Universal Service Fund is only just being set up − There is a high cost of capital (high interest rate of 24%) − Market players experience large fluctuations in the yearly available government budget for connectivity	• Interview with MNO • Interview with infrastructure provider • Desk research
		+ Government funding for market players to expand to rural areas is becoming available	+ The government has recently set up the Universal Service Fund (USF), and the first tenders have just been issued + The Connect-A-School initiative is supported with funding by Malawi's Universal Service Fund as well as a recent partnership of UNICEF and Airtel Malawi (Aug. 2023)	• Interview with MNO

Notes: 1) Giga's connectivity map shows that 43% of schools are covered by good quality internet (> 3G); 2) Within the scope of this study we could not validate this hypothesis and further research is required
Sources: Giga, interviews, Deloitte analysis

# Malawi | Broader context & status of school connectivity

In Malawi, only 1.5% of schools are connected to the internet, although 43% of schools are covered by a good-quality network

Of all 8,000 public schools, only 1.5% are connected to the internet, although 43% of schools have good internet coverage (3G or 4G)
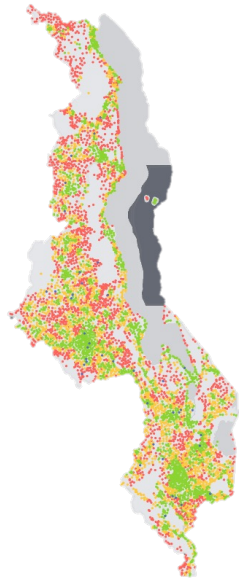
Overview
- Population: **20 million**
- Pop. density: **122 inhab. / km²**
- Urban/rural split: **18%/82%**
- GNI/capita: **$640**
- GNI/capita (PPP[1]): **$1,700**

No coverage	2G	3G/4G	Data unavailable

School coverage: 28% | 28% | 43% | 1%
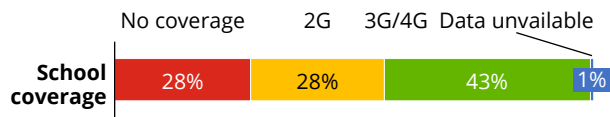
Government support for school connectivity

- However, the **government** is **committed** to **digitalizing education** as outlined in its Malawi 2063 strategy; through the 'Connect-A-School' initiative, Malawi aims to **connect all schools by 2030**
- The **Connect-A-School** initiative is **supported with funding** by Malawi's Universal Service Fund as well as a recent partnership of **UNICEF** and **Airtel** Malawi

Electricity

- In **rural areas**, access to electricity is **major barrier**

Total	14%	86%
Urban	54%	46%
Rural	6%	94%

☐ *% of population with access to electricity*
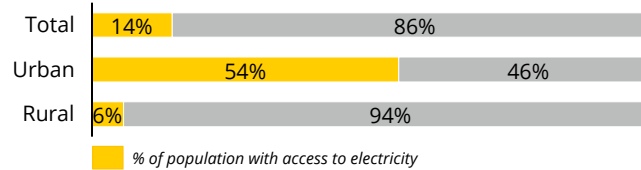
Digital literacy

- Digital literacy is low in Malawi; **24% of individuals** in Malawi are using the internet
- Malawi scores a 2.2 on the Wiley 'Digital Skills Gap Index', **ranking 21st out of 26 countries** in Sub-Saharan Africa

Key takeaways

- **Acceptability:** Low uptake of internet in communities, due to **digital illiteracy**

- **Delivery:** while in urban areas there is some access to electricity, **in rural areas there is almost no access to electricity**

+ **Funding security: the government is committed to connect every school by 2030 to the internet**, illustrated by the Connect-A-School initiative

- **Availability:** lack of business viability for expanding due **to lack of general road infrastructure**, low **population density** and low **ability to pay**

Note: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production
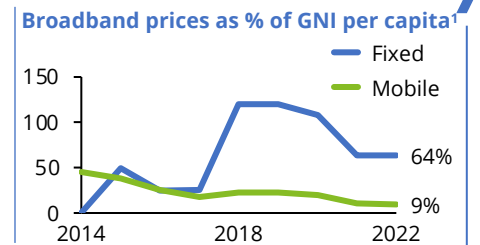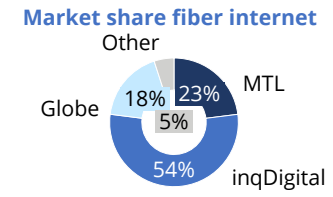Sources: Giga, ITU, World Bank, Wiley, Deloitte analysis

Malawi | Fiber internet market

The national fiber backbone in Malawi is gradually expanding, and competition has increased, but affordability remains a major challenge

Key insights into the fiber internet market

Coverage	• Malawi is connected to the national telecom networks of Tanzania. Through Tanzania and its neighbouring countries, Malawi has created **multiple optic fiber gateways** to the landing stations of the **SEACOM** and **EASSy sea cables** • Malawi has a **national fiber backbone** connecting al 28 districts in the country. The first phase covered over **1.300 km of fiber**. The second phase, which is currently deployed, will cover an **additional 1.500 km**
Market players	• Open Connect Limited (as 100% subsidiary of MTL) used to have a monopoly on the optic fiber backbone, but **new backbone operators have entered** the market, including inqDigital, Globe, and SimbaNet • This has **stimulated additional connections** to **different undersea fiber networks** in neighboring countries and therefore **lower connectivity prices** for consumers
Pricing & quality	• The **price** for a **fixed broadband** is **64% of the GNI per capita** and has not improved in the past year • Despite international gateways broadband **capacity remains low** and as a result the **wholesale price for bandwidth is high** • Ookla's Speedtest Global Index indicates that Malawi has a **download speed of 14 Mbps**, which ranks it **146th out of 181** countries
Market trends	• Malawi signed a memorandum of understanding with the Chinese government for a loan of ~$23 million, which will be used for the **construction of a national fiber optic network** to improve internet connectivity. The project is **financed through a soft loan from China's Export-Import Bank** and is **implemented by Huawei Technologies**

> " Fixed Wireless Access shoots far, it is a technology that is now mature in the market. In Kenya, Poa! Internet is using it to service remote areas. "
> **- Infrastructure provider**

Market share fiber internet

MTL 23%, 5%, inqDigital 54%, Globe 18%, Other

Broadband prices as % of GNI per capita[1]

- Fixed: 64%
- Mobile: 9%

(2014, 2018, 2022)

HUAWEI — 中国进出口银行 THE EXPORT-IMPORT BANK OF CHINA

Key takeaways

+ **Competition:** new operators have entered the **middle-mile fiber market,** which has increased competition

+ **Competition:** backbone operators provide an **open access network** which enables competition among ISPs

− **Affordability: high prices** for fixed bandwidth because the country is **landlocked**, has limited bandwidth usage and lacks adequate **long-term agreements**

− **Quality:** average speed of the **fixed internet is low**

Malawi | Wireless internet market

## The mobile internet market in Malawi is dominated by two major players; affordability is a major challenge

Key insights into the wireless internet market

Coverage	• Most of the country is **covered in 2G or 3G mobile network** and **4G covers** mostly **urban areas** • At the beginning of 2022 the **mobile penetration rate was 61%,** which is still behind the average penetration rate of 66% in SADC • **20% of the population** in Malawi has **access to the internet**
Market players	• The **two major mobile network operators** are Airtel Malawi and Telekom Networks Malawi (TNM) • **TNM is the biggest operator** and is currently the only operator that **provides 5G** and also holds two licenses for fixed network services • A **third** mobile network **operator, Malcel, received an operating licenses in 2022** and the operator is **planning to go live in October 2023**
Pricing & quality	• There are currently **high taxes** on **devices** (17.5%) • **Prices for mobile connectivity** are **lower than** for **fiber**, but still is at **9% of GNI per capita** (which is significantly above Broadband Commission's 2% target)
Market trends	• Earlier in 2023 Telkom Networks Malawi (TNM) has **started a pilot for 5G internet**, following approval from the Malawi Communications Regulatory Authority (MACRA). The 5G base stations are based in Blantyre and Lilongwe. Additional sites will be added in Mzuzu and Zomba. TNM has **partnered with Huawei** for the rollout of its 5G pilot

% of population covered (2022)

- 2G: 88%
- 3G: 86%
- 4G: 70%
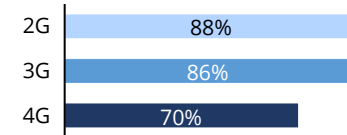
Market share (2023)

- TNM 54%
- Airtel 46%
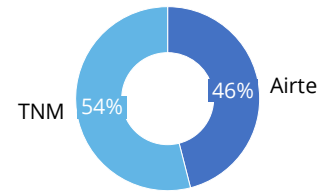
> " The biggest challenge for creating meaningful internet connectivity is the availability of smartphones " **- MNO**

Connecting Africa

May 2023

Telekom Networks Malawi pilots 5G

Key takeaways

- **Availability:** most of the country is covered, but **4G is mainly in urban areas**

- **Competition: Duopoly** in mobile broadband market, can result in **limited competition** and keep prices high

- **Affordability: high taxes** are imposed on **devices**, which is reflected in the price

Sources: ITU, Connecting Africa, Company websites, Interviews, Deloitte analysis

Malawi | Satellite internet market

The satellite market in Malawi seems to be nascent, but Starlink's entrance into the market could provide a new connectivity solution for rural areas
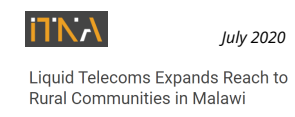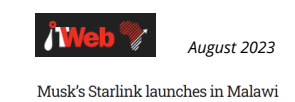
Key insights into the satellite internet market

Coverage	• The country is **covered by GEO and LEO/VSAT satellites** that can provide internet to people in Malawi
Market players	• **GEO/VSAT satellite internet** is provided by the **ISP Vizocom** and by **Liquid Technologies** • Since **Starlink** launched in August 2023, the country has access to **LEO satellite internet as well**
Pricing & quality	• **GEO internet provided** by Vizocom and Liquid Technologies, but the **prices** for those services are **not readily available** • The **price of Starlink's LEO satellite internet** is **$49 USD per month** with a **one-off equipment & shipping price** of **~$550 USD** [1] • Starlink promises that the **internet speed is high** and with **low-latency** and **short maintenance periods**
Market trends	• At the end of **2022 Starlink** was **granted a license to operate satellite broadband services** in Malawi from MACRA. Starlink became the first licensed high-speed, low-latency broadband satellite service in the country • **Liquid Telecom provides VSAT connectivity services to mbora**, a social FinTech enterprise in Malawi, through community hubs. Each hub is serviced with **broadband speed of up to 36 Mbps**. Liquid Telecom is using satellites of its long-term partner **Intelsat** and providing an **uncapped data service** to mbora

" Satellite internet is developing and would be the ideal technology. [...] I see that as the future. "
- MNO

" Starlink is selling at ~$700 at one-off cost and then $50 dollar per month. That could work for rural areas "
- MNO

August 2023
Musk's Starlink launches in Malawi

July 2020
Liquid Telecoms Expands Reach to Rural Communities in Malawi

Key takeaways

− **Competition: limited number of satellite internet providers** could result in increased prices

+ **Availability:** LEO satellite can **offer new connectivity solutions** for rural areas

− **Affordability:** satellite internet tends to sit at a **higher price point**, but offers an alternative for connectivity solutions with high CAPEX (e.g. fiber)

Note: 1) Prices based on online available information (source: Connecting Africa) and these have not been verified for school connectivity
Sources: IT Web, IT News Africa, Connecting Africa, Company websites, Interviews, Deloitte analysis

Malawi | Enabling environment

The government has just set up the Universal Service Fund which may boost network coverage in rural areas, but access to finance remains a challenge

Regulations

- Malawi recently adopted the **convergence licensing framework** that focuses on **technological neutrality** of **communication services** in the country. With this framework in place, **operators are not constrained** by the **technology they deploy** to offer these services.

- MACRA plans to **construct 75 ICT labs in collaboration with Ministry of Education** across the country. Currently, only 241 out of 1,610 secondary schools offer computer studies due to the lack of technological and physical infrastructure. Macra, through the Universal Service Fund, will construct **100 ICT Labs annually** for the next five years under Phase 1 of the ministry's 'Connect-a-School Project.

> " The government and regulator set up a Universal Service Fund where all operators bid to take the network in the rural areas. The fund will help subsidize these projects. The first tenders have just been issued and we are in the midst of preparing for that.
> **- MNO** "

G4 | Malawi's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 4: 'integrated regulation'** [1]

Access to finance

- The **interest rate is high**, which means that the **cost of capital** is very high **for potential investors**
- The **local currency is weak** in comparison to the USD, which makes **importing of raw materials, equipmen**t and license fees (which have to be paid in USD) **very expensive** for market players

> " The government will not have funding every year, so doing an IRIU (Indispensable Right of Use) model is an opportunity. We sell it for five or ten years and get paid in advance for that time period.
> **- Infrastructure provider** "

Access to finance indicators

$ Exchange rate to USD: **0.00088**

Government Debt to GDP (% of GDP): **67%** (2022)

Interest rate: **24%** (2023)

Domestic Credit to private sector (% of GDP)[2]: **10%** (2016)

Key takeaways

- – **Affordability:** suppliers experience high costs, due to **exchange rates, taxes and duties**, which increases the prices of connectivity for end-users

- + **Funding security:** the government set up a Universal Service Fund (USF) and **issued tenders for increasing** the **connectivity** in rural areas

- – **Funding security:** the high interest rate makes **capital investments expensive**

- – **Funding security:** the government **budget for connectivity fluctuates** from year to year

Zimbabwe | Assessment of market shortcomings [1/2]

In Zimbabwe, the main market shortcomings have been identified in the affordability, availability, competition and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Usage gap market dimensions (usage gap: ~53% of schools[1])				
Acceptability	Products are culturally appropriate and well-adapted for low-income settings	− Lack of uptake from communities because of digital illiteracy (suppliers have the perception that not all teachers are willing to transition to digital learning)	− Digital illiteracy; digital literacy is relatively low in Zimbabwe with 35% of individuals in Zimbabwe using the internet	• Interview with community network • Desk research
Affordability	Prices are low enough to meet gov't ability & willingness to pay	− High price of mobile connectivity; price of data-only mobile broadband is at 18% of GNI per capita, being the least affordable out of all 9 assessed countries	− High broadband transmission costs (given that Zimbabwe is a landlocked country) − High equipment costs (equipment mostly is imported and often needs to be paid in US dollars which is a challenge given the lack of access to foreign currencies) − Lack of access to electricity (grid power often needs to be paid in US dollars), which is why diesel generators are often used (more expensive and thus higher price) and are susceptive to theft (resulting in the need for security which is also costly and has an impact on price)	• Interview with MNO • Interview with community network
		− High price of devices, with the cheapest handheld device being around $80 USD which is out of reach for many people	− Low GNI per capita ($1,500 USD and $2,460 USD at Purchasing Power Parity (PPP))	• Interview with MNO • Desk research
		− High price of GEO satellite internet	− High installation price of GEO satellite internet ($1,500 USD)	• Interview with community network
		− Low government budget for school connectivity[2]	− Low GNI per capita ($1,500 USD and $2,460 USD at Purchasing Power Parity (PPP))	• Desk research
Competition	Competitive and reliable supplier base (e.g. no monopoly and low barriers to entry)	− Low level of competition in the mobile connectivity market segment	− Lack of available spectrum, which is a major barrier for new entrants − Market is highly regulated and there are price controls, which results in reduced competition on price or quality but rather a focus on reducing costs	• Interview with MNO
		− Lack of availability of spectrum for new entrants or community networks	− Lack of spectrum available or inadequate spectrum regulations − MNOs do not want to share or sell unused parts of their spectrum − Lack of government policy to incentivize MNOs to sell or share unused spectrum	• Interview with community network • Interview with MNO
Delivery	Products & services are delivered reliably, cost effectively and on time	− Lack of uptake of connectivity solutions due to lack of electricity	− Lack of electricity (access to electricity is at 49% of population and only 32% in rural areas)	• Desk research
Quality	Products meet quality standards	− ~28% of schools are connected to the internet; but all these schools have internet of low quality (< 5 Mbps) and none of the schools have access to meaningful connectivity	− Lack of business viability of investing in telecommunication infrastructure and the low level of competition	• Desk research
		− Quality of fixed broadband is low in Zimbabwe, with Zimbabwe ranking 165th out of 181 countries by Ookla's Speedtest Global Index	− Lack of business viability of investing in telecommunication infrastructure and the low level of competition	• Desk research

Notes: 1) Giga's connectivity map shows that 53% of schools are covered by good quality internet (> 3G), but no schools are connected to good quality connectivity; 2) Data on government expenditure on school connectivity has not been found, but the available government budget has been compared among the 9 focus countries by looking at GNI per capita and government expenditure on education as percentage of GDP
Sources: Giga, interviews, Deloitte analysis

Zimbabwe | Assessment of market shortcomings [2/2]

In Zimbabwe, the main market shortcomings have been identified in the affordability, availability, competition and funding security market dimensions

Assessment of school connectivity market

Dimension	Desired situation	Assessment of **market shortcomings (-)** / **market strengths (+)**	Identified **root causes** of market shortcomings (-) / market strengths (+)	Source of root cause
Coverage gap market dimensions (coverage gap: ~47% of schools[1])				
Availability	Sufficient volumes of appropriate connectivity solutions and easily accessible	− Lack of business viability for investing in fiber & mobile connectivity (particularly in rural areas)	− Profitability in rural areas is low due to the low population density and low commercial activity − Lack of electricity (access to electricity is at 32% in rural areas in Zimbabwe) − Lack of general road infrastructure − Government price controls (a maximum tariff for connectivity is set by POTRAZ) limit the possibility of price differentiation and are experienced by market players as pressure to reduce costs, resulting in a lack of incentive to invest in expanding coverage	• Interview with MNO • Interview with community network • Desk research
		+ Market players are investing in fiber infrastructure across different regions in Zimbabwe	+ Vodacom-owned Dark Fibre Africa, TelOne and Liquid Technologies have recently increased their fiber networks across Zimbabwe, improving general connectivity	• Desk research
		+ There is precedent for the successful set-up of community networks which has brought connectivity to communities at relatively low cost; and there is government support for these community networks	+ Example of community network where they have used fixed-wireless solutions to build a mesh network which provides connectivity to the whole community (school, hospital etc.) where the network is deployed and owned by the community + Hosting of e-learning content on the central server of the community network + Support from the government regulatory agency POTRAZ which announced in 2022 their aim to open community networks in every province in Zimbabwe	• Interview with community network • Desk research
		+ LEO satellite internet is not yet available, but Starlink will become available in 2024	+ Starlink has recently (Sept. 2023) received approval to operate in Zimbabwe, but is expected to be available in the second quarter of 2024	• Desk research
Funding security	Market players have sufficient funding security	− Lack of access to finance for market players to invest in expanding their coverage (e.g. MNOs)	− Lack of foreign currencies (US dollars) given that investment contracts often need to be paid in US dollars − Perception of an unsuccessful implementation of the Universal Service Fund (USF) and difficulty to gain access to USF funding − There is hyperinflation and an extremely high interest rate (~150%) in Zimbabwe	• Interview with MNO • Desk research

Note: 1) Giga's connectivity map shows that 53% of schools are covered by good quality internet (> 3G)
Sources: Giga, interviews, Deloitte analysis

Zimbabwe | Broader context & status of school connectivity

In Zimbabwe, ~28% of schools are connected to the internet; but all these schools have internet with speeds of less than 5 Mbps

Around 76% of schools in Zimbabwe are covered by mobile broadband, but less than a third are connected to the internet

Overview
- Population: **15 million**
- Pop. density: **43 inhab. / km²**
- Urban/rural split: **32%/68%**
- GNI/capita: **$1,500**
- GNI/capita (PPP[1]): **$2,460**

	No connectivity	2G
School connectivity	72.2%	27.7%
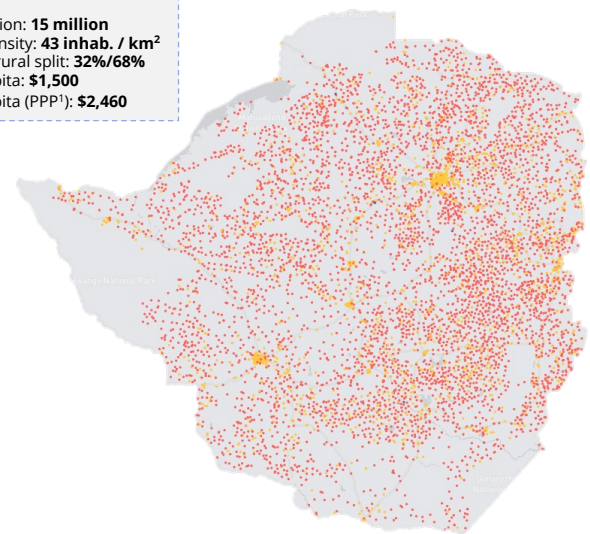
Government support for school connectivity
- Telecom operators in Zimbabwe are obligated to allocate 1.5% of their annual turnover to the Universal Service Fund (USF). This fund is managed by POTRAZ to offer free internet facility in rural schools. As of 2021, over **400 schools have benefitted** from **free internet through the USF fund**
- Broadband plan, adopted by Zimbabwean government for the period of 2023 – 2030, aims to reduce internet costs to 2% of average monthly income. The initiative aims to **encourage schools to integrate technology** into **teaching methods, promote ICT education and digital literacy**

Electricity
- In **rural areas**, access to electricity is **major barrier**

Total	49%	51%
Urban	86%	14%
Rural	32%	68%

■ *% of population with access to electricity*

Digital literacy
- Digital literacy is low in Zimbabwe; **35% of individuals** in Zimbabwe are using the internet
- Zimbabwe scores a 2.8 on the Wiley 'Digital Skills Gap Index', **ranking 15th out of 26 countries** in Sub-Saharan Africa
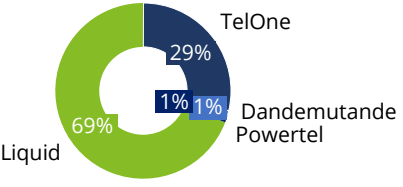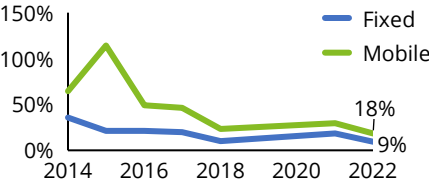
Key takeaways

- **Acceptability: low digital literacy** and internet usage limits the uptake of connectivity

- **Availability:** the **low population density** diminishes the business viability and profitability for internet in rural areas

- **Delivery:** overall **lack of electricity** with 51% of the population having no access to electricity

- **Quality**: 28% of schools are connected to the internet; but all these schools have **low-speed internet** (<5 Mbps)

Note: 1) Gross national income at Purchasing Power Parity (PPP), with gross national income defined as the gross domestic product plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production
Sources: Giga, World Bank, Wiley, Deloitte analysis

Zimbabwe | Fiber internet market

The fiber internet market in Zimbabwe is shaped by two major players; coverage of the fiber network is expanding throughout the country

Key insights into the fiber internet market

Coverage	• Zimbabwe's **National Broadband Backbone** (NBB) brings international broadband to Zimbabwe and **interconnects major cities** and **towns** across the country • The **backbone** was built by the Posts and Telecommunications Corporation of Zimbabwe (PTC), which was **commercialized in 2000** into three companies • The **population** with a **fixed internet** connection is **below 2%**
Market players	• **TelOne and Zol Zimbabwe** (part of Liquid Home) are the **largest fixed internet providers** in Zimbabwe. • Apart from TelOne, **Dark Fibre Africa** (a subsidiary of Vodacom) was granted a license to operate as an **open-access-connectivity provider** in Zimbabwe • Zimbabwe has a **several ISPs** including TelOne, Zimbabwe Online (ZOL), Liquid (a subsidiary from Econet Wireless), Africom and PowerTel. Most (smaller) **ISPs buy** their **bandwidth** from **TelOne**
Pricing & quality	• Price of **fixed broadband** is at **9% of GNI per capita**; although more affordable than mobile broadband, it is still significantly above Broadband Commission's target of 2% of GNI per capita • The average **price** for **100GB** of fixed internet **is $85 USD** per month with a speed of 3 – 15 Mbps • Zimbabwe ranks **165th out of 181** countries in terms of quality of fixed broadband in **Ookla's Speedtest Global Index** (2nd lowest rank of 9 focus countries)
Market trends	• In January 2023, Vodacom-owned **Dark Fibre Africa** announced plans to use Zimbabwe's **major rail network** to **lay 2,000km of fiber** across the country. The project has laid down **1,180km of fiber** in its first phase

— Fiber backbone

Equipped International Internet Bandwidth Capacity (2023)

TelOne 29%
Dandemutande 1%
Powertel 1%
Liquid 69%

Broadband prices as % of GNI per capita[1]

- Fixed
- Mobile

150%
100%
50%
0%
2014 2016 2018 2020 2022
18%
9%

AFRICAN WIRELESS COMMUNICATIONS   *February 2023*

DFA and BCS progress on long-haul fibre project along Zimbabwe's rail tracks

Key takeaways

− **Competition: limited number of market players** in the middle-mile, which can lead to high prices

− **Affordability: price** for fixed broadband is **significantly above** the **2% of GNI per capita** target set by the Broadband Commission

− **Quality:** quality of fixed broadband is **low** in Zimbabwe

+ **Availability:** market players are **investing** in **infrastructure**, which increases coverage and connectivity,

Note: 1) Broadband prices as found in ITU's 'ICT prices dashboard', in which the yearly price for the cheapest offer by the market leader is compared with GNI per capita
Sources: Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ), Ookla, African Wireless, Interviews, Deloitte analysis
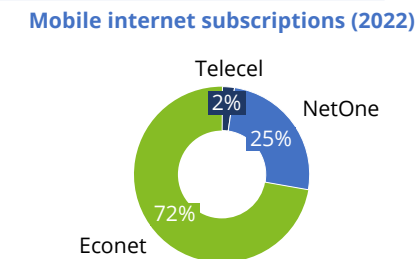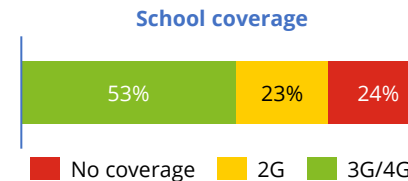
Zimbabwe | Wireless internet market

The mobile internet market in Zimbabwe is dominated by one player and affordability is a major challenge

Key insights into the wireless internet market

Coverage	• Roughly **84%** of the country **is covered by mobile broadband** (3G and/or 4G) • **76% of the schools are covered by mobile broadband connection,** but only **53% receive coverage** that is fast enough **for meaningful internet connectivity** • In 2022 Econet Wireless has deployed 22 **base stations** in Harare for **5G connectivity**
Market players	• There are **three Mobile Network Operators;** NetOne (one of the other companies founded after the commercialization of the PTC), Telecel Zimbabwe, and Econet Wireless Zimbabwe • Each MNO has their **own base stations**, providing **different levels of coverage across Zimbabwe** • Econet is currently the **only mobile network operator with 5G** infrastructure • The **spectrum** that is **available for mobile service providers** by the government is **limited** and **companies** do not to **sell** their **unused spectrum**
Pricing & quality	• Price of data-only **mobile broadband** is at **18% of GNI per capita**, being the least affordable out of all 9 focus countries • The average retail price for **50 GB** of mobile internet sits at **$38 USD** at a download speed between **2 – 8 Mbps** • **Prices** for **handheld devices** start at **$80 USD**
Market trends	• POTRAZ has granted Dolphin Telecoms the **first mobile virtual network operator (MVNO)** license. This means **Dolphin Telecoms will compete** with Econet, Telecel and NetOne **as a mobile service operator** without having their own base stations • **Dolphin telecom specializes** in **capacity wholesale** and **internet bandwidth** for other ISPs

School coverage

53%	23%	24%

■ No coverage ■ 2G ■ 3G/4G

Mobile internet subscriptions (2022)

Telecel 2%
NetOne 25%
Econet 72%

> The cheapest handset is currently $80 USD, which is out of reach for communities
> **- MNO**

Connecting Africa

March 2022

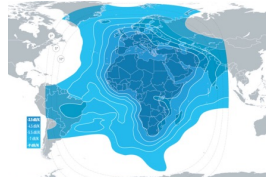Dolphin Telecoms gets MVNO license in Zimbabwe

Key takeaways

– **Availability:** in rural areas, **coverage** is **limited**

– **Competition: low level** of competition and **dominance** of **one market player**

– **Competition:** there is **limited spectrum available,** creating barriers for new entrants or community networks

– **Affordability: high prices** of mobile connectivity (at 18% of GNI per capita)

Sources: Company websites, Connecting Africa, Interviews, Deloitte analysis

Zimbabwe | Satellite internet market

The market for satellite internet is growing, but affordability of GEO satellite internet is a barrier

Key insights into the satellite internet market

Coverage	• **VSAT/ GEO internet** satellite connections are **available everywhere** in Zimbabwe • **LEO satellites are not available**, but as the government is considering Starlink's application this might change in 2024
Market players	• Most **major ISPs offer VSAT internet to schools** in rural areas • **TelOne**, **ZOL** (Liquid Home), and Utande are the main VSAT internet providers • **TelOne** has created a **strong presence** in Zimbabwe's VSAT internet market by **leveraging Eutelsat** and **Avanti** satellites • The second largest provider ZOL offers **discounted broadband connectivity** to a few **selected schools** in Zimbabwe • **Utande** is still **expanding its operations** but **offers faster speed** than the other two market players
Pricing & quality	• GEO satellite internet price ranges from **$180 USD** to **$300 USD per month** and download speed varies from **5 to 25 Mbps** • Initial **installation prices** of GEO satellite internet are **approx. ~$1,500 USD**
Market trends	• Zimbabwe's minister of information, publicity, and broadcasting services, has confirmed that **POTRAZ** has **received an application** for an **operating license from Starlink**. The application is currently being reviewed, while **Starlink plans** to **launch** in Zimbabwe in **Q2 2024**

Example Eutelsat satellite coverage

" Starlink might be too expensive as of now, but it could help school connectivity and perhaps there are ways to bring down the price

— MNO "

TelOne VSAT offer

www.telone.co.zw

TelOne SATELLITE

Achieve Better Crop Quality and Yield

TEKEDIA *September 2023*

Zimbabwe Government Makes U-turn on Starlink Approval, Reviews License Application

Key takeaways

+ **Competition:** there is a market for satellite connectivity in Zimbabwe with **several players**

+ **Availability:** GEO satellite internet **providers**, that focus on providing internet in rural areas

− **Availability:** LEO satellite internet is **not available** in Zimbabwe as of 2023

− **Affordability:** GEO satellite internet in Zimbabwe is **considered not affordable** due to the high monthly subscription and installation price

Sources: Tekedia, POTRAZ, Company websites, Interviews, Deloitte analysis

Zimbabwe | Enabling environment

Access to finance and foreign currencies is a major challenge in Zimbabwe

Regulations

- In 2018, the Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) was established, which is responsible for **regulating** and **promote competition** and **investment in the telecom sector**
- **Operating licenses for mobile phone services** are **$137.5 million**, which hinders new **players** from **entering** the **market**
- Suppliers indicate that **license fee requirements can be stringent** for privately owned businesses
- PORTAZ has **increased tariffs related to broadband** and associated services for all telecommunications operators, because of the **volatility in its national currency**. Telecom operators may pass on these additional costs to customers, including schools

> " Because of the price controls, we cannot differentiate on price and therefore the focus is on optimizing costs. This has been one of the reasons why we have barely invested in infrastructure between 2014 and 2022 "
>
> **- MNO**

G3 Zimbabwe's telecom regulation maturity is classified by ITU's ICT Regulatory tracker as **Generation 3: 'enabling investment & access'** [1]

Access to finance

- An estimated **$36 million** of upfront **capital expenditure** is needed to provide **last mile connectivity** to all underserved schools in Zimbabwe[2]
- The government also seeks to **attract Foreign Direct Investments** ("FDI") and has implemented the Zimbabwe Investment Authority (ZIA) to **promote and facilitate foreign direct investment**
- The amount of **FDI has risen to $342 million in 2022** from $250 million in 2021 but is still low compared to before the Covid-19 pandemic

> " Shortage of foreign currencies (mostly USD) is a major challenge. This limits investments and also results in high equipment costs, as equipment needs to be sourced from abroad and paid in dollars. "
>
> **- MNO**

Access to finance indicators

- $ Exchange rate to USD: **0.00276** (2023)
- Government Debt to GDP (% of GDP): **93%** (2022)
- Interest rate: **130%** (2023)
- Domestic Credit to private sector (% of GDP)[3]: **12%** (2022)

Key takeaways

- **Availability:** government **price controls** may hinder investments in expanding coverage

- **Funding security: inadequate foreign currency reserves** reduces market players' profitability and limits investments

- **Funding security: hyperinflation** and **high interest** rates lead to a lack of access to finance for investments into network expansion

Notes: 1) The ITU ICT Regulatory Tracker distinguishes four generations in telecom regulation maturity: G1 – Command & control approach, G2 – Early open markets, G3 – Enabling investment & access, G4 – Integrated regulation; 2) As estimated by Dalberg in 2020 based on Giga mapping and modelling data; 3) Domestic Credit to Private Sector refers to the financial resources provided to the private sector (such as through loans or purchases of non-equity securities) that establish a claim for repayment (source: OECD)
Sources: Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ), Giga, ITU, Trading Economics, Interviews, Deloitte Analysis

7 **Appendix A**
Industry consultation report-out

Industry consultation

On 14th and 15th November 2023, suppliers provided feedback on Giga's target service profile and on the challenges & opportunities they see with providing school connectivity in Africa

Key insights from supplier feedback

Use of connectivity (education content)	• Participants highlighted the importance of showcasing **use cases** for school connectivity, to convince why schools/governments should prioritize funding towards school connectivity • There is potential in aggregating or harmonizing online education, through **certification of online education courses** (either by Giga or by gov'ts)
Target Service Profile	• As for Giga's target service profile, participants noted that it is important to **define** what we mean with a **connected school** (e.g. connected for administration purposes only, or establishing multiple access points to enable suitable connectivity for teaching & learning) • Some participants **indicated a minimum requirement** of **50 Mbps** (download speed) • An important aspect is the **monitoring** of established connectivity (capacity & usage), to assess when connectivity drops (e.g. due to vandalism or theft) and to measure quality of connectivity • Considering **security of children** is an important element of managed services. This includes establishing a **child protection officer** (e.g. to ensure equal access to connectivity (e.g. independent of gender)) and **enabling of content filtering** (e.g. ability to differentiate in teacher/student profiles) • Suppliers indicated that they would benefit if **desired network characteristics** would be specified in the Target Service Profile • Suppliers indicated that being **technology-agnostic** is the **right approach**, specifically regarding the network equipment which needs to be used
Supplier best practices	• **Community engagement** is essential (in rural areas), to enable local ownership of connectivity & power source and reduce vandalism & theft. Schools are also considered to be the center of a community, and the impact of school connectivity scales across the community. • Certain suppliers (e.g. Avanti Communications) indicated that they are already deploying an **integrated solution** together with partners, which includes **connectivity**, **devices**, **solar panel kit** and **community engagement**. Responding to RFPs in a consortium of partners is considered viable. • It is recommended to **host digital content** on **own network** as much as possible, in order to keep traffic local and reduce cost • **Limiting OPEX** as much as possible is important, e.g. by using high-quality equipment which has higher investment but low maintenance and by training local communities to do maintenance & support. Giga could support suppliers by specifying the **optimal technical solution from a cost-perspective** • Establishing **long-term agreements** with a set of **selected suppliers** can facilitates the tender process
Supplier challenges	• The identified **challenges and root causes** from the market assessment resonated with the participants of the industry consultation • **Scalability** was highlighted as a challenge, to scale footprint abroad (e.g. Avanti Communications deployed in Kenya, but difficult to scale to other countries) • **Sustainability** of the connectivity after the initial funding period is a major challenge; now certain suppliers take over as part of their Corporate Social Responsibility efforts but this is not considered a sustainable solution • **Security of devices** is a challenge**,** particularly when children take them home after school • **Transferability of digital skills** for teachers & technical personnel requires attention, to reduce risk of losing skills when teachers/personnel leave; a supplier indicated that this could be addressed on a community level

7 **Appendix B**
Desk research sources

Desk research sources

As part of the desk research of this study, various previous studies have been reviewed as well as statistics, company and news websites

Overview of main sources

Reports	• UNICEF (2023) "The connectivity market systems" • UNICEF (2023) "UNICEF's approach to influencing markets" • Giga Infrastructure Analyses (2023) (Benin, Rwanda) • ITU (2022) "Guide for procuring last-mile connectivity data networks" • Giga (2022) "LEO Satellites – Opportunity Brief" • Giga & BCG (2021) "Meaningful school connectivity: an assessment of sustainable business models" • Giga & Dalberg Opportunity Briefs (2020) (Rwanda, Kenya, Sierra Leone, Zimbabwe) • ITU (2020) "The Last-mile Internet Connectivity Solutions Guide" • UNICEF (2020) "Guidance on Market-Based Sanitation" • UNICEF "Market Shaping" (article by Gian Gandhi)
Databases	• Giga Project Connect Connectivity Map, accessed in October 2023, https://projectconnect.unicef.org/map • ITU DataHub, accessed in November 2023, https://datahub.itu.int/ • ITU ICT prices dashboard, accessed in November 2023, https://datahub.itu.int/dashboards/?id=1 • ITU ICT Regulatory Tracker, accessed in November 2023, https://app.gen5.digital/tracker/metrics • ITU Infrastructure Connectivity Map, accessed in November 2023, https://bbmaps.itu.int/bbmaps/ • ITU Digital Development Dashboard, accessed in January 2024, https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx • Global statistics databases: e.g., GSMA Mobile Connectivity Index, World Bank Open Data, World Bank Development Indicators, World Population Review, Wiley Digital Skills Gap Index, Cable.co.uk Global broadband pricing, Trading Economics, Ookla Speedtest Global Index
Others	• National telecommunications industry statistics: e.g., CA (Kenya), RURA (Rwanda), NCC (Nigeria), NATCOM (Sierra Leone), ARCEP (Benin), ICASA (South Africa), BOCRA (Botswana), MACRA (Malawi), POTRAZ (Zimbabwe) • Various company websites: e.g., Safaricom, Poa! Internet, Airtel, Telkom, Starlink, Globalstar, Viasat, MTN, Liquid Technologies, Africell, Orange • Various news websites: e.g., CIO Africa, Techweez, Space in Africa, Connecting Africa, Starlink Insider, The New Times, Telecom Review Africa, IOL • Other research: e.g., OECD, IMF, UNCTAD, UN-OHRLLS, Economist Intelligence Unit, International Trade Administration, USA Bureau of Economic and Business Affairs, USTDA, S&P Global, University of Oxford

For more information, contact us at **giga.global**

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www.unicef.org

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New York, NY 10017
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International Telecommunication Union (ITU)

www.itu.int

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1211 Geneva 20
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