Regulatory and Market Analysis for Wireless Internet Service Providers (WISP) in Brazil, Kenya, Indonesia, Nigeria, and South Africa

Final Report

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Contents

Executive Summary

This report analyzes the market dynamics, spectrum access, challenges, and opportunities of small Wireless Internet Service Providers (WISP) in Brazil, Kenya, Indonesia, Nigeria, and South Africa. From such analysis, the report explores good practices and recommends policy and regulatory actions to improve the WISP market in each country.

This report compiles and compares the different WISP market maturity levels, which are directly associated with the level of maturity of the overall fixed broadband market in each country. It shows that countries with a better-developed WISP market tend to perform better in Internet adoption and fixed broadband penetration indicators.

Another aspect that helps to understand the level of maturity of the WISP market is the role of industry associations and their interaction with the relevant regulators. Countries with strong WISP ecosystems usually have an industry association representing their interests with a solid presence and continuous interaction with the regulator and other government entities. Such interaction has proven useful when developing regulations that eventually affect (either positively or negatively) the WISP's business model or the ability to comply with regulations.

From the findings of this report, a qualitative analysis of the maturity level of the fixed broadband market, in terms of penetration, technologies deployed, coverage, and other factrs, is shown in Figure 1. Assessing the different levels of maturity of the fixed broadband market provides indications about the regulatory actions that countries can use to foster the ICT ecosystem, the challenges that small WISPs might be facing, and the places or aspects where government programs and regulations can help to improve the business landscape to promote the growth and evolution of the Internet market.

Figure 1. Level maturity of the fixed broadband market in countries under study

Source: TMG analysis.

Brazil and Nigeria provide useful examples for the link between ICT market performance indicators and the level of deployment of the WISP market. Regarding overall ICT market performance indicators, the study found that Brazil's fixed broadband penetration rate is currently 17.1percent, a rate that has more than doubled in the past 10 years. In contrast, Nigeria's fixed broadband penetration rate remains at less than 0.1 percent.

This penetration level is consistent with the level of deployment of the WISP market. Specifically, Brazil is reaching some maturity, with small providers initially becoming strong players in the ICT ecosystem. Brazil's policies to foster WISPs have been effective so far, although the fixed broadband market may face challenges due to mergers and acquisitions of formerly small ISPs, which could negatively impact market concentration and competition in selected markets. The National Telecommunications Agency (ANATEL) and the Ministry of Communications (MCOM) can work on ways to improve them and broaden their reach and granularity to impact smaller operators and more rural and remote areas.

Conversely, the current status of the fixed broadband market in Nigeria reveals an immense opportunity for the growth of fixed broadband providers (both big and small-scale ISPs) and the overall ICT ecosystem. Nigeria's regulator and other government agencies can leverage experiences from more mature fixed broadband markets to identify and adopt policies that help Nigeria move from a niche market to a massive subscriber fixed broadband market. Given the fragmented nature of Nigeria's WISP market, their business models differences (e.g., niche enterprise and retail), and their Small-Medium Enterprise (SME) status, it is common for government agencies and regulators to face difficulties finding information regarding specific challenges and needs of WISPs, such as their expansion plans, possibilities to grow both in coverage and capacity, and their overall ability and availability to support government connectivity projects at their service areas.

Often times there are difficulties in accessing to specific information of the WISP market in different countries. To overcome this information gap, this study entailed more than 30 interviews that were conducted with stakeholders across the five countries, including with regulators and other government entities, WISPs of various sizes, from different regions, and with varying business models, and associations and other industry groups. The interviews were part of theoverall research process that included the review and analysis of the ICT regulatory framework, connectivity indicators, the composition of the fixed broadband market in each country, and the status of deployment of a national fiber backbone network or similar initiatives.

One of the main lessons learned in this study is that WISPs play asignificant—and often underestimated—role in improving the connectivity and the quality of Internet services in suburban, rural, and remote areas. This underestimation occurs mostly due to the above-mentioned information gap. This gap prevents regulators and other government agencies from obtaining insights into how to orient a connectivity policy that includes all players and not only the large operators with whom government has established relationships and lines of communication. WISPs industry associations could be a good vehicle to help close this information and communication gap. The Wireless Access Providers Association (WAPA) and the South African Black Internet Service Providers' Association (SABISPA) in South Africa as well as the Indonesian Internet Service provider Association (APJII) in Indonesia are examples of industry associations with strong relantionships with regulators and government (see sections 2.2.3 and 5.2.6).

This report details each surveyed country with an analysis of the relevant ICT regulatory framework for WISPs, including licensing and spectrum access; the WISP market, business models, coverage, and access to backhaul; the targeted initiatives to support WISPs and provide access to funding; and status of the WISP or other ISP industry associations. The final section of this report contains the conclusions and recommendations for each country while identifying good practices that could be adopted in other jurisdictions to help WISP to grow and thrive. The comparative analysis allows the identification of common factors and conclusions that shaped the recommendations in section 6. These include the main findings of this study, as noted below.

1. WISPs are key players in strategiesto close the digital gap

In most of the surveyed countries, WISPs have the capacity to reach unserved and underserved areas and markets effectively. Also, WISPs have shown their intention and ability to deploy access networks to low-income markets, while bigger operators are taking longer to reach such markets. The local nature of WISPs allows them to understand the needs and limitations of rural and remote markets, positioning them to create innovative business models that serve small communities.

Countries should favor the formation and sustainability of WISPs as such policies provide benefits in two ways. The first way is that WISPs contribute to the closing of connectivity gaps (e.g., coverage, service, and affordability) by reaching rural and remote areas, as well as urban and suburban areas, due to the price reductions and increased service quality in competitive environments. Secondly, as SMEs

themselves, the growth and sustainability of WISPs will depend on the overall treatment of SMEs as they are a critical factor for local economies, job creation in the regions, as well as local tax income, contributions, and investment.

2. Spectrum access is essential for the growth and sustainability of WISPs

Although there is a clear trend toward the migration to fiber optics for access networks, spectrum access continues to be a critical element for the growth and consolidation of WISPs in the market. Unlicensed spectrum, such as the 2.4 GHz, 5 GHz, and 6 GHz bands, will continue to be fundamental for the WISP business model as Wi-Fi networks are the primary way for WISP subscribers to access Internet services. The use of the full 6 GHz range for unlicensed use is indispensable to maintain the ability of WISPs to compete against other providers and technologies (e.g., satellite constellations, 5G) in the medium and long term. Point-to-point links in both licensed and unlicensed bands are essential for the roll-out of Internet services, especially in rural and remote areas. In mature markets, small Internet providers are even accessing mobile spectrum such as the 3.5 GHz band or mmWaves to improve their services (See, for example, section 1.3.1.2).

3. Access to backhaul networks is one of the biggest challenges for WISPs

One of the most significant factors for the rollout and the sustainability of WISPs is access to backhaul networks. When launching services, access to backhaul networks is one of the primary costs for WISPs and one of the main limitations when the capacity node is far from the area where WISPs expect to offer services. In many cases, WISPs must deploy wireless links or fiber optics from the node to the service area, representing additional capital expenditures (CAPEX) to begin operations. Also, there are asymmetries between the access to backhaul between large and small WISPs providers, which could harm the smaller operators growth and sustainability..

Rural areas suffer the most from this issue, as backhaul providers usually pay an incremental price proportional to the distance between the service area and the backhaul node. It is common to see WISPs in rural areas pay more for the same capacity than those in suburban areas. Regulation (e.g., standardized interconnection contracts or public reference offers) and improving the coverage of public backbone fiber networks or other neutral fiber networks are essential to provide WISPs in rural areas with better access to capacity to continue improving their offers over time.

4. Targeted support for WISPs as SMEs helps to promote competition and close connectivity gaps

As with other kinds of SMEs, incubation initiatives and targeted support for WISPs are critical in the early stages of development. The support for WISPs could be via direct funding or credit lines or through regulations that reduce WISP's in line with their size and logistic capacities. Exemptions or reductions on taxes or regulatory fees could also benefit small WISP entering the market. In essence, WISPs should be part of the incentives that countries put in place for overall SME creation and growth.

1. Brazil

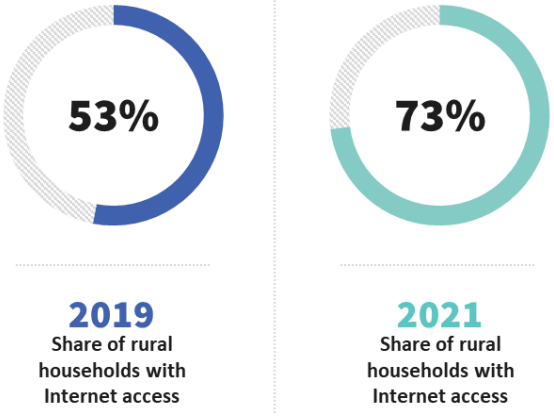
1.1. Introduction

Brazil is the largest country in South America, both by population and gross domestic product (GDP). It is a regional leader in the telecommunications sector. The country has made great strides in terms of broadband deployment, and in 2021, for the first time, the fixed broadband subscriptions in households surpassed mobile broadband subscriptions.[1] In this context, Brazil provides good examples on the importance of the smaller Internet service providers (ISP), including their overall share of the broadband market. Some ISPs, in addition to providing connectivity via fiber, also use spectrum to provide service, thus being considered wireless ISP (WISP). This report considers the overall ISP market, and the specific conditions for the operation of WISPs.

Brazil's regulatory framework for ISPs, including WISPs, has helped foster competition in the Internet services market and expanded connectivity across the country. The government has also assisted in advancing 5G technologies. It held one of the largest 5G spectrum auctions in history at the end of 2021.[2] Reports indicate that the deployment of 5G services has notably outpaced the previous timeline of 4G deployment.[3] This is important for WISPs, as mobile networks, particularly 5G, are an essential component of their customer offerings.

In 2021, for the first time, the share of households with fixed broadband subscriptions surpassed those with mobile broadband subscriptions. These competing trends underscore the need to continue promoting the growth and stability of smaller providers in the rapidly changing telecommunications market, especially given the significant changes to be generated by 5G fixed wireless access (FWA).[4]

With the ongoing deployment of 5G infrastructure, WISPs offer the potential to help achieve national connectivity goals. Most of Brazil's population are Internet users (81%). However, the digital divide between urban and rural communities is stark. According to a 2021 survey from the Regional Center for Studies for the Development of the Information Society, Internet access in rural areas still lags behind the national average, despite a significant increase during the COVID-19 pandemic (53% penetration in 2019 to



[1] IBGE, Internet is already accessible in 90.0% of the country's households in 2021 (September 16, 2022), https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/34954-internet-ja-e-acessivel-em-90-0-dos-domicilios-do-pais-em-2021.

[2] World Bank, Brazil Overview, https://data.worldbank.org/country/brazil and GSMA, Brazil multi-band auction: one of the largest in mobile history (December 21, 2022), https://www.gsma.com/spectrum/brazil-multi-band-auction-one-of-the-largest-in-mobile-history/.

[3] BNAmericas, Brazil's initial 5G adoption faster than 4G – study (September 12, 2022), https://app.bnamericas.com/article/section/all/content/x1t8jrfnt-brazils-5g-adoption-faster-than-4g-lte---study.

[4] TelecomPaper, 5G FWA revenues to surge to USD 2.5 bn in 2023 - study (September 20, 2022), https://www.telecompaper.com/news/5g-fwa-revenues-to-surge-to-usd-25-bln-in-2023-study--1437849?utm_source=headlines_-_english&utm_medium=email&utm_campaign=21-09-2022&utm_content=textlink.

73% in 2021).[5] Fixed connections via cable or optical fiber is the most common primary network connection, accounting for the majority of households (61%). Brazil has 17.1 fixed broadband subscriptions per 100 people, a rate that has more than doubled in the past ten years.[6] Market conditions and public policies have enabled a relatively robust WISP ecosystem, with small and regional providers comprising about 45% of the fixed broadband market. The Internet services market in Brazil is competitive, with over 19,000 fixed broadband providers, including major mobile operators and ISPs (both via fiber and wireless).[7] Even so, three large operators account for a majority of total national market share.[8] This case study examines the challenges and opportunities for developing the WISP market in Brazil, providing recommendations to foster future growth.

1.2. WISP market analysis

The current market conditions for Internet services in Brazil demonstrate the key role that WISPs play in increasing competition and coverage. Due to the size of the overall market, even the largest ISPs and WISPs in Brazil can meet the regulatory definition of being small, or *Prestador de Pequeno Porte* (PPP), when they have less than 5,000 subscribers, or less than 5% market share in all markets. These metrics are consistent with the definitions used by Brazilian regulatory authorities to identify small providers in the context of service licensing and quality of service obligations, respectively.

As demonstrated in the analysis below, this regulatory definition can result in larger companies (e.g., over one million subscribers) being categorized with smaller local providers (e.g., less than 5,000 subscribers). On the other hand, the broad definition allows very small providers to grow significantly while maintaining their regulatory status. There are also tax benefits for smaller operators when they are under the *Simples* tax regime, allowing all taxes to be paid in conjunction with a fixed rate.

1.2.1. Market and business model review

WISPs have increased competition in Internet service market, prompting larger providers to improve consumer service offerings. This is particularly relevant in Brazil, given the trends of growth and concentration observed among the country's major providers. Among the largest Internet providers are Brisanet, Unifique, and Desktop. These companies all had initial public offerings (IPO) in 2021, and have ambitious infrastructure expansion plans, largely focused on investments in 5G networks and equipment.[9] Part of the infrastructure investment, in the cases of Brisanet and Unifique, result from obligations associated with spectrum rights granted in the 5G spectrum auction that took place in 2021. As 5G deployment continues in Brazil, companies are exploring every opportunity for growth in this competitive market.

Provider	Subscribers	Market share	5G spectrum	Expansion plans

[5] ZDNet, Brazil sees growth in Internet use in rural areas (June 24, 2022), https://www.zdnet.com/home-and-office/networking/brazil-sees-growth-in-internet-use-in-rural-areas/.
[6] World Bank, Fixed broadband subscriptions (per 100 people) – Brazil, https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=BR.
[7] ABRINT, Renewed Challenges for Regional ISPs (August 31, 2022), https://www.abrint.com.br/abrint-na-midia/desafios-renovados-para-os-provedores-regionais-de-internet
[8] BNAmericas, Brazil hits 40mn fixed broadband accesses with help of ISPs, fiber expansion (December 7, 2021), https://app.bnamericas.com/article/section/all/content/xveubcz4w-brazil-hits-40mn-fixed-broadband-accesses-driven-by-isps-and-fiber.
[9] BNAmericas, Spotlight: The investment plans of Brazil's leading ISPs (March 28, 2022), https://app.bnamericas.com/article/section/all/content/xd7m3owzt-spotlight-the-investment-plans-of-brazilian-leading-isps.

Brisanet	1,019,446	4.7%	Yes – 80 MHz blocks in the 3.5 GHz band in two different regions; 50 MHz block in 2.3 GHz band in northern region	Significant investments in 5G; Entry into mobile market; Pilot of 2.3 GHz technology; Increase FTTH footprint.
Unifique	596,922	2.8%	Yes – led a consortium of ISPs to acquire an 80 MHz block in the 3.5 GHz band in the southern region	Partnerships with major operators; Provision of wholesale fiber access; Continue acquisition of smaller ISPs.
Desktop	739,631	3.4%	No – did not acquire spectrum	Increase fiber footprint; Continue acquisition of smaller ISPs.

Source: ANATEL data as of August 2022.

1.2.1.1. Consolidation of WISP market

WISPs are currently focusing on acquisitions as a means to growth. Both Unifique and Desktop are active participants in the current trend towards market consolidation. In 2021, Desktop acquired eight smaller providers, and in 2022 announced the acquisition of at least eight more companies. Nearly half of its current customer base come from acquisitions.[10] In 2022, AmericaNet reached an agreement to acquire FTTH provider Opyt.[11] AmericaNet is the fourth largest Internet provider in São Paulo region and has expanded recently due to its series of acquisitions.[12] Regional provider WEBBY also completed several acquisitions resulting in significant subscriber growth.[13]

In this context, it is notable that the Brazilian National Telecommunication Agency (ANATEL) imposes investment requirements as a condition for acquisitions, in an effort to account for potential negative impacts on consumers in the face of market consolidation.[14]

1.2.1.2. Neutral networks

Privately-owned neutral fiber optic networks are also gaining in popularity and inspiring innovative business models in Brazil, such as Telefonica's partnership with Canadian firm CDPQ to create a neutral

[10] BNAmericas, Brazilian ISP Desktop negotiates exclusively and performs due diligence for 8 M&A (March 31, 2022), https://app.bnamericas.com/article/section/all/content/xqacyrmcp-brazils-desktop-in-due-diligence-exclusivity-contracts-for-8-new-mas.
[11] Comms Update, AmericaNet swoops for Opyt (October 3, 2022), https://www.commsupdate.com/articles/2022/10/03/americanet-swoops-for-opyt/?utm_source=CommsUpdate&utm_campaign=97fc4c9c43-CommsUpdate+03+October+2022&utm_medium=email&utm_term=0_0688983330-97fc4c9c43-11667217.
[12] BNAmericas, Brazil's AmericaNet goes shopping again (August 24, 2022), https://app.bnamericas.com/article/section/all/content/xf4aohsui-americanet-goes-shopping-again-with-new-isp-acquisition.
[13] Comms Update, WEBBY Internet acquires ISP; reaches 110,000 subscriptions (September 1, 2022), https://www.commsupdate.com/articles/2022/09/01/webby-internet-acquires-isp-reaches-110000-subscriptions/?utm_source=CommsUpdate&utm_campaign=a52ad602cd-CommsUpdate+01+September+2022&utm_medium=email&utm_term=0_0688983330-a52ad602cd-11667217.
[14] BNAmericas, Claro Brasil ordered to build 700km of fiber after acquisitions (September 14, 2022), https://app.bnamericas.com/article/section/all/content/xrqffmuw2-america-movils-claro-ordered-to-build-over-700km-of-fiber-over-acquisitions.

network company called FiBrasil.[15] Neutral networks allow various local providers to access shared fiber infrastructure, presenting new opportunities for the supply of wholesale fiber capacity in the market increases.

The growth of the neutral network market also impacts the infrastructure and tower companies.[16] For example, American Tower, which has a regional fiber neutral network, is facing competition from the growing number of neutral networks.[17] There is a further trend of consolidation within infrastructure providers. For example, neutral fiber optic infrastructure provider V.tal recently announced an integration with submarine cable operator Globenet. Both companies are controlled by the investment bank BTG Pactual.[18]

ANATEL representatives have stated that there is no intention to introduce specific regulation for neutral networks, with the agency instead viewing the infrastructure as one aspect of the parent company's overall holdings and market position.[19] This is notable given the growing investment in neutral networks, both by operators in Brazil and by foreign investment firms.[20]

1.2.2. WISP coverage

WISPs play an important role in providing connectivity across Brazil. Nationwide, the market share of small and regional ISPs and WISPs is about 48%. While ANATEL data does not differentiate the type of access technology, whether fiber or wireless, among traditional ISPs and WISPs there are more than 19,000 Internet providers across the country, with Brisanet being the largest by subscribers and market share. Due to the disparity in Internet penetration rates across the country, Internet providers tend to focus their growth efforts in underserved areas.[21] Overall, there are almost 7,500 providers in Brazil required to report to ANATEL, from small community networks to the larger regional and national operators.[22]

1.2.2.1. WISPs and their use of fiber networks

In the 1990's and early 2000's, when the first small Internet providers began to operate in Brazil, they relied mostly on wireless operations using unlicensed spectrum. This spectrum eventually got

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[15] BNAmericas, FiBrasil gains ground in neutral market, but remains silent on contracts (September 27, 2022), https://app.bnamericas.com/article/section/all/content/xrw6w9bdi-fibrasil-sees-gains-in-neutral-market-but-seals-lips-over-contracts and Intelligent CEO, Telefônica Brasil and CDPQ create a neutral fiber wholesale network provider in Brazil (March 4, 2021), https://www.intelligentcio.com/latam/2021/03/04/telefonica-brasil-and-cdpq-create-a-neutral-fiber-wholesale-network-provider-in-brazil/#.

[16] BNAmericas, The main tower companies in Latin America (August 18, 2022), https://app.bnamericas.com/article/section/all/content/xcegd3xle-spotlight-the-state-of-latam-leading-tower-companies?utm_source=newsletter&utm_medium=email&utm_campaign=morning_briefing&url=article/section/all/content/xcegd3xle-spotlight-the-state-of-latam-leading-tower-companies.

[17] BNAmericas, American Tower believes in fiber growth potential despite threat from neutral networks (August 29, 2022), https://app.bnamericas.com/article/section/all/content/x3735b6gk-american-tower-sees-fiber-potential-despite-telcos-neutral-networks-growth.

[18] Convergenica Latina, Integration of Globenet with V.tal completed (September 1, 2022), https://www.convergencialatina.com/News-Detail/339465-12-23-Integration_of_Globenet_with_V_tal_completed?Lang=EN&SMMK=6075.58334363426w.K21gY3LreK.

[19] BNAmericas, Brazilian regulator says there is no need to adjust neutral fiber networks (September 2, 2022), https://app.bnamericas.com/article/section/all/content/xlvez9ycr-brazils-anatel-no-reason-to-regulate-telcos-backed-fiber-business

[20] Valor International, Neutral fiber optics creates new business in Brazil (April 5, 2022), https://valorinternational.globo.com/business/news/2022/04/05/neutral-fiber-optics-creates-new-business-in-brazil.ghtml.

[21] Interview with ABRINT representative, September 28, 2022.

[22] ANATEL, Dados (August 2022), https://informacoes.anatel.gov.br/paineis/acessos/banda-larga-fixa.

overcrowded in some areas, and with the advance of technologies, reduced costs of implementation of other technologies, and growth in market demand, most providers migrated to fiber networks.

Fiber access remain critical for Internet providers, as it is the most popular form of providing service. ISPs, including WISPs, have played a significant role in Brazil's fiber expansion for several years.[23] Fiber is a key investment for small providers, which have accounted for 60% of Brazil's total fiber deployment to date. However, the high cost of fiber deployment presents a challenge to the expansion of WISPs' own fiber networks.

Fiber access strategies for WISPs in Brazil

Wholesale agreements

A key trend in the Brazilian market in recent years has been the deployment of fiber optic networks by large wholesale providers, coupled with partnerships with local ISPs to offer services to end users. These network investments are being led by a range of stakeholders in the telecommunications market including dedicated infrastructure providers such as American Tower, and neutral networks supported by large telecommunications operators such as FiBrasil and V.tal (owned by Telefonica and Oi, respectively).

Government support

In addition to partnering with larger service providers and infrastructure owners, there are some government-supported partnerships that aim to expand access to fiber infrastructure. Piauí Conectado is a public-private partnership that provides a fiber optic network covering 90% of the state of Piauí's population. The network has agreements with 80 local ISPs. The national government is advancing efforts to identify and support more partnerships as well.

One market factor that has helped to enable the development of WISPs in Brazil is increased access to leased fiber infrastructure. Brazil has a relatively developed national network of fiber infrastructure, whose expansion is encouraged by regulatory policies such as deployment requirements associated with spectrum authorizations. This in turn has inspired major investments by national operators.

The nationwide infrastructure rollout of major providers, especially in currently unserved areas, presents an opportunity for smaller providers to develop tailored service offerings for consumers in these markets. For example, regional provider Vero Internet recently announced a 10-year wholesale deal that will utilize national neutral network provider FiBrasil's fiber-to-the-home (FTTH) infrastructure to provide service to users.[24] This partnership highlights a key trend in current WISP funding and deployment strategies: the involvement of a larger telecom player to support cost-intensive inputs such as fiber infrastructure.

[23] S&P Global Market Intelligence, Regional Providers Playing A Big Role In Fiber Expansion In Brazil (May 15, 2017), https://www.spglobal.com/marketintelligence/en/news-insights/blog/regional-providers-playing-a-big-role-in-fiber-expansion-in-brazil.

[24] Teletime, Vero contracts neutral network from FiBrasil for ten years (August 18, 2022), https://teletime.com.br/18/08/2022/vero-contrata-rede-neutra-da-fibrasil-por-dez-anos/.

Though Vero Internet is a leading provider in the regions it serves, the company only operates in four states in southern Brazil.[25]

More recently, Internet providers are considering again complementing their fiber operations with unlicensed wireless access, operating as WISPs in providing connectivity to specific markets, such as commercial installations. There is a great interest from WISPs in the evolution of Wi-Fi technologies, including Wi-Fi 6E, although concerns have been raised regarding availability and cost of equipment in Brazil.[26]

1.2.2.2. Targeted support for WISPs

Various national initiatives are working to promote a more competitive Internet services market in Brazil by supporting the establishment and development of strong local operators. One example is CooLab, which works with community members and stakeholders to deploy networks for affordable connectivity in underserved areas.[27] CooLab provides financing, technical support, and professional networking opportunities for partners working to expand connectivity in their own communities. The projects that CooLab supports are focused largely in rural areas with small populations and little or no competition in the local Internet services market. Their model is centered around collaboration with local stakeholders on the ground and supporting communities to maintain their own networks. CooLab has leveraged community partnerships and empowered local leaders to provide connectivity to hundreds of Internet users in several rural communities across the country.

However, CooLab's projects have also faced challenges that are common to WISPs. Despite the successful installation of a network in the Amazonian village of Juruti Velho, and the training of local partners to manage the network, access to the Internet was ultimately never achieved due to the high cost of interconnection. CooLab's loan was never repaid, and the organization took the experience as a lesson learned about the importance of strong ties with reliable local partners. The failure underscores the high costs faced by small providers, and the challenges of expanding connectivity to the most remote areas of Brazil.

Interconnection remains a possible barrier for the operation of small WISPs in underserved areas, especially in cities where there is only one backhaul option. This is due to limitations of capacity from incumbent fixed communications providers, such as the incumbent Oi.[28]

[25] Vero Internet, https://verointernet.com.br/.
[26] Interview with Netserv representative, October 20, 2022.
[27] CooLab, About CooLab, https://www.coolab.org/quem-somos/.
[28] Interview with Netserv representative, October 20, 2022.

1.2.2.3. Community Networks

In addition to broader initiatives to support local Internet providers, some programs are focused specifically on certain regions, industries, and social or demographic groups. One example is a grant program managed by the Internet Society in Brazil that offers grants for the development of community networks.[30] The grant funding is intended to foster connectivity projects targeted at marginalized communities, especially for rural areas and indigenous populations. The program can also include funding for training on navigating ANATEL's regulatory requirements. Funding through this program has been available since 2018 and, as a result, several community networks are now in various stages of deployment.[31]

Connectivity for education

As part of Brazil's 5G auction process, winning bidders committed to provide connectivity to elementary schools around the country. The *Entidade Administradora da Conectibilidade de Escolas* (EACE) was created to manage and facilitate these projects. To facilitate the participation of regional providers, EACE published a call for interested parties to participate in a pilot project to bring Internet services to 181 schools in ten municipalities. This call was also circulated by a major industry group for small providers. In the next phase of the program, 8,000 schools will be connected. The government will award contracts for each individual school, rather than one contract for all schools to encourage the participation of small and local providers. [29]

Another initiative to support community networks is focused on developing a supportive regulatory environment for local Internet providers. The Association for Progressive Communications (APC) has partnered with various organizations, including the Internet Society, on advancing this goal.[32] For example, in 2021, APC collaborated with ANATEL to publish a Community Networks Manual to assist operators in planning, implementing, and managing their own local network.[33] In addition, APC published a Policy Brief for ANATEL which focused on potential reforms to remove barriers and promote the development of community networks across Brazil.[34] Their proposed regulatory reforms included more granular coverage data, better transparency on actual spectrum occupancy, and more specific service categories to better understand type of service is being offered.

1.2.2.4. Access to funding

A significant challenge that WISPs face is access to sufficient funding. In Brazil, there are a numerous programs and initiatives aimed at helping operators manage the high costs required to deploy, operate, and maintain a network. While these funds fall short of current demand from operators and are not targeted specifically at WISPs, they play an important role in the overall availability of financing for infrastructure expansion.[35] Some public funds and programs to support investment in telecommunications networks include the following.

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[29] ABRINT, EACE invites regional providers to pilot project (August 23, 2022), https://www.abrint.com.br/noticia/eace-convida-provedores-regionais-para-projeto-piloto.
[30] Internet Society, Addressing Historic Inequalities in Brazil—through Community Networks (August 5, 2021), https://www.internetsociety.org/blog/2021/08/addressing-historic-inequalities-in-brazil-through-community-networks/.
[31] Internet Society Foundation, Three new community networks are helping safeguard communities in rural Brazil (May 20, 2021), https://www.isocfoundation.org/story/three-new-community-networks-are-helping-safeguard-communities-in-rural-brazil/.
[32] APC, Online launch: Building an enabling environment for community networks in Brazil (October 18, 2021), https://www.apc.org/en/news/online-launch-building-enabling-environment-community-networks-brazil.
[33] APC, Community Networks Manual, https://www.apc.org/en/ManualCN.
[34] APC, Policy brief and recommendations for an enabling environment for community networks in Brazil (October 20, 2021), https://www.apc.org/en/pubs/policy-brief-and-recommendations-enabling-environment-community-networks-brazil.
[35] Interview with representative of the Ministry of Communications, September 28, 2022.

In August 2022, the Managing Committee of the Fund for the Universalization of Telecommunications Services (FUST) approved a resolution on the use of the fund that implements the relevant law originally passed in 2020.[36] This reform is significant because it expands the potential use of the fund, previously reserved for fixed telephony services, to support the expansion of Internet connectivity. In its resolution, the Managing Committee specifies that funds should be prioritized for areas with lower levels of social development and areas with the largest population that would potentially benefit. While this can help address the need for connectivity in poor communities, the focus on population size is a potential impediment to funding for rural areas. The new FUST rules also include a significant focus on providing connectivity for educational institutions.

FUNTTEL

The Fund for the Technological Development of Telecommunications (FUNTTEL) is another public fund that offers financing to support innovation, research, and development in the telecommunications sector.[37] It is funded by a 0.5% tax on revenue from telecommunications service providers that is managed by the Ministry of Communications (MCOM). MCOM makes the money available to state-owned financial institutions for distribution to operators. The use of FUNTTEL resources has some limitations, such as the need of submitting a detailed project specification, business plan, and other documents that, although necessary, can make the use of the fund difficult for some smaller providers given the need of having or hiring specialized staff to be able to participate.[38]

Incentivized Debentures

MCOM works to provide access to financing to support investments in telecommunications networks, including through "incentivized debentures". This allows companies to claim reimbursements for the costs associated with advancing priority infrastructure projects. In July 2022, MCOM published an ordinance expanding access to this funding for companies with various types of corporate structures.[39] Funding can be used for a variety of costs associated with network deployment, expansion, and maintenance, including concession and spectrum fees. This program has enabled millions of dollars in funding to expand FTTH and other telecommunications technologies, though a large share has been claimed by some of the country's major operators and other large stakeholders in the sector.[40]

Other national funding sources have been made available to support fiber optic network infrastructure in remote areas, some specifically targeted at small Internet providers. The National Bank for Economic and Social Development (BNDES) has provided more than USD 10 million to finance the acquisition of fiber optic cables and telecommunications equipment for regional ISPs.[41] The government is also investing in

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[36] Resolution CG-FUST No. 2, of August 8, 2022, https://www.in.gov.br/en/web/dou/-/resolucao-cg-fust-n-2-de-8-de-agosto-de-2022-423168023.

[37] MCOM, Fund for the Technological Development of Telecommunications - Funttel (updated August 30, 2022), https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/funttel.

[38] Interview with representative of the Ministry of Communications, September 28, 2022.

[39] TeleTime, MCOM ordinance specifies requirements for telecommunications projects financed by incentivized debentures (July 22, 2022), https://teletime.com.br/22/07/2022/portaria-do-mcom-especifica-requisitos-de-projetos-de-telecomunicacoes-financiados-por-debentures-incentivadas/.

[40] Teletime, MCom authorizes Weclix to raise BRL 200 million with incentivized debentures (September 26, 2022), https://teletime.com.br/26/09/2022/mcom-autoriza-captacao-de-r-200-milhoes-da-weclix-com-debentures-incentivadas/.

[41] https://www.convergencialatina.com/News-Detail/339875-12-23-BNDES_to_finance_the_expansion_of_networks_of_five_regional_providers?Lang=EN&SMMK=6089.61935763889w.VGqDvxpYON.

regionally focused connectivity expansion initiatives, such as the Ministry of Science, Technology, and Innovation (MCTI) funding of a fiber backbone in the Northeast.[42]

Additional cost of risk mitigation/response

Beyond funding the investments needed to deploy networks, small Internet providers may face challenges in maintaining the integrity of existing networks. In addition to standard maintenance and upgrades, network operators in Brazil must contend with instances of vandalism, blocked access to equipment, and theft, even including a notable increase in stolen fiber optic cables.[43] The prevalence of these incidents led sector representatives to publish an Open Letter to Society in late 2021 decrying the risks they pose to the reliability and security of telecommunications networks.[44] Addressing the theft and destruction of network infrastructure is a key priority for the sector, with advocates supporting legislation that would institute higher penalties for these crimes.[45]

In addition to the risks to the physical network infrastructure, Brazil also faces one of the worst incidences of cybercrime in the world, leading the government to consider a national strategy to address the problem.[46] These threats are common to all providers, but the funding constraints typically faced by small providers can make preventative action and rapid response difficult. It is essential that future work to address these pervasive issues in Brazil consider the needs and constraints of WISPs.

1.2.3. Internet provider's associations

As evidenced by the initiatives discussed above, Brazil's WISP ecosystem is relatively developed and organized. Some of this can be attributed to the existence of designated trade association comprised of regional ISPs and WISPs. The biggest association in Brazil is the Association of Internet and Telecommunications Providers (ABRINT), an industry group focused on advocating for the interests of small and medium-sized Internet and telecommunications providers.[47] ABRINT's activities include representing its membership before government and regulatory bodies in the ICT sector. In addition to government engagement and advocacy, ABRINT provides information to its members regarding opportunities for government cooperation and support in the deployment and management of regional networks. Other relevant organizations with similar scope include Telcomp and NEO.

These associations are active and engaged participants in Brazil's telecommunications sector, demonstrated by their participation in the ANATEL Advisory Board.[48] Notably, they maintain sustained engagement with ANATEL staff and processes, including through participation in an ANATEL working group for small providers. This increases the group's impact by allowing the perspective of WISP operators to be considered throughout the policy development process.[49] According to a representative, ABRINT's

[42] https://app.bnamericas.com/article/section/all/content/xmpusvvss-brazil-hires-argo-energia-to-extend-fiber-backbone-to-alcantara-center.
[43] Conexis, 2.34 million meters of telecom cables were stolen in the 1st half of 2022 (September 6, 2022), https://conexis.org.br/234-milhoes-de-metros-de-cabos-de-telecom-foram-furtados-no-1o-semestre-de-2022/.
[44] Conexis, Telecom sector launches Open Letter with warning about the serious impact of theft and theft of cables and telecommunications equipment (December 1, 2021), https://conexis.org.br/setor-de-telecom-lanca-carta-aberta-com-alerta-sobre-o-grave-impacto-do-furto-e-roubo-de-cabos-e-equipamentos-de-telecomunicacoes/.
[45] Conexis, Approval of the bill that punishes the crime of theft of telecommunications equipment is essential for the country's growth (September 8, 2022), https://conexis.org.br/aprovacao-do-pl-que-pune-crime-de-roubo-de-equipamentos-de-telecomunicacoes-e-essencial-para-o-crescimento-do-pais/.
[46] ZDNet, Brazil debates creation of national strategy to tackle cybercrime (September 13, 2021), https://www.zdnet.com/article/brazil-debates-creation-of-national-strategy-to-tackle-cybercrime/.
[47] ABRINT, Who we are, https://www.abrint.com.br/sobre-nos.
[48] ABRINT, Abrint's representative assumes the Presidency of the ANATEL Advisory Board, (June 14, 2022), https://www.abrint.com.br/noticia/representante-da-abrint-assume-presidencia-do-conselho-consultivo-da-anatel.
[49] Interview with ANATEL representative, September 21, 2022.

forward looking agenda will focus on issues such as ANATEL's regulatory simplification efforts, promoting the use of a secondary spectrum market, opportunities to provide mobile services as an MVNO and access to numbering resources, and promoting lessons learned from early 5G deployments.

1.3. Regulatory framework status

Brazil's regulatory framework includes separate procedures to obtain a license to provide service, and access to spectrum, respectively. This section highlights key aspects, opportunities, and limitations of these frameworks in the context of WISPs.

1.3.1. Spectrum framework

Spectrum management activities in Brazil are led by ANATEL and the MCOM. ANATEL is the agency in charge of most functional spectrum management tasks including the allocation, monitoring, and assignment of frequencies for telecommunications networks. Information on the allocation of specific frequencies is provided in the Plan for Assignment, Destination and Distribution of Frequency Bands in Brazil (PDFF), updated by ANATEL each year.[50] In addition to allocating and assigning spectrum, ANATEL monitors the use of assigned spectrum to ensure its lawful utilization in compliance with the terms of applicable spectrum authorizations.

In 2021, Brazil held one of the largest 5G auctions in history, raising BRL 42.7 billion (USD 8.5 billion) through its offers of 700 MHz, 2.3 GHz, 3.5 GHz, and 26 GHz spectrum. ISPs won regional blocks of 80 MHz in the 3.5 GHz band including a consortium of ISPs from the southern region.

RCR Wireless: https://www.rcrwireless.com/20211108/5g/brazil-raises-total-8-billion-5g-spectrum-auction.
GZH Economy: https://gauchazh.clicrbs.com.br/economia/noticia/2021/11/leilao-do-5g-conheca-o-consorcio-que-arrematou-lote-em-cidades-de-ate-30-mil-habitantes-na-regiao-sul-ckvldl0xk00a1017fc99ygyp3.html

The use of radio spectrum in Brazil requires prior authorization from ANATEL.[51] The administrative process to obtain a spectrum authorization begins with an official request for the use of specific frequencies through the agency's online MOSAICO platform. ANATEL will then initiate a public call soliciting any other requests for use of that spectrum.[52] Subject to availability and technical limitations, ANATEL will then grant authorizations to all interested parties. If the amount of available spectrum is insufficient to meet the demand, its authorization depends on a bidding process.[53] Notably, in its establishment of a bidding process for particular frequencies, ANATEL may reserve certain spectrum for "social and digital inclusion projects".[54] ANATEL may also consider commitments to infrastructure deployment and service provision as bidding requirements.

[50] ANATEL, Plan for Assignment, Destination, and Distribution of Frequency Bands in Brazil (2020), https://sistemas.anatel.gov.br/anexar-api/publico/anexos/download/db36871563204c812e300856bd9b2794.
[51] ANATEL, Resolution No. 671 (November 3, 2016), Title I, Section 3, https://informacoes.anatel.gov.br/legislacao/resolucoes/2016/911-resolu%25C3%25A7%25C3%25A3o-671.
[52] ANATEL, Resolution No. 671 (November 3, 2016), Title III, Chapter II, https://informacoes.anatel.gov.br/legislacao/resolucoes/2016/911-resolu%25C3%25A7%25C3%25A3o-671.
[53] ANATEL, Resolution No. 671 (November 3, 2016), Title III, Chapter II, https://informacoes.anatel.gov.br/legislacao/resolucoes/2016/911-resolu%25C3%25A7%25C3%25A3o-671.
[54] ANATEL, Resolution No. 671 (November 3, 2016), Article 36, https://informacoes.anatel.gov.br/legislacao/resolucoes/2016/911-resolu%25C3%25A7%25C3%25A3o-671.

While Brazil's leadership as one of the first countries in the region to hold a 5G auction demonstrates a commitment to making new spectrum available, there are still opportunities to improve the efficiency of spectrum assignment in the country. WISPs use of licensed 5G spectrum remains possible only for the larger providers, considering the high volume of investments required. For example, following the 5G auction, Internet provider Neko became the second winning bidder to return spectrum in the 26 GHz band.[55] According to recent reports, ANATEL will fine Neko for failing to comply with the commitments established during the bidding process.[56] As recently as December 2021, Neko had planned to use the spectrum to establish a neutral network for 5G FWA and IoT applications.[57]

1.3.1.1. Unlicensed spectrum technical operation

There is a growing interest among WISPs in utilizing unlicensed spectrum as a means to provide service. Though still not as common as fiber, providers are exploring the use of Wi-Fi technology in unlicensed spectrum given the technological benefits presented by Wi-Fi 6.[58] The rules for using unlicensed spectrum describe three limitations for such use: services provided via equipment with restricted radiation; temporary, scientific, or experimental applications; and services associated with satellites.[59]

The use of equipment with restricted radiation the current regulated output power in the 2.4 GHz band used by Wi-Fi technologies limits links to about 10 km, compared to over 30 km in Canada.[60] In the 5.8 GHz band, Brazil limits link distance to 6 km, far shorter than the 15 km limit in Argentina or 20 km in the United States and Canada.

As for the use of the 6 GHz band, Brazil made the full 5,925-7,125 MHz band available for unlicensed use. However, the regulation of the use for outdoor standard power is still under development as it continues exploring the technical measurements to protect incumbent services. The use of the outdoor standard power at the 6 GHz band for Wi-Fi 6E technology would be an important aspect to improve the WISP services offer and therefore their capacity of competing in the market.

1.3.1.2. Frequency bands used by WISPs

WISPs in Brazil use a variety of frequency ranges to offer their services. In Brazil's 2021 5G auction, Brisanet and Unifique acquired spectrum in the 3.5 GHz band, with Brisanet acquiring an additional block in the 2.3 GHz band. Brisanet is currently advancing with plans to begin activating 2.3 GHz 5G network by the end of 2022, although the company has noted it will wait until the price of compatible smartphones decreases before rolling out its 3.5 GHz network.

However, other WISPs benefitted from increased access to spectrum because of the auction as well. Unifique participated in the auction through a consortium that included Copel as a 1/3 stakeholder. Other companies won spectrum with the intention of making wholesale offers to customers including WISPs. Two such companies are Winity, which was awarded a 2 x 10 MHz block in the 700 MHz band, and

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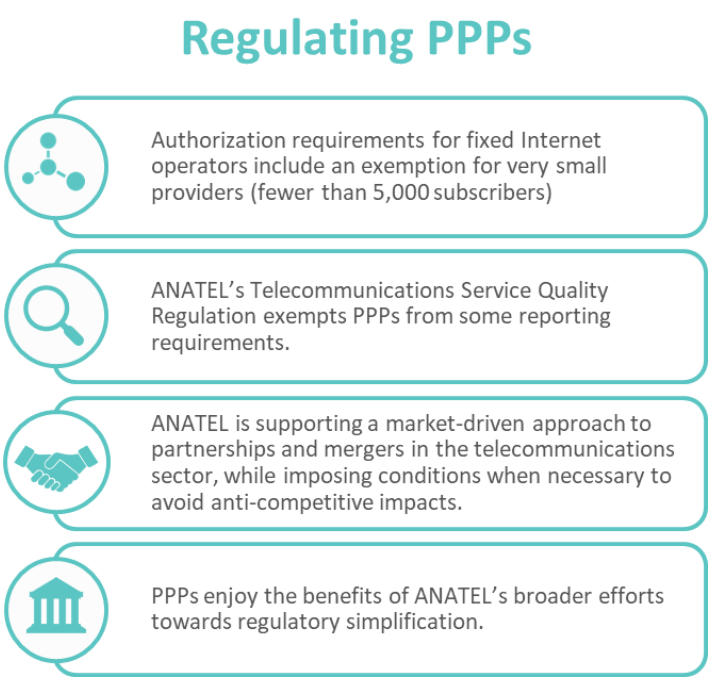
[55] Teletime, Neko gives up the 26 GHz grant (September 5, 2022), https://teletime.com.br/09/05/2022/neko-desiste-da-outorga-de-26-ghz/.
[56] Telecompaper, Neko loses deposit after giving up 26 GHz band license (September 6, 2022), https://www.telecompaper.com/news/neko-loses-deposit-after-giving-up-26-ghz-band-licence--1436364.
[57] Telesintese, Neko will be a gateway for a foreign operator in the Brazilian market (December 6, 2021), https://www.telesintese.com.br/neko-sera-porta-de-entrada-para-operadora-estrangeira-no-mercado-brasileiro/.
[58] Interview with ABRINT representative, September 28, 2022.
[59] ANATEL, Resolution No. 671 (November 3, 2016), Section 3, https://informacoes.anatel.gov.br/legislacao/resolucoes/2016/911-resolu%25C3%25A7%25C3%25A3o-671.
[60] Internet Society, Innovations in Spectrum Management (March 2019), p. 31, https://www.internetsociety.org/wp-content/uploads/2019/03/InnovationsinSpectrumManagement_March2019-EN-1.pdf.

Cloud2u, which was awarded a regional 80 MHz block in the 3.5 GHz band which covers Rio de Janeiro and other densely populated areas. Winity has already agreed to a non-exclusive network sharing agreement with large operator Vivo which is currently undergoing regulatory review.[61]

More recently, ANATEL has published a public consultation on the proposed regulation of the 4.9 GHz band, proposing it to be available for mobile services and Internet providers.[62]

1.3.2. Telecommunications regulatory framework

Brazil's telecommunications regulatory framework identifies the important role of networks targeted toward specific communities. Recent reforms to the framework have attempted to reduce regulatory burdens for small operators in certain circumstances, though substantial barriers to market entry remain.



The country's framework for service licensing requires providers to obtain prior authorization from ANATEL to provide any telecommunications service in the country. There is a separate application process for each service. Provision of fixed Internet access is classified as a Multimedia Communications Service (SCM).[63] The authorization process begins with an application through ANATEL's online portal, providing documentation to support the company's legal, technical, economic qualifications. The applicant must pay a service fee of BRL 400 (USD 80). This is substantially less than the BRL 9,000 (USD 1,780) fee for other services such as mobile and fixed switch telephone services.

However, some providers may not even be required to pay this lower fee for SCM authorization. In 2019, a key amendment to Brazil's General Telecommunications Law expanded the government's ability to fund investments in broadband infrastructure and introduced the possibility of a secondary spectrum market to increase efficient use of assigned frequencies.[64]

In an important reform to the authorization framework in 2020, ANATEL created an exemption for providers with fewer than 5,000 subscribers.[65] This provides a useful opportunity for small and local networks to avoid the regulatory requirements associated with obtaining a formal authorization to

[61] CommsUpdate, Winity-Vivo network sharing deal undergoing regulatory scrutiny (September 23, 2022), https://www.commsupdate.com/articles/2022/09/23/winity-vivo-network-sharing-deal-undergoing-regulatory-scrutiny/.
[62] ANATEL, Public Consultation 23/2022 (April 14, 2022), https://apps.anatel.gov.br/ParticipaAnatel/VisualizarTextoConsulta.aspx?TelaDeOrigem=3&ConsultaId=10001.
[63] ANATEL, Obtain authorization to provide Fixed Internet Access service (modified July 25, 2022), https://www.gov.br/pt-br/servicos/obter-autorizacao-para-prestar-servico-de-acesso-a-internet-fixa.
[64] Law No. 13,879, of October 3, 2019, http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2019/lei/l13879.htm
[65] ANATEL, Resolution No. 720 (February 10, 2020), https://www.in.gov.br/en/web/dou/-/resolucao-n-720-de-10-de-fevereiro-de-2020-242818732.

provide service. This targeted exception for small providers is not limited to service authorizations. ANATEL's Telecommunications Service Quality Regulation (RQUAL) also exempts small providers from its requirements.[66] In this context, small providers are defined as those with less than 5% market share in each retail market in which it operates.[67] While not required, small providers may voluntarily provide information on their quality-of-service metrics. The RQUAL nationwide monitoring system came into effect in 2022 and provides indicators to gauge the quality of services received by consumers.

There has been some pushback from larger operators against provisions directed at supporting WISPs. Large operators are reportedly calling for ANATEL to reverse what they see as preferential regulatory treatment for small providers, claiming that the market is saturated and that these providers have substantial market power in certain areas.[68] An ANATEL representative confirmed that, when taken together, small providers have upwards of 70% market share in some cities. And as the concessions granted under the current regime come to the end of their term, some at ANATEL have expressed an openness to a broader review of the country's telecommunications law.[69] This could present a risk or opportunity for some key regulatory considerations that have fostered the growth of the WISP ecosystem in Brazil. ANATEL suggests that small providers may be addressed in a future revision of the national competition plan, or that an intermediary organization may be created to manage their participation in the market. Any future regulatory considerations for ISPs and WISPs should include stakeholder participation from small regional operators and consider their important role in promoting competition in the Internet services market.

Other aspects of ISP and WISP regulation do not differentiate among large and small providers. For example, the *Marco Civil da Internet* requires content neutrality in traffic management, among other provisions, for large and small providers alike.[70] There are also gaps in Brazil's current regulatory framework, specifically in relation to nationwide planning. The country's National Broadband Plan was adopted in 2010 for the period 2010-2016, and a few companies signed terms of commitment to expand broadband access and affordability.[71] However, there has been no recent discussion of updating, modernizing, or replacing the expired plan.

Despite the lack of a coordinated National Broadband Plan, regulatory efforts are ongoing to encourage network infrastructure deployment across Brazil. In January 2021, ANATEL published the fifth iteration of its General Plan of Universalization Goals (PGMU).[72] The regulation is focused on fixed telephone service providers, but its impact has extended to the provision of Internet services due to new requirements for infrastructure deployment. The latest version of the PGMU requires the country's fixed telephony

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[66] ANATEL, Telecommunications Service Quality Regulation – RQUAL, https://informacoes.anatel.gov.br/legislacao/resolucoes/2019/1371-resolucao-717.

[67] ANATEL, PGMC, https://informacoes.anatel.gov.br/legislacao/resolucoes/2018/1151-resolucao-694.

[68] Estadao, Regional internet operators reach almost 50% of the market and provoke a reaction from the large telecoms (September 5, 2022), https://www.estadao.com.br/economia/operadores-regionais-internet-metade-mercado-grandes-teles-anatel/.

[69] Convergencia Latina, Baigorri: the end of concessions is a good time to review the Telecommunications Law (September 5, 2022), https://www.convergencialatina.com/News-Detail/339549-12-23-Baigorri_the_end_of_concessions_is_a_good_time_to_review_the_Telecommunications_Law?Lang=EN&SMMK=6079.58146391204w.749JMBjfPO.

[70] Presidency of the Republic, Law No. 12,965, of April 23, 2014, http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12965.htm.

[71] ANATEL, National Broadband Plan, https://www.gov.br/anatel/pt-br/regulado/universalizacao/plano-nacional-de-banda-larga.

[72] ANATEL, General Plan of Universalization Goals (modified August 25, 2022), https://www.gov.br/anatel/pt-br/regulado/universalizacao/plano-geral-de-metas-de-universalizacao.

concessionaires to deploy fiber optic backhaul in areas of the country currently without service. The envisioned timeline is ambitious, aiming for 45% coverage of unserved areas by the end of 2023, and 100% coverage by the end of 2024. This has encouraged further deployment and provision of services through fiber networks. Further government efforts to incentivize infrastructure deployment include an MCOM program to reduce tax rates for priority projects including telecommunications infrastructure.[73] In addition to national regulations, municipalities are making progress on regulations to facilitate infrastructure deployment to support 5G services.[74]

[73] MCOM, Priority Projects, https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/projetos-prioritarios.
[74] BNAmericas, 160 Brazilian municipalities approve municipal antenna laws to receive 5G technology (August 24, 2022), https://app.bnamericas.com/article/section/all/content/xnv87cj4v-160-cidades-brasileiras-aprovam--leis-municipais-de-antenas-para-receber-a-tecnologia-5g.

2. Indonesia

2.1. Introduction

Indonesia is one of the largest markets in East Asia and the Pacific, with the second highest population and the fifth highest GDP in the region.[75] It hopes to capitalize on the digital revolution and become a leader in emerging technologies.

More than half of Indonesia's population are Internet users (54%). While this metric lags behind competitors in the region and globally, it represents more than double the rate of Internet use seen in 2016 (25%).[76] Fixed broadband penetration in Indonesia (4%) is far below the global average (16%), despite doubling since 2016. Even with this growth in recent years, two key aspects of the Indonesian market present challenges to the expansion of Internet services:

Fixed network performance: Indonesia lags significantly behind regional peers in metrics including median fixed broadband download speeds, with the second lowest average in Southeast Asia in 2021 (20.08 Mbps). Despite a reported improvement through the first quarter of 2022 (to 21.23 Mbps), the gap between network performance in Indonesia and regional leaders such as Singapore and Thailand (each over 150 Mbps) remains stark.[77]

Indonesia's **median fixed broadband speed** ranks in the bottom half of countries globally according to Ookla data as of October 2022.

The 2021 **cost of fixed broadband services** in Indonesia ranks in the bottom half of countries globally according to ITU data.

Cost of fixed services: Fixed services in Indonesia are typically more expensive compared to global and regional peers. Data from the International Telecommunication Union (ITU) indicate that, in terms of the cost of fixed broadband for 2021, Indonesia ranked 125 out of the 177 countries where data were available.[78]

Given the persistent challenges related to cost and performance, the Indonesian government continues to explore new ways to improve access to meaningful connectivity. These initiatives include both direct investment in infrastructure such as the Palapa Ring Project, and regulatory reform such as the 2020 Omnibus Bill which included provisions to promote sharing of existing infrastructure.

In this context, various local and regional Internet service providers (ISPs) are working to establish a position in the Internet services market. Despite these efforts, small providers comprise only a small share of the overall broadband market. Some ISPs, in addition to providing connectivity via fiber, also use spectrum to provide service, thus being considered a wireless ISP (WISP). This report considers the overall ISP market, and the specific conditions for the operation of WISPs.

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[75] World Bank data as of 2021, see: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=Z4&most_recent_value_desc=true; and https://data.worldbank.org/indicator/SP.POP.TOTL?locations=Z4&most_recent_value_desc=true.

[76] World Bank, Fixed broadband subscriptions (per 100 people) – Indonesia, https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=ID.

[77] Ookla, Fixed Broadband Network Performance in Indonesia Falling Further Behind Regional Peers (June 2, 2022), https://www.ookla.com/articles/indonesia-fixed-broadband-network-performance-q3-q4-2021-2.

[78] ITU, ICT Price Baskets, Fixed-broadband basket 2021, https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/IPB.aspx.

WISPs play an important role in increasing competition, thereby improving the prices and quality of services for consumers. The WISP ecosystem in Indonesia can be considered competitive, with about 830 WISPs currently operational in the country, primarily marketing their services to end users' homes, enterprises, and small and medium-sized enterprises (SMEs).[79] At a national level, the market for fixed broadband services is dominated by PT Telkom Indonesia, which holds roughly 80% of the market share through its IndiHome brand.[80] Even with the dominant market share currently held by one operator, the low overall penetration rate of fixed services presents an opportunity for significant growth

This case study examines challenges and opportunities for the development of the WISP market in Indonesia, providing recommendations to foster future growth.

2.2. WISP market analysis

This section provides an overall description of the market conditions for Internet services in Indonesia and assesses the current participation of WISPs in the provision of connectivity. It examines the respective market shares of relevant WISPs and provides an overview of their impact on the market for Internet access services. This section also identifies key players in the WISP ecosystem, as well as trade and commercial associations that are active in Indonesia. There is no formal regulatory definition in Indonesia to identify small providers. For Indonesia's case, based on the concentration currently observed in the market, all ISPs other than the dominant fixed broadband provider can be considered as a small ISP. Three small ISPs are also relevant market players at the national level. Section 1.2.1 examines how the business models of Indonesia's largest ISPs have developed in recent years, while section 2.2.2 focuses on the experiences of smaller local and regional providers.

2.2.1. Market and business model review

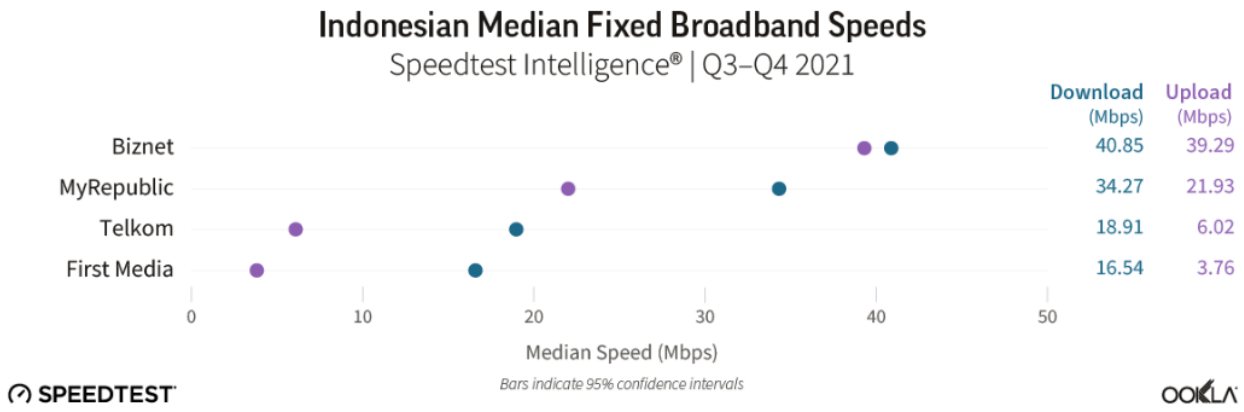
At a national level, the largest ISP in Indonesia is Telkom, with 80% market share nationwide. Two other providers with relatively large nationwide subscriber bases when compared with other small ISPs are First Media and Biznet.[81]

Telkom is active in numerous markets beyond fixed broadband, including mobile services and infrastructure deployment. Telkom recently announced a planned integration of its mobile and broadband segments, further concentrating Indonesia's telecommunications market.

The other largest Internet providers in Indonesia are focused on fiber deployment to expand their networks. Both First Media and Biznet have publicly announced plans to expand their fiber footprints. First Media plans to expand its network to 45 cities on the island of Java over the next five years, while Biznet hopes to deploy 10,000 km of fiber in 2022. Biznet is also investing in new fiber technologies to enhance its network capacity.[82] Notably, Biznet currently offers the fastest fixed broadband speeds among these three providers, with an offer more than twice the speeds of market leader Telkom. This demonstrates the ability of smaller providers to offer competitive services in comparison with larger operators.

[79] Interview with Laxo ISP, November 12, 2022.
[80] Data Center Knowledge, Indonesia's Biggest Telco to Combine Mobile, Broadband Business (August 18, 2022), https://www.datacenterknowledge.com/business/indonesia-s-biggest-telco-combine-mobile-broadband-business.
[81] Ookla, Fixed Broadband Network Performance in Indonesia Falling Further Behind Regional Peers (June 2, 2022), https://www.ookla.com/articles/indonesia-fixed-broadband-network-performance-q3-q4-2021-2.
[82] Ciena, Biznet to Accelerate Connectivity Across Indonesia with Ciena (September 15, 2022), https://www.ciena.com/about/newsroom/press-releases/biznet-to-accelerate-connectivity-across-indonesia-with-ciena

Figure 2: Fixed broadband speeds by operator (2021)



Source: Ookla.

Despite the dominant position of Telkom in the market, the variety of business activities and expansion plans being explored by Indonesia's largest ISPs demonstrates the dynamic nature of the market and evolving technologies to bring service to customers. Although the market is still concentrated at the national level, 10 different providers claim more than a 3% market share at the regional level.[83] Even with the additional competition from providers focused on a particular region, Indonesia experiences relatively low penetration rates and slower-than-average speeds for fixed Internet services.

2.2.1.1. Geographic and meteorological challenges

ISPs in Indonesia face particular challenges to provide reliable and high-quality Internet services, especially in remote areas due to Indonesia's geography and climate. In terms of geography, Indonesia is an archipelago consisting of over 10,000 populated islands that extend over 3,000 miles from east to west.[84] This creates high infrastructure deployment costs to cover remote and underserved areas. In addition, WISPs have highlighted that the heat and humidity common to the region impose reliability issues for lower-cost wireless network equipment.[85] Both conditions underscore the importance of robust infrastructure deployment, particularly the expansion of the country's fiber optic backbone network.

2.2.2. WISP coverage

WISPs play an important role in providing connectivity across Indonesia. Nationwide, the market share of small and regional ISPs and WISPs is about 20%. While data from regulators and industry groups do not differentiate the type of access technology, whether fiber or wireless, among traditional ISPs and WISPs there are more than 800 Internet providers across the country. Due to the disparity in Internet penetration rates across the country, it would be possible to find growth opportunities for ISPs in remote, rural, and underserved areas. In fact, WISP representatives confirmed that the typical WISP business model focuses on providing last-mile connectivity in rural and underserved areas. As such, one of the main factors for WISPs' ability to compete and grow is access to both fiber and spectrum, particularly unlicensed spectrum.

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[83] Ookla, Fixed Broadband Network Performance in Indonesia Falling Further Behind Regional Peers (June 2, 2022), https://www.ookla.com/articles/indonesia-fixed-broadband-network-performance-q3-q4-2021-2.
[84] Britannica, Indonesia, https://www.britannica.com/place/Indonesia.
[85] Interview with Wavecomindo ISP, September 29, 2022.

2.2.2.1. Wireless vs. fiber-based services

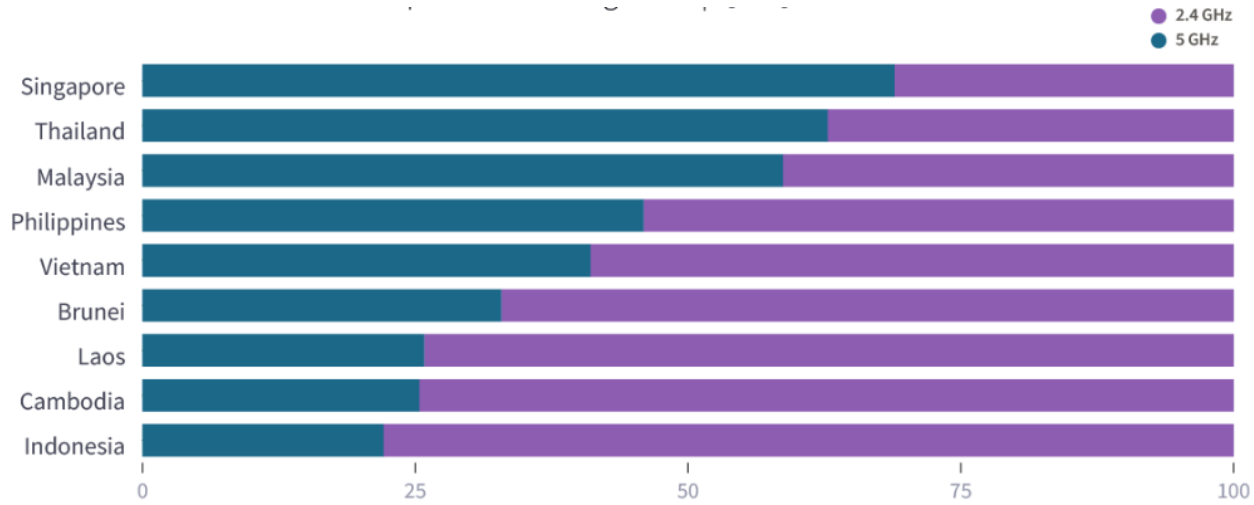
In Indonesia, fiber-based services remain the primary method of delivering fixed Internet access to homes and businesses. Recent government initiatives such as the Palapa Ring Project have focused primarily on fiber backbone deployment as a means of expanding connectivity. To date, while Indonesia boasts a relatively developed fiber backbone, fiber deployments are typically concentrated in certain areas of the country as shown in Figure 3.

Figure 3: Fiber optic cable networks in Indonesia

Source: Ministry of Communication and Informatics, Strategic Plan 2020-2024.

Fiber access remains costly, especially for smaller providers that do not own infrastructure nor have favorable sharing agreements with infrastructure owners.[86] As a result, providers in this situation turn to wireless solutions.[87] Within the unlicensed Wi-Fi bands, WISPs in Indonesia rely heavily on the 2.4 GHz frequency band, as compared with the 5 GHz frequency band more commonly used among other Southeast Asian (SEA) countries.

Figure 4: Wi-Fi frequency bands use in SEA



[86] Interview with Laxo ISP, November 12, 2022.
[87] Interview with APJII, September 30, 2022.

Source: Ookla (2021).

2.2.2.1. Access to funding

Deployment cost constraints and lack of access to funding are key issues for ISPs, particularly WISPs and small providers. This issue is in no way exclusive to Indonesia, but current market and regulatory conditions have resulted in additional pressure on operating budgets for small ISPs and WISPs. For example, the proliferation of new, more data-intensive applications have increased network bandwidth usage. However, the high costs associated with expanding and operating these networks often outpace the revenue gains resulting from increased demand. This effect is particularly notable in underserved areas, where it can be difficult for operators to recoup high buildout costs.[88] Additionally, broad restrictions on foreign ownership limit potential sources of funding for Indonesian providers.

To bridge this funding gap, BAKTI, the managing entity of the Universal Service Fund in Indonesia, is targeting certain funds specifically at ISPs that collaborate with village-owned enterprises (BUMDES). This funding allows ISPs to expand their services through a variety of technologies including VSAT, mobile cellular, and fiber optic or broadband wireless access that will be connected to the Palapa Ring backbone network.[89]

BAKTI initiatives

BAKTI manages four types of programs funded through the Universal Service Fund:

- ***Infrastructure development*** (e.g., Palapa Ring)
- ***Base transceiver station investment***
- ***Satelit Republik Indonesia (SATRIA)*** (satellite system to support connectivity)
- ***Public Internet access services*** (focused on public locations such as schools and healthcare centers, but also including rural areas)

Another recent reform with implications for the fixed broadband market is the lifting of foreign ownership restrictions introduced by a new presidential regulation. Among other provisions, this regulation removes limits on foreign ownership for fixed telecommunications networks (previously capped at 67%).[90] This introduces new opportunities for Indonesian ISPs to access funding for network expansion and aims to increase infrastructure deployment nationwide. This may increase the supply of fiber optic capacity available to WISPs and, in turn, lower costs.

2.2.3. WISP associations

To date, in Indonesia no industry group or association is specifically focused on representing the interests of WISPs. However, one large industry association represents a diverse membership including hundreds of ISPs.

APJII

The Indonesia Internet Service Providers Association (APJII) is an industry association with a broad membership within the country's ISP ecosystem, including small, wireless, and regional providers. However, only 10% of APJII members are WISPs.[91] APJII was formed in 1996 with an agenda to support government work on five key issue areas[92]:

1. Internet Service Tariff;

[88] Interview with APJII, September 30, 2022.
[89] Interview with APJII, September 30, 2022.
[90] Presidential Regulation No. 10 of 2021.
[91] Interview with Wavecomindo ISP, September 29, 2022.
[92] APJII, Background, https://apjii.or.id/pengurus/latar_belakang.

2. Formation of the Indonesia-Network Information Center (ID-NIC);
3. Establishment of the Indonesia Internet Exchange (IIX);
4. Telecommunications Service Infrastructure Tariff Negotiations; and
5. Proposed Number and Type of Providers.

The group has successfully advanced these priorities and is now focused on a new work program for the period 2021-2024.[93] This work program includes several initiatives that could provide significant benefits to WISPs, such as managing a network of Internet exchange services (IXPs), providing assistance to the MCI in fighting illegal ISPs, and advocating for permit moratoriums in already congested areas to limit interference caused by competing providers and services.

2.3. Regulatory framework status

Indonesia 's regulatory framework includes separate licensing procedures to obtain a license to provide service and access to spectrum. This section highlights key aspects, opportunities, and limitations of these frameworks in the context of WISPs.

2.3.1. Spectrum framework

Spectrum management activities in Indonesia are led by the Directorate General of Resources and Equipment of Post and Information Technology (Kominfo), a unit within the Ministry of Communications and Informatics. This unit of Kominfo is the government body responsible for the majority of functional spectrum management tasks including the allocation, monitoring, and assignment of frequencies for telecommunications networks. Information on the allocation of specific frequencies is provided in the National Table of Frequency Allocation, most recently updated in 2018 through a ministerial regulation.[94] In addition to allocating spectrum, Kominfo monitors the use of assigned spectrum to ensure its lawful utilization in compliance with the terms of applicable spectrum authorizations.

All use of radio spectrum in Indonesia requires a license from Kominfo.[95] Three types of licenses are applicable for different uses of spectrum:

- **Bandwidth License –**give rights of use for a particular spectrum band for a 10-year term, renewable once**.**
- **Radio Station License –** give rights of use for a particular radio frequency channel for five years, renewable indefinitely for five-year terms.
- **Class License –** give holder access to non-exclusive (shared) rights of use subject to applicable technical conditions and included in the certificate of telecommunication equipment for an approved device.

Grantees of the Bandwidth License and Radio Station License are required to pay an annual fee at the beginning of each year.[96] The ability to transfer spectrum rights is limited to the Bandwidth License, which requires prior approval from Kominfo.

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[93] APJII, Work Program, https://apjii.or.id/pengurus/program_kerja.
[94] Kominfo, National Frequency Allocation Table (2018), https://www.postel.go.id/downloads/40/20190320112920-1539317233-PM_Kominfo_No_13_Tahun_2018_JDIH.pdf.
[95] Kominfo, Use of the Radio Frequency Spectrum (2021), https://www.postel.go.id/downloads/40/20220811140351-permen_2021-07_penggunaan_spektrum_frekuensi_radio.pdf.
[96] Kominfo, First Media and Bolt Must Participate in Re-Auction (November 15, 2018), https://www.kominfo.go.id/content/detail/15359/first-media-dan-bolt-harus-ikut-lelang-ulang/0/sorotan_media.

Unlicensed spectrum technical operation

Interest is growing among WISPs in utilizing unlicensed spectrum to provide service. Although still viewed by many providers as secondary to fiber, unlicensed spectrum plays an important role in the provision of Internet services, particularly in the 2.4 GHz and 5 GHz bands. This spectrum is used as a cost-effective alternative by WISPs as backhaul links in areas where access to fiber is costly or unavailable.[97] Industry representatives have confirmed that access to spectrum used for point-to-point and multipoint links is one of the key issues faced by WISPs.

A key spectrum issue currently under discussion in Indonesia involves the use of a lower portion of the 5 GHz band (5150-5250 MHz). The band is used for unlicensed applications, especially low power indoor (LPI) applications, in much of the world. A 2019 revision to International Telecommunication Union (ITU) Resolution 229, which establishes considerations for the use of the band globally, also empowers administrations to allow the frequency range to be used for outdoor applications such as the provision of Internet service.[98] While the band is not currently available in Indonesia for use by WISPs, Kominfo representatives have indicated an interest in opening the band for more applications.[99] However, they emphasized that more information is required to open the use of the band. As such, the Ministry of Communications and Informatics is planning a consultation on the use of the band for 2023. Based on engagement with Kominfo, there is an openness to allowing the outdoor use of the band for the provision of Internet services. Cooperative engagement with industry to determine an efficient and open use of the band would allow Kominfo to provide this additional spectrum for WISPs, addressing the scarcity of available frequencies and fostering the growth of the WISP ecosystem. Additional ranges, such as the 6 GHz band, are also being examined in line with international trends.

2.3.2. Telecommunications regulatory framework

Indonesia's telecommunications regulatory framework is comprised of a variety of laws and regulations, with the most significant being Law No. 36 of 1999 on Telecommunication, most recently amended in 2020.[100] This law establishes the licensing requirements and conditions for ISPs, which are further expanded through a series of subsequent ministerial regulations and decisions. For example, Indonesia's regulations impose a Universal Service Obligation (USO) of 1.25% of gross revenues on all ISPs.[101] ISP representatives that were interviewed indicate that the licensing regime in Indonesia is complicated, with operators subject to additional non-budgetary fees imposed by local governments which vary across jurisdictions.

Licensing processes and requirements can present a challenge for small ISPs and WISPs, as separate licenses are required to provide Internet services, and to establish and manage networks, respectively.[102] This introduces a more intensive administrative burden for ISPs that wish to offer services on their own networks and serves as a barrier to infrastructure investment by ISPs themselves. As such, many WISPs are forced to negotiate interconnection agreements for existing networks that can prove costly. Infrastructure sharing is also difficult at this stage in the market's development, both due to technical

[97] Interview with APJII, September 30, 2022.
[98] WRC Resolution 229 (Rev. WRC-19), https://www.itu.int/dms_pub/itu-r/oth/0C/0A/R0C0A00000F0076PDFE.pdf.
[99] Interview with Kominfo, November 24, 2022.
[100] Law No. 36 of 1999 on Telecommunication, https://cyrilla.org/api/files/1588772615948fxinzrzfakg.pdf.
[101] Regulation No. 17 of 2016 on Guideline of Tarif and Non-Tax State Revenue for Telecommunication Organisation Right and Universal Service Obligation: Article 3(2).
[102] Interview with APJII, September 30, 2022.

limitations on serving many ISPs in some areas, and due to opposition from some competing service providers (such as mobile operators) that own their own infrastructure.

Indonesia's government has been working to expand access to telecommunications infrastructure around the country, perhaps most notably though the Palapa Ring Project.[103] Palapa Ring is a national fiber-optic backbone network infrastructure development project aimed at expanding broadband access throughout Indonesia. The project consists of seven fiber optic small circles in Sumatra, Java, Kalimantan, Nusa Tenggara, Papua, Sulawesi, and Maluku, respectively. It began in 2016 and underwent several stages of development leading to its completion in late 2019. While the project's completion coincided with a significant increase in Internet access and relative growth in fixed Internet subscriptions, more must be done to address the cost and quality of service issues for fixed broadband in Indonesia.

The Indonesian government's 2021 approval of a Strategic Plan 2020-2024 for the Ministry of Communications and Informatics is a promising signal for the continued development of the country's Internet services market.[104] The strategic plan highlights some of the government's key accomplishments in recent years, including the aforementioned completion of the infrastructure deployment for the Palapa Ring Project. Notably, the plan highlights the forward-looking priorities of fostering interconnection between the Palapa Ring and privately-owned networks. It also mentions consideration of future expansion of the project. Additionally, on the topic of fixed broadband access, the plan discusses the importance of supporting access in particular areas such as tourist centers, industrial areas, and areas with a high concentration of SMEs.

2.4. Spectrum use

Spectrum is an important resource to enable the provision of Internet services across Indonesia. Access to unlicensed spectrum is a key aspect of WISP business models. The most commonly used frequencies are the 2.4 GHz and 5.8 GHz, which are commonly used for both backhaul (with speeds of up to 1 Gbps) and access to the end user.[105] Licensed spectrum is used by some WISPs, but these cases are largely limited to areas with high population densities and competition among service providers for access to frequencies.

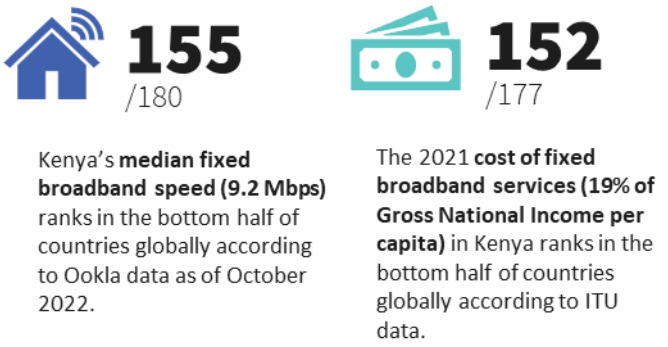
[103] Palapa Ring, Backbone, https://palaparing.id/.
[104] Ministry of Communications and Informatics, Strategic Plan 2020-2024, https://www.postel.go.id/downloads/40/20220811141228-permen_2021-02_Renstra_Kominfo_2020-2024.pdf.
[105] Interview with APJII, September 30, 2022.

3. Kenya

3.1. Introduction

Kenya is one of the fastest-growing markets in Africa, with a projected 5.3% gross domestic product (GDP) growth in 2022.[106] According to the African Development Bank, extreme poverty in Kenya declined from 17% in 2020 to 16% in 2021, and the unemployment rate decreased from 14.3% to 12.3% over the same period.[107]

Kenya's information and communications technology (ICT) sector has experienced steady growth over the last decade. According to the sector statistics report published by the Communications Authority (CA), the telecommunications regulator in Kenya, 98% of the population was covered by at least one 4G mobile network as of September 2022.[108] This growth is accompanied by ambitious public policies that aim to make Kenya one of Africa's biggest players in the digital economy, such as the National Broadband Strategy 2018-2023 and the National Digital Master Plan 2022-2032, discussed further in sections 0. and 3.2.2.1 respectively.



Sources: Ookla Speedtest Global Index and ITU ICT Price Baskets (2021).

In Kenya, an Internet connection with a minimum speed of 2 Mbps is considered a broadband connection.[109] The sector statistics reported by the CA show a high share of mobile broadband connections, which account for over 97% of total broadband connections. The remaining 3% of broadband connections are fixed, with fiber/wired access serving as the most popular option, followed by Fixed Wireless Access (FWA).[110]

Fixed broadband penetration reaches only 7.5% of households, trailing significantly when compared to the OECD average (34.4%) but above to the average penetration observed in the Sub-Saharan region (0.6%) and similar countries such as South Africa (0.34%) and Nigeria (0.13%).[111]

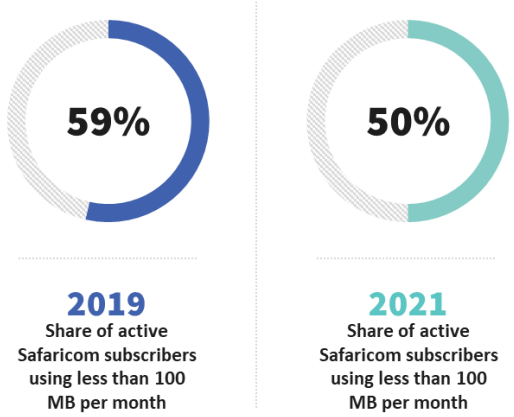
The relatively low fixed broadband penetration rate observed in Kenya contrasts with the mobile broadband coverage, a significantly higher rate of overall Internet use (65%), and the high penetration of

[106] IMF, World Economic Outlook database, https://www.imf.org/en/Publications/WEO/weo-database/2022/April
[107] World Bank, Kenya country overview, https://www.worldbank.org/en/country/kenya/overview
[108] Communications Authority (CA), Statistics of ICT Sector Report, September 2022, https://www.ca.go.ke/wp-content/uploads/2022/11/Sector-Statistics-Report-Q1-2022-2023.pdf, and Communications Authority (CA), Statistics of ICT Sector Report, January 2013 https://www.ca.go.ke/wp-content/uploads/2018/02/Sector-Statistics-Report-Q4-2012-13.pdf
[109] Communications Authority (CA), Statistics of ICT Sector Report, September 2022, https://www.ca.go.ke/wp-content/uploads/2022/11/Sector-Statistics-Report-Q1-2022-2023.pdf
[110] Ibidem
[111] OCDE data, Fixed broadband subscriptions, https://data.oecd.org/broadband/fixed-broadband-subscriptions.htm; data from the Sub-Saharan region from the Word bank data https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=ZG-KE-NG-ZA; ICASA, State of ICT Sector Report March 2022, section 4.4 https://www.icasa.org.za/legislation-and-regulations/state-of-the-ict-sector-in-south-africa-2022-report ; and data from Nigeria from the NCC's Industry statistics, https://www.ncc.gov.ng/statistics-reports/industry-overview#view-graphs-tables-4

mobile banking solutions (94%).[112] In 2022, mobile broadband networks covered almost the entire Kenyan population, although significant differences exist between the coverage footprints of the three mobile network operators (MNOs) in the market. Safaricom's 3G and 4G services provide nearly universal coverage and are available to 99% and 98% of the population, respectively.[113]

Adoption is limited despite the wide coverage of mobile Internet services. According to the GSMA, as of 2019, 70% of the population was not yet using mobile Internet despite living in an area covered by mobile broadband.[114] Data usage is also limited, and in 2021, Safaricom Kenya reported that half of its active data subscribers used less than 100 MB per month. Similarly, Airtel Africa reported that 80% of its data traffic is driven by its 4G users, which accounts for 20% of its subscriber base.[115]

The Kenyan mobile broadband market is highly concentrated in terms of revenue and subscribers, with Safaricom holding a dominant market position. Safaricom serves over 70% of all mobile broadband lines) in the country, more than three times the subscriber base of Airtel, the second-largest MNO.[116]



Source: TMG and Safaricom financial reports.

Total mobile revenues are also highly concentrated, with Safaricom receiving around 90 percent of revenue in the market, nine times the revenue share of Airtel. These significant differences in scale and revenues have remained relatively constant over the last five years, indicating that Safaricom's market position is stable and faces little challenge from competing MNOs. It is worth noting that the government of Kenya owns 40% of Safaricom shares.

Safaricom also leads in market share for fixed broadband service (35%). A detailed discussion of fixed broadband market conditions, which is the relevant market for Internet Service Providers (ISPs), including Wireless Internet Service Providers (WISPs), is provided in section 3.2.

This case study examines the challenges and opportunities for developing the WISP market in Kenya, providing recommendations to foster future growth given their importance in supporting the overall broadband market in expanding coverage, increasing affordability, and enhancing competition.

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[112] Dalberg, Omidyar Network, Kenya's Digital Economy report, August 2021, https://digitaleconomy.ke/assets/download/Kenyas_Digital_Ecomony_Full_report_Aug_2021.pdf

[113] Safaricom Investor Presentation FY22, 2022, https://www.safaricom.co.ke/images/Downloads/FY22_Investor_Presentation_12_May_2022_.pdf

[114] GSMA, Accelerating mobile internet adoption, 2021, https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/05/Accelerating-Mobile-Internet-Adoption-Policy-Considerations.pdf

[115] GSMA, The State of Mobile Internet Connectivity 2022, https://www.gsma.com/r/wp-content/uploads/2022/10/The-State-of-Mobile-Internet-Connectivity-Report-2022.pdf?utm_source=website&utm_medium=download-button&utm_campaign=somic22

[116] Safaricom Investor Presentation FY22, 2022, https://www.safaricom.co.ke/images/Downloads/FY22_Investor_Presentation_12_May_2022_.pdf, and Communications Authority (CA), Statistics of ICT Sector Report, September 2022, https://www.ca.go.ke/wp-content/uploads/2022/11/Sector-Statistics-Report-Q1-2022-2023.pdf,

3.2. WISP market analysis

This study integrates research with the results of numerous interviews with stakeholders, including ISPs, WISP industry associations and providers (from medium sized companies to small community networks), and government institutions, such as the CA. These interviews provide unique insights into the WISP market in Kenya, specifically regarding different business models, technological trends, and challenges providers are facing.

According to CA statistics reports, mobile broadband accounts for the majority of Internet connections in Kenya. The fixed broadband market is nascent (only 3% of population and 7.5% of household penetration). The table below, reproduced from the latest CA report, shows that 91% of fixed Internet access connections are concentrated among nine companies: [117]

Table 1. Fixed Broadband Market share in Kenya

Company	Subscribers	Market share
Safaricom PLC	350,724	35.6%
Wananchi Group (Kenya) Limited	251,133	25.5%
Jamii Telecommunications Ltd	218,036	22.1%
Poa Internet Kenya Ltd	106,571	10.8%
Liquid Telecommunications Kenya	16,370	1.7%
Mawingu Networks Ltd:	14,370	1.5%
Dimension Data Solutions East Africa Limited	12,820	1.3%
Telkom Kenya Ltd	4,541	0.5%
Vilcom Network Limited:	3,423	0.3%

Source: CA Statistics of ICT Sector Report, September 2022.

Notably, mobile operators such as Safaricom (the dominant operator), Wananchi Group (Kenya) Limited, and Jamii Telecommunications (an MVNO) account for over 58% of fixed broadband subscriptions. This underscores the significant role of mobile operators in the fixed broadband market in Kenya.

3.2.1. Market and business model review

Most WISP business models currently are focused on deploying fiber-to-the-home (FTTH) connections in and around major metropolitan areas. WISPs typically complement this fiber connectivity with wireless access technology for the last-mile connection. In 2020, 27.8 % of the country's population is urban (14,975,059 people).[118] The UN projects that more than half of Kenya's population will be living in urban areas by 2025.[119] This trend of rapid urbanization invites a growth opportunity for WISPs in urban and suburban areas.

[117] Population and household penetration calculated from the information on 2022 population projection from the Kenya National Bureau of Statistics (KNBS), updated on October 2022, https://www.knbs.or.ke/download/population-projections/, and the Communications Authority (CA), Statistics of ICT Sector Report, September 2022, section 2.2, https://www.ca.go.ke/wp-content/uploads/2022/11/Sector-Statistics-Report-Q1-2022-2023.pdf. Information from CA report does not identify business fixed broadband connections. Total penetration is calculated from the total of connections, and therefore the actual penetration rate might be lower than the number obtained.

[118] National Bureau of Statistics (KNBS), updated on October 2022, https://www.knbs.or.ke/download/population-projections/

[119] Urbanization in Kenya. UN Habitat. https://unhabitat.org/kenya

Understanding that reliability is a common issue for mobile networks in Kenya, WISPs have effectively addressed such challenges thanks to their knowledge of local communities and their ability to service and maintain fewer sites locally. The main driver for attracting clients is price. To be competitive, WISPs provide low-price offerings such as daily subscriptions in open Wi-Fi spots in highly transited areas.[120] Typical download speeds available from an average WISP range between 5 and 20 Mbps, with some offerings available for lower throughput plans, down to 2 Mbps. The differences in the offer depend mainly on the community being served.

As mentioned above, Kenya's ICT market is characterized by one dominant market player, with Safaricom leading in almost all aspects of the ICT ecosystem. WISPs comprise less than 20% of Kenya's fixed broadband market share.

Illegal providers

WISPs highlighted unlicensed providers as a problem for the industry.

Illegal providers usually have very small operations where a single person decides to provide services or share his or her own connection with several people (known as *sambaza* –sharing-- in Swahili). The proliferation of this kind of provider impacts fair competition and spectrum access, especially in license-exempt bands where some illegal providers use the equipment outside the regulation's technical parameters, polluting the 2.4 GHz and 5 GHz bands.

WISPs typically serve suburban and rural areas that are not fully dominated by direct fiber subscriptions, filling the gap for customers and enterprises where fiber is absent or unreliable. In dense urban areas, WISPs have limited ability to compete with offerings from large providers, given the difficulties in accessing fiber backbone connections, high prices of them, and problems related to congestion due to intensive use of the 2.4 GHz and 5 GHz bands.[121]

3.2.1.1. Neutral networks

One of the main projects of Kenya's National Digital Master Plan is the deployment of 100,000 km of fiber for the National Optic Fiber Backbone (NOFBI) to provide Internet to all schools, government institutions, populated centers (wards), health facilities, rural businesses, homes, and public spaces. The deployment of this extension to the current backbone network is scheduled to occur between 2022 and 2025.[122]

Another relevant nationwide network is owned by Liquid Telecom, which operates in various African countries. Founded in 2009, Liquid owns the largest independent fiber network in the country, with over 100,000 km of fiber. Liquid's networks offer connectivity to all the main submarine cable systems that connect Africa. Liquid Telecom was also the first company to establish a direct terrestrial communication link between Cape Town, South Africa and Cairo, Egypt.

Although not a neutral network, Safaricom grants WISPs access to its fiber network. Some of the providers indicated that Safaricom access is more expensive than the other alternatives, as it is the only available network in some geographical areas. In this sense, WISPs believe that accessing the Safaricom network is a temporary but not sustainable long-term alternative.[123]

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[120] See for example the Poa street Internet offer of 100MB for free every day. Users access the network using over 10,000 public Wi-Fi hotspots. Additional data includes offers from KSH 20 (USD 0.16) for every 1GB of data after usage of the free 100 MB.

[121] The WISP interviewed by TMG manifested that the price of backbone can be high and even prohibitive in some rural areas. Also, a common concern of WISPs is the interference issues in the license-exempt bands.

[122] Ministry of ICT, Innovation and Youth Affairs, the Kenya National Digital Master Plan 2022-2032, https://repository.kippra.or.ke/bitstream/handle/123456789/3580/Kenya%20-%20Digital%20Master%20Plan.pdf?sequence=1&isAllowed=y

[123] Interview with Farouk Ramji, CEO Mawingu, December 9, 2022.

Small Internet providers have noted challenges regarding costs and the possibility of accessing backhaul services using fiber. In general, accessing NOFBI fiber is difficult due to technical limitations and network management issues. Furthermore, coverage is limited to urban and suburban areas, with Safaricom owning the biggest network.

In this sense, an extension of the public backbone fiber network (as proposed by the National Digital Master Plan) and facilitating access for all players (e.g., solving the management issues at NOFBI and further improving the regulation regarding access and prices), will be helpful for WISPs to expand their coverage and compete with offerings and prices.

3.2.2. WISP coverage

Most interviewed WISP coverage areas are in suburban zones and the surroundings of major cities. This market reality is consistent with the urbanization trend in Kenya and the persistent income gap between rural and urban areas.[124] WISPs providing services in rural areas notes a considerable service gap in such areas due to the significant investments and permits needed, as well as the overall cost of deploying a network in Kenya moreover if the fiber backbone access is distant from the target service area.[125]

3.2.2.1. WISPs and their use of fiber networks

Numerous stakeholders have noted a migration trend from wireless solutions to fiber. Fixed Wireless Access technologies, especially using license-exempt bands, is largely limited to less dense areas where the business case is still developing. This trend towards fiber is driven by various factors, such as the population concentration in urban areas, the capacity of fiber optics to improve offers to customers with minimal investment when compared to wireless solutions, and the difficulty of accessing unlicensed spectrum given the congestion and aggregate interference that WISPs experience (produced by congestion due the extensive use and by illegal use outside the technical parameters published in the CA guidelines).[126]

3.2.2.2. Targeted support for WISPs

There is no evidence of government initiatives specifically designed to support and promote the growth of WISPs in Kenya. According to various stakeholders, it would be beneficial to review the Universal Service Fund (USF) target to include small and medium providers.[127] To date, universal service access funding has been focused on subsidizing initial capital expenditure (CAPEX) for deploying the networks. Such subsidies might mask sustainability issues such as relating to the business outlook, competition, and other business threats that funded operators might miss.

It would be helpful for the government to consider expanding USF subsidies to service provision.[128] A good recent example can be found in Brazil regarding the connection of 8,000 public schools. The government

[124] World Bank, Poverty & Equity Brief Kenya Africa Eastern & Southern, October 2022 https://databankfiles.worldbank.org/data/download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/current/Global_POVEQ_KEN.pdf

[125] Interview with Farouk Ramji, CEO Mawingu, December 9, 2022. Mawingu focuses its coverage in semi-rural (small towns with substantial growth) areas being a 100% wireless provider. https://mawingu.co/about/company/#coverage

[126] Interview with Dirk Jan Koeman, CBDO Poa Internet, October 18, 2022, and Interview with Ian Kasyoki, Executive Director Syokinet, November 8, 2022.

[127] Interview with Dirk Jan Koeman, CBDO Poa Internet, October 18, 2022

[128] Interview with Farouk Ramji, CEO Mawingu, December 9, 2022.

intends to award contracts for each individual school, rather than one contract for all schools so as to encourage the participation of small and local providers.[129]

Kenya's Micro and Small Enterprises Policy

In 2020, Kenya's government published the Micro and Small Enterprises Policy. This policy seeks to provide the right incentives to foster the growth of small and medium-sized enterprises (SME) in Kenya. Guaranteed access to an Internet connection can be as crucial to a Kenyan SME as access to electricity. In this sense, the policy's goals of skills and capacity development and access to decent and affordable infrastructure can be a vehicle to create projects that benefit both SMEs and WISPs, having in mind that WISPs are in fact SMEs themselves. SME's development in all sectors is crucial for achieving the national development goals anchored in broader initiatives such as Kenya Vision 2030 (discussed further in section 3.3.1).[130]

One of the main targets for WISPs is providing Internet services to SMEs, which tend to be more stable than residential clients, and WISPs aim to create a long-lasting relationship with such companies. The Micro and Small Enterprises Policy 0 seeks to assist WISPs with strengthening relationships with SMEs. Under the policy, the CA and the Minister can design incentives to help with WISP sustainability by, for example, subsidizing the Internet connection for SMEs provided by WISPs. These focused subsidies will work in two ways: (i) helping SMEs grow and compete and (ii) assisting WISPs to become more sustainable and improve their operations.

In line with the Micro and Small Enterprises Policy, one example of a regulatory initiative that can benefit WISPs is the introduction of specific provisions in Kenya's telecommunications licensing framework oriented to foster the WISPs market in a similar fashion as the Licensing and Shared Spectrum Framework for Community Networks that targets small non-profit networks.

3.2.3. Community networks

The main difference between WISPs and community networks is that the latter often seek sustainability over profitability, targeting their services to the bottom of the pyramid in rural and remote areas. In May 2021, the CA issued a Licensing and Shared Spectrum Framework for Community Networks that outlines steps the government will take to facilitate spectrum access for small-scale, community-based network services. One of the most significant changes is the introduction of a new category of service license for small-scale providers at the sub-county level. This regulation only applies to non-profit organizations.[131]

This license facilitates community network operation and requires less onerous regulatory obligations than licenses that authorize service in wider geographic areas. In addition to the flexible licensing regime, the regulation specifically addresses license-exempt use of spectrum and would reduce or eliminate regulatory fees for service providers in underserved areas. This initiative is an example of Kenya's work towards facilitating access to spectrum for local network providers and represents a positive step towards enhancing connectivity around the country.

A key challenge faced by community networks in comparison with WISPs more broadly is a lack of technical skills and training. To address this skills gap, universities, institutes, associations, and even WISPs

[129] ABRINT, EACE invites regional providers to pilot project (August 23, 2022), https://www.abrint.com.br/noticia/eace-convida-provedores-regionais-para-projeto-piloto.
[130] Ministry of Industrialization, Trade and Enterprise Development, https://msea.go.ke/wp-content/uploads/2021/07/MSEs-Policy.pdf
[131] Communications Authority of Kenya, Licensing and Shared Spectrum Framework for Community Networks (May 2021), https://www.ca.go.ke/document/licensing-and-shared-spectrum-framework-for-community-networks-may-2021/.

should work to provide resources to develop the technical and business skills of community network staff without the need for formal training courses.

Also, one of the main challenges is the access to backbone capacity networks. Typically, backbone fiber nodes are located in urban areas distant from the area that Community networks intend to cover. This reality results in costs for accessing fiber increasing geometrically depending on the distance to the capacity node. Such cost can be prohibitive for a small non-profit community network as the price to the final user could be considered high when compared with the average income in rural areas.

3.2.4. Access to funding

For most small WISPs, access to funding is a core challenge to their business model. Without targeted public support for WISPs from the USF or specific banking products, the only option to date beyond self-funding has been foreign intervention or ICT funds. One example is the case of Poa Internet, which raised an estimated KSH 36 million (USD 290,000) in 2020 from Africa50, an infrastructure financier backed by the Africa Development Bank (AfDB) Group.[132]

In general, however, funding for WISPs remains a challenge. For example, banks typically accept only traditional guarantees such as real estate to access loans, and banks also usually reject business cases with which they are unfamiliar.[133]

3.2.5. ISP associations

There is no formal WISP-specific industry association or advocacy group in Kenya. The association of Technology Service Providers of Kenya (TESPOK) is the most prominent ICT association in Kenya, with a membership that includes a broad set of ICT companies from mobile operators (Safaricom, Telkom, and Aritel) to fixed Internet providers (e.g., Poa), as well as equipment and installation providers.[134]

There is a burgeoning initiative to organize a WISP association (WISP Kenya Owners Forum (WKOF)). However, such an initiative is still in early stages and needs more support and organization to become a reality.[135] Creating an association focused on WISPs' agenda will help these operators get a particular voice tied to their interests. Bigger associations sometimes experience challenges tied to the diversity of their members' interests, leading them to remain silent about certain issues. Examples of strong associations can be found in South Africa with the Wireless Access Providers Association of South Africa (WAPA) and the South African Black Internet Service Providers' Association (SABISPA). The Indonesian Internet Service Provider Association (APJII for its acronym in Indonesian) is also a good example. In the case of Indonesia, APJII even develops projects such as deploying and managing Internet exchange points (IXP) that facilitate local traffic exchange, reducing latency and saving costs for ISPs.

3.3. Regulatory framework status

Kenya has adopted what is referred to as a technology-neutral Unified Licensing Framework (ULF) for ICT networks and services. However, in practice, the framework functions as a hybrid multi-service and service-specific licensing regime with multiple license categories and sub-categories.

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[132] See more at, https://techcrunch.com/2022/01/18/kenyan-low-cost-isp-poa-internet-secures-28-million-in-round-led-by-afdb-backed-africa50-plans-to-link-region-with-cheap-limit-free-connectivity/

[133] Interview with Ian Kasyoki, Executive Director Syokinet, November 8, 2022; Interview with Dirk Jan Koeman, CBDO Poa Internet, October 18, 2022.

[134] See https://www.tespok.co.ke/?page_id=11646

[135] Interview with Ian Kasyoki, Executive Director Syokinet, November 8, 2022.

3.3.1. Telecommunications regulatory framework

According to the Kenya Information and Communications Act and the Kenya Communications Regulations, any telecommunications system and services operation requires a license. The following table describes the types of licenses under the ULF:

License name	Facilities/Non-Facilities Based	Description, Including Geographic Scope
Network facilities provider (NFP) tier 1	Facilities-based	Nationwide infrastructure deployment using any technology, including national exclusive spectrum utilization (spectrum authorization must be obtained separately).
NFP Tier 2	Facilities-based	Nationwide infrastructure deployment using any technology, including regional exclusive spectrum utilization spectrum authorization, must be obtained separately).
NFP Tier 3	Facilities-based	Regional infrastructure deployment using any technology except satellite and regional exclusive spectrum utilization (spectrum authorization must be obtained separately).
Applications service provider (ASP)	Non-facilities based	Nationwide provision of any telecom service to end users (excluding content) using infrastructure leased from an NFP licensee, including voice, data, Internet, and mobile virtual network operator.
Content service provider (CSP)	Non-facilities based	Nationwide provision of content-related services to end users who are customers of ASPs (e.g., information, entertainment, education, health, social via text, voice, or video). CSPs use the infrastructure of NFP licensees.
Submarine cable landing	Facilities-based	Authorizes the establishment of submarine cable systems to provide international connectivity services across the sea.
International gateway systems and services	Facilities-based	Authorizes establishing and operating international gateway systems and provides international gateway services using satellite communication services across the globe or terrestrial systems across contiguous countries.
Community networks & service (CNS)	Facilities-based	Non-commercial license for Community-based networks that must be of non-profit organizations.
Satellite landing rights	Non-facilities based	Authorizes satellite operators of global mobile personal communications systems (GMPCS) to establish an agreement with a GMPCS gateway service provider in Kenya.
Private very small aperture terminal	Non-facilities based	Authorizes domestic entities to operate VSAT or SNG terminals in Kenya that are supported by hubs outside of Kenya.

(VSAT) and satellite news gathering (SNG)		

The CA has in place several different license application forms for electronic communications service (ECS) providers under the ULF, which are used for NFP Tier 2, NFP Tier 3, ASP, CSP, E-CSP, and international gateway operator licenses.[136]The license fees under the ULF vary depending on the services provided and generally consist of the following components:

- license application fee (usually between KSH 1,000 (USD 8) and KSH 4,000 (USD 16));
- initial operating fee (usually KSH 200,000);
- annual operating fee based on the operator's annual gross turnover; and
- where appropriate, a frequency spectrum access fee and an annual spectrum fee.

For small WISPs, some of the regulatory costs could be burdensome and even prohibitive. It is important to highlight that licensing also requires registration with the tax authority and associated tax obligations, which some of the companies interviewed consider too high (16% VAT, 20% exercise duty, 30% income tax, for an average net tax rate of 40%).[137]

Another important aspect of licensing in Kenya is the ownership requirements. In August 2020, the Ministry of ICT, Innovation and Youth Affairs (MIIYA) published the National ICT Policy Guidelines pursuant to the Kenya Vision 2030 development goals, which increased the minimum local ownership requirement from 20% to at least 30% in order to encourage Kenyans to participate in the ICT industry.[138] Although licensees have three years to meet the Kenyan ownership requirements and may apply to the Cabinet Secretary for a one-year extension of this deadline with "appropriately acceptable justifications," foreign ownership caps may serve as a barrier to effective competition in Kenya's ICT markets.

3.3.2. Spectrum regulatory framework

Kenya has a defined spectrum allocation, monitoring, and management framework under the purview of the CA and Ministry of Information, Communications and the Digital Economy (MOIC-DE). The CA is responsible for managing Kenya's spectrum resources and is the primary body responsible for spectrum management. Additionally, MOIC-DE is involved in developing national spectrum policies.[139]

3.3.2.1. Spectrum framework

The CA manages spectrum allocation, licensing, monitoring, and enforcement in Kenya.[140] On the assignment side, the CA has a general application procedure in place for a variety of services, including

[136] CA, Application for an electronic communications service provider license under the unified licensing framework, https://www.ca.go.ke/wp-content/uploads/2021/03/Application-Form-For-Electronic-Communications-Services1-TL-3.7.pdf.
[137] Interview with Ian Kasyoki, Executive Director Syokinet, November 8, 2022; Interview with Dirk Jan Koeman, CBDO Poa Internet, October 18, 2022; and Interview with Farouk Ramji, CEO Mawingu, December 9, 2022.
[138] MICT, National ICT Policy Guidelines (August 7, 2020), https://www.ca.go.ke/wp-content/uploads/2020/10/National-ICT-Policy-Guidelines-2020.pdf
[139] https://ict.go.ke/about-the-ministry/
[140] Communications Authority of Kenya, Frequency Spectrum Overview, https://www.ca.go.ke/industry/frequency-spectrum/overview/.

point-to-point links, point-to-multipoint links, fixed wireless access, and cellular mobile.[141] Applicants must file an application to the CA and pay a non-refundable application fee of KES 1,000 (USD 8.33).[142] The CA will examine the application to ensure that it complies with the provisions of the National Frequency Allocation Table and other technical requirements and will then carry out a technical analysis to identify frequencies for assignment.[143]

After the technical analysis, the CA will provide the applicant with an offer to assign frequencies, relevant terms and conditions, and an applicable spectrum fee.[144] After the applicant submits the spectrum fee, the CA assigns the frequencies.[145] Additionally, the applicant must make sure to obtain the CA type-approval on its radio equipment before beginning the installation process.[146] The CA will issue a radio communication license after the equipment is approved and the frequency license fee is paid.[147] Spectrum licenses are valid for one year and are renewed annually via payment of the license fee on June 30 of each year.[148]

The Radio Spectrum Policy

In late 2021, MOIC-DE published the draft National Radio Frequency Spectrum Policy. This draft is currently being finalized through stakeholder consultations. As it stands, the draft policy is focused on promoting the efficient use of spectrum and facilitating the deployment of new wireless technologies, while maintaining sufficient available spectrum for essential public services, enhancing flexibility and transparency in spectrum management, and achieving economic benefits through the timely introduction of new technologies and services in Kenya. [149]

3.3.2.2. License-exempt spectrum use

The CA and MOIC-DE are working to implement innovative approaches to spectrum management that enable the deployment and adoption of new technologies. These include flexible regulatory frameworks for experimental technologies, localized spectrum access for small operators and private networks, promoting shared use of spectrum, and identifying key bands for license-exempt use. For example, Kenya's broadband policy mentions the promotion of the flexible use of spectrum and sharing across users and platforms, such as mobile, satellite, and new technologies like High Altitude Platform Stations (HAPS) and Terragraph (Terragraph projects typically use the 60 GHz band).[150]

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[141] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 2, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[142] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[143] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[144] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[145] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[146] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[147] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[148] Communications Authority, Procedure for Licensing Use of Radio Frequencies and Resolution of Harmful Interference, p. 3, https://www.ca.go.ke/wp-content/uploads/2018/04/Procedure-for-Licensing-use-of-Radio-Frequencies.pdf.
[149] Ministry of ICT, Innovation, and Youth Affairs, National Radio Frequency Spectrum Policy, https://ict.go.ke/wp-content/uploads/2021/03/Draft-National-Spectrum-Policy-for-stakeholder-validation.pdf
[150] Ministry of ICT, Innovation, and Youth Affairs, National Radio Frequency Spectrum Policy, https://ict.go.ke/wp-content/uploads/2021/03/Draft-National-Spectrum-Policy-for-stakeholder-validation.pdf

In Kenya, WISP operators report extensive use of the license-exempt 2.4 GHz and 5 GHz bands. In fact, many operators note that the band is congested due to the number of users using the frequencies and use outside of technical parameters set in the guidelines by illegal and informal operators. The Guidelines on the Use of Radio-frequency Spectrum by Short-Range Devices issued and regularly updated by the CA regulate the use of the 2.4 GHz and 5 GHz bands.

In June 2022, the CA updated such guidelines to allow the use of the lower 6 GHz band (5925-6425 MHz) for license-exempt use. The regulation allows the use of the band by low-power indoor (LPI) devices and very low-power (VLP) devices, both indoor and outdoor. Additionally, the CA notes that an adequate spectrum-sharing mechanism shall be implemented for channel access and occupation.[151]

WISPs have stated that using the full range of the 6 GHz band, including for standard power applications, would solve congestion problems experienced in other license-exempt bands (particularly 2.4 GHz and 5 GHz) and provide room for future growth both in the subscriber base and their capacity to compete by improving their offers to consumers. Estimates suggest that the cumulative economic value between 2022 and 2031 associated with enabling license-exempt access to the 1200 MHz in the 6 GHz band in Kenya would amount to USD 20.29 billion, comprised of USD 14.28 billion in additional GDP, a USD 1.12 billion producer surplus to Kenyan enterprises, and USD 4.89 billion in consumer surplus to the Kenyan population.[152]

For reference, Brazil made the entire 5925-7125 MHz band available for unlicensed use, starting with the LPI and VLP use cases. Regulation of the use of standard outdoor power is under development as the regulator continues exploring the technical measurements to protect incumbent services.

3.3.2.3. Other frequency bands used by WISPs

While WISPs predominately report the use of fiber for backhaul, there is also some use of microwave links. However, the CA's Frequency Spectrum Allocation and Assignment Report show that most of the microwave bands are used for mobile networks for backhaul.[153]

In May 2021, the CA published the Dynamic Spectrum Access Framework for Authorization of the Use of TV White Spaces (TVWS) to enable spectrum sharing between broadcasting services and TVWS devices. In particular, the CA authorized the use of TVWS in the 470-694 MHz UHF band, allocated to broadcasting services on a primary basis. The framework allows white space devices (WSDs) to access the 470-694 MHz UHF band on a non-protected, non-interference basis.[154]

Regarding the use of the TVWS, one WISP indicated that the costs of the TVWS devices could be a barrier to the use of these bands. Poa Internet also reported ongoing trials in the mmWave networks to test high-capacity use cases. [155]

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[151] Communications Authority of Kenya, Guidelines on the Use of Radio-frequency Spectrum by Short-Range Devices 2022, https://www.ca.go.ke/document/guidelines-on-the-use-of-radio-frequency-spectrum-by-short-range-devices-pdf/.
[152] Dynamic Spectrum Alliance, Assessing the economic value of unlicensed use of the 6 GHz band in Indonesia (October 2021), https://dynamicspectrumalliance.org/wp-content/uploads/2022/02/Assessing-the-economic-value-of-unlicensed-use-of-the-6GHz-band-in-Indonesia.pdf.
[153] Communications Authority, Dynamic Spectrum Access Framework for Authorization of the Use of TV White Spaces May 2021, https://www.ca.go.ke/wp-content/uploads/2022/09/Public-Version-Spectrum-Asignment-and-Allocation-Report-4th-Quarter-April-June-2022.pdf
[154] Ibidem, p. 1.
[155] Interview with Dirk Jan Koeman, CEO, Poa Internet, October 18, 2022.

4. Nigeria

4.1. Introduction

Nigeria is the most populous country in Africa, with over 220 million inhabitants.[156] Like many large developing economies, Nigeria faces numerous macroeconomic challenges in the wake of the pandemic-induced recession in 2020, including high inflation, global commodity shocks, and increased poverty rates. However, there is reason for optimism as World Bank estimates project an average gross-domestic product (GDP) growth of more than 3% from 2022-2024.[157]

Nigeria's information and communications technology (ICT) sector has experienced significant growth, with the share of the population using the Internet tripling between 2010 and 2020 (12% to 36%).[158] The Nigerian Communications Commission (NCC) is responsible to support the public policies that aim to advance Nigeria's position in the global digital economy, such as the Federal Ministry of Communications and Digital Economy (FMoCDE) development of the Nigerian National Broadband Plan 2020-2025 and the National Digital Economy Policy and Strategy 2020-2030, discussed further in section 0.

144 /179

Nigeria's **median fixed broadband speed (12.2 Mbps)** ranks in the bottom quartile of countries globally according to Ookla data as of January 2023.

160 /177

The 2021 **cost of fixed broadband services (21.5% of Gross National Income per capita)** in Nigeria ranks among the most expensive globally according to ITU data.

In Nigeria, an Internet connection with a minimum download speed of 1.5 Mbps is considered a broadband connection.[159] Fixed broadband penetration reaches only 0.03% of households, far below the Organisation for Economic Co-operation and Development (OECD) average of 34.4%. It lags the average penetration observed in Sub-Saharan Africa (0.6%), as well as comparable countries such as South Africa (0.34%).[160] Notably, fixed broadband active subscriptions increased from 173,290 in December 2020 to 179,668 in 2021. Between December 2020 and December 2021, Fiber to Home subscriptions increased significantly from 14,706 to 18,590, although still low compared to peer economies.[161]

The relatively low fixed broadband penetration rate observed in Nigeria contrasts with a significantly higher rate of overall Internet use (36%) and broadband penetration (47%).[162] Fixed broadband services hold only a 0.05% market share among Nigerian users of telecommunications services, compared to the

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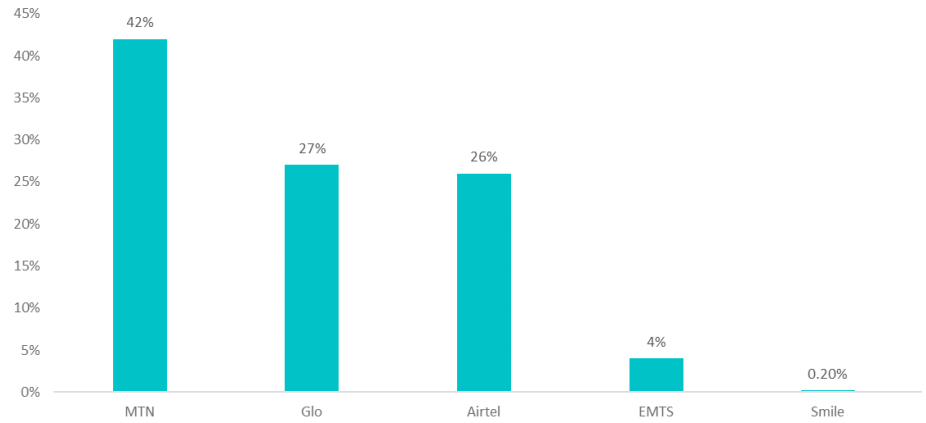
[156] IMF, Nigeria at a Glance, https://www.imf.org/en/Countries/NGA.
[157] World Bank, Nigeria country overview, https://www.worldbank.org/en/country/nigeria/overview
[158] World Bank, Individuals using the Internet (% of population) – Nigeria, https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=NG.
[159] Nigerian National Broadband Plan, https://www.ncc.gov.ng/documents/880-nigerian-national-broadband-plan-2020-2025/file
[160] World Bank, Fixed broadband subscriptions (per 100 people) – Nigeria, https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=NG; OCDE data, Fixed broadband subscriptions, https://data.oecd.org/broadband/fixed-broadband-subscriptions.htm; data from the Sub-Saharan region from the Word bank data https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=ZG-KE-NG-ZA; ICASA, State of ICT Sector Report March 2022, section 4.4 https://www.icasa.org.za/legislation-and-regulations/state-of-the-ict-sector-in-south-africa-2022-report
[161] NCC, Year-end subscriber/network data report, 2021, section G, https://www.ncc.gov.ng/docman-main/industry-statistics/policies-reports/1075-2021-year-end-subscriber-network-data-report-1/file
[162] NCC, Industry statistics, https://www.ncc.gov.ng/statistics-reports/industry-overview#view-graphs-tables-4

mobile market share of 99.84%, as of December 2022. By the third quarter of 2022, 4G mobile coverage reached 78.7% of Nigeria's population, while 3G coverage reached 86.8%.[163]

Despite the growing coverage of mobile networks, adoption remains a challenge. Less than half (45.5%) of individuals with coverage are currently connected.[164] On the other hand, data usage is significant. For example, the mobile operator MTN reports an average monthly data usage of 7.1 GB from its data active subscribers (39.5 million).[165]

The Nigerian mobile broadband market is relatively competitive. It has national players, but is led by three large operators: MTN, Glo, and Airtel. MTN is the dominant operator with 42% of the market share, followed by Glo and Airtel with 27% and 26% respectively. The other two players, EMTS and Smile, have much smaller market shares -- 4% and 0.2%, respectively.[166]

Figure 5: Mobile broadband market share



Source: NCC.

In the fixed broadband market, Spectranet is the largest operator with 115,103 active subscriptions as of the third quarter of 2022 – accounting for 56% of the active fixed broadband subscriptions reported by the NCC.[167] Other fixed broadband operators include Tizeti (8.9%), Astramix (7.3%), and ipNX (6.4%). A detailed discussion of the fixed broadband market characteristics and business models of Internet Service Providers (ISPs), including Wireless Internet Service Providers (WISPs), is provided in section 3.2.

This report examines the challenges and opportunities for developing the WISP market in Nigeria, providing recommendations to foster future growth given their importance in supporting the overall broadband market in expanding coverage, increasing affordability, and enhancing competition. Given the relatively low size of the fixed broadband market, including WISP market, interviews were hard to obtain with operators often hesitating to share information. Fixed broadband market in Nigeria remains as a

[163] Project Management Office (PMO) Q3-2022 Report to the Broadband Implementation Steering Committee (BISC), December 2022

[164] Project Management Office (PMO) Q3-2022 Report to the Broadband Implementation Steering Committee (BISC), December 2022

[165] MTN Nigeria, Investor presentation 2022, https://www.mtn.ng/wp-content/uploads/2023/02/MTN-Nigeria-Investor-Presentation-FY-2022.pdf

[166] NCC, Year-end subscriber/network data report, 2021, section G, https://www.ncc.gov.ng/docman-main/industry-statistics/policies-reports/1075-2021-year-end-subscriber-network-data-report-1/file

[167] NCC, Statistics & Reports Subscriber Data, Q3 2022, https://www.ncc.gov.ng/statistics-reports/subscriber-data#internet-service-operator-data

niche market with small sized operators providing services to specific sectors and few offering services to the public.

4.2. WISP market analysis

Currently, a small number of medium-size players dominate the Nigerian Internet market. However, Spectranet, as noted above, controls over half of the fixed Internet services market (56%). The Nigerian government has been trying to increase access to Internet services in the country. It set a target of 70% broadband penetration by 2025 and has implemented policies to increase Internet access in rural and underserved areas.[168] However, the market has encountered challenges, including a lack of infrastructure, particularly in rural areas, and unreliable and expensive electricity.

Despite these challenges, the Nigerian Internet market is expected to continue to grow in the coming years, driven by increasing demand and the government's efforts to increase access to Internet services in the country, including supporting WISPs, as outlined in its National Broadband Plan.

4.2.1. Market and business model review

Most Internet providers' business models are currently focused on deploying fiber-to-the-home (FTTH) connections in and around major metropolitan areas. WISPs typically complement this fiber connectivity with wireless access technology for the last-mile connection. Since 2017, the majority of Nigeria's population is concentrated in urban areas, a rate that has continued to grow steadily with 53% of the population living in urban centers as of 2021.[169] This urbanization trend provides an opportunity for WISPs to continue deployment in urban and suburban areas.

However, the current growth trajectory of WISPs indicates that there is room for improvement in both the number of operators and subscribers. According to NCC data, the total number of registered Internet providers has decreased since its peak of 170 in 2018. To better understand the reason for this decrease, the NCC developed a study focused on the challenges of Internet providers licensees in the Nigerian telecommunications market. The study identified the following main challenges faced by ISPs, including WISPs:[170]

- Competition with MNOs offering mobile broadband Internet services;
- Difficult business environment;
- Inadequate backhaul infrastructure;
- Multiple taxation; and
- Vandalization of infrastructure.

WISPs typically serve suburban areas that are not fully served by mobile 3G/4G networks. Fixed broadband connections are targeted to customers and enterprises that need a faster and more reliable Internet connection than those offered by mobile broadband networks. In dense urban areas, WISPs have

[168] Nigerian National Broadband Plan, https://www.ncc.gov.ng/documents/880-nigerian-national-broadband-plan-2020-2025/file

[169] World Bank, Urban population (% of total population) – Nigeria, https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=NG

[170] NCC, an exploratory study on the challenges and survivability of ISP licensees in the Nigerian telecom sector, 2020, https://www.ncc.gov.ng/docman-main/research-development/978-study-on-the-challenges-and-survivability-of-isp-licensees-in-the-nigerian-telecom-sector/file

limited ability to compete with offerings from large providers, given the difficulties in deploying fiber connections and the high prices associated with accessing existing fiber deployments.[171]

Some of the existing providers in Nigeria indicated that the main driver for attracting clients is price. In this regard, WISPs have been able to compete by providing low-price offerings, such as daily subscriptions for open Wi-Fi spots in highly transited areas.[172] Typical download speeds available from a WISP range between 5 and 20 Mbps, with some offerings available for lower throughput plans, down to 0.5 Mbps.[173] The differences in the offer depend mainly on the community and type of customer being served.

4.2.1.1. Neutral networks

A key goal of the Nigerian National Broadband Plan is the deployment of 120,000 km of open access shared fiber infrastructure by 2025, to support the government's broader goals of increased connectivity around the country. The Plan also identifies specific goals and metrics to provide fiber connectivity to public institutions such as hospitals, schools, and local governments.

Achieving the Plan's 2025 fiber deployment has proven challenging. In terms of overall deployment, the Plan set an intermediary goal of 90,000 km of fiber deployment by 2023. As of the third quarter of 2022, only 52,000 km of fiber (58% of the 2023 goal and 43% of the 2025 goal) were successfully deployed.[174] Significant gains have been achieved in connecting educational institutions, but efforts to connect health and local government facilities have fallen short of government goals.

Uncertainty exists regarding how the government will manage the neutral fiber network in Nigeria. As the deployment is a joint public-private effort, details about the management, access, and quality of service (QoS) policies, prices and other essential factors remain unclear for WISPs.

Currently, small Internet providers face challenges regarding costs and the possibility of accessing backhaul services using fiber. An extension of the public backbone fiber network, as proposed by the National Broadband Plan, and facilitating access for all players (e.g., improving the regulation regarding the access and prices), would be important for Internet providers to expand their coverage beyond urban and suburban areas, and to compete with offerings and prices.

4.2.2. WISP coverage

As noted above, most WISP coverage areas are in major cities and suburban areas. This reality is consistent with the urbanization trend in Nigeria and the persistent income gap between rural and urban areas.[175] While some WISPs provide services in rural areas, these operators note that there is a considerable service gap in these areas due to the significant level of investment and required permits, as well as the overall cost of deploying a network in Nigeria.[176]

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[171] Interview with Lawrence Alele, CEO Brass Wave.
[172] See for example the Tizeti offer using over 5,000 public Wi-Fi hotspots in Lagos and Abeokuta. See www.wifi.com.ng
[173] NCC, Year-end subscriber/network data report, 2021, section B, e., https://www.ncc.gov.ng/docman-main/industry-statistics/policies-reports/1075-2021-year-end-subscriber-network-data-report-1/file
[174] Project Management Office (PMO) Q3-2022 Report to the Broadband Implementation Steering Committee (BISC), December 2022
[175] The World Bank, Urban population (% of total population) – Nigeria, https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=NG
[176] Interview with CEO Cyberspace.

4.2.2.1. WISPs use of fiber networks

Various stakeholders have noted a trend of migration from wireless solutions to fiber. Wireless technology, using both licensed and license-exempt bands, is largely limited to less dense areas where the business case is still developing, or to specific applications such as enterprise solutions.

The trend towards fiber is driven by numerous factors, such as the concentration of the population in urban areas, the capacity of fiber optics to improve offers to customers with minimal investment compared to wireless solutions, and the difficulty of accessing unlicensed spectrum given the congestion and aggregate interference that WISPs experience in license-exempt bands.[177]

4.2.2.2. Targeted support for WISPs

There is no evidence of government initiatives specifically designed to support and promote the growth of WISPs in Nigeria. According to various stakeholders, including those that have not initiated commercial operations yet, it is difficult to access funding from the Universal Service Provision Fund (USPF).[178] To date, the funding for universal service access has been focused on subsidizing initial capital expenditure (CAPEX) for deploying networks in the context of two main projects to connect rural areas: the Rural Broadband Initiative (RUBI) and Community Resource Centres (CRC). The RUBI project aims to provide wholesale wired and wireless broadband Internet in rural areas. According to information from the USPF, there has been no advance on the coverage from the RUBI project since 2020. [179]

It would be helpful for the government to consider expanding USPF subsidies to service provision.[180] A recent example can be found in Brazil regarding recent efforts to connect 8,000 public schools. To achieve this goal, the government intends to award contracts to individual ISPs for each school (rather than one large contract for all schools) to encourage the participation of small and local providers.[181]

Nigeria's Small and Medium Enterprises Policy

In 2021, the Small and Medium Enterprise Development Agency of Nigeria (SMEDAN) published a revised National Policy on Small and Medium Enterprises (2021-2025). This policy seeks to provide incentives to foster the growth of small and medium-sized enterprises (SMEs) in Nigeria. Guaranteed access to an Internet connection can be as crucial to a Nigerian SME as access to electricity. In this sense, the updated policy mentions the importance of digitalization and the use of e-commerce tools to facilitate the expansion and sustainability of SMEs in Nigeria. The policy also highlights the role of digitalization in innovation and the consequential creation of new companies and business models.[182]

One of the main targets for WISPs is providing Internet services to SMEs, as professional clients tend to be more stable customers, and WISPs aim to create a long-lasting relationship with these companies. Under the Micro and Small Enterprises Policy, the NCC, as well as the USPF, could design projects and incentives to help with WISP sustainability by, for example, subsidizing Internet connections for SMEs. These focused subsidies work in two ways: helping SMEs grow and compete, and helping WISPs be more sustainable in improving their offerings.

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[177] Interview with APC.
[178] Interview with Lawrence Alele, CEO Brass Wave.
[179] Universal Service Provision Fund (USPF), RUBI Initiative, https://www.uspf.gov.ng/projects/rubi and CRC Initiative.
[180] Interview APC.
[181] ABRINT, EACE invites regional providers to pilot project (August 23, 2022), https://www.abrint.com.br/noticia/eace-convida-provedores-regionais-para-projeto-piloto.
[182] Small and Medium enterprise development agency of Nigeria (SMEDAN), Small and Medium Enterprises policy (2021-2025), https://smedan.gov.ng/images/PDF/MSME%20National%20Policy%20(2021%20-2025%20Latest%20Review).pdf

In line with the Small and Medium Enterprises Policy, one example of a regulatory initiative that can benefit WISPs is the introduction of specific provisions in Nigeria's telecommunications licensing framework oriented to foster the WISP market.

Given the industry transversal impact of the access to broadband for SMEs, the Nigerian government could consider creating a specific incubation strategy for WISPs to help accelerate the growth of the Internet provider ecosystem.

4.2.3. Community networks

Community networks are a subset of Internet providers that often seek sustainability over profitability, targeting their services to the bottom of the pyramid in rural and remote areas. While other countries in the region have dedicated policies to support community networks, no specific regulatory framework in Nigeria exists for these providers.

Since 2020, the Association for Progressive Communications (APC) has worked with the Center for Information and Technology adoption (CITAD) in a two-tier model to support community networks: (1) a national outlook where partners focus on developing the capacity of existing or potential new community networks; and (2) assisting community-level organizations that are interested in running or supporting community networks.[183]

APC indicates that the number of community network projects in Nigeria is low, and that these providers face challenges such as the affordable access to backhaul networks and passive infrastructure.

Additionally, a key challenge faced by community networks in comparison with WISPs more broadly is a lack of technical skills and training. To address this skills gap, APC is providing technical and business training to provide community network staff with the necessary skills to ensure the sustainability of the community networks.

4.2.4. Access to funding

For most WISPs, access to funding is a core challenge. As there is no targeted public support for WISPs from the USPF or specific banking products, the only option to date beyond self-funding has been foreign intervention or ICT funds. Most of the funding for ISPs is self-provided or investor driven. As such, funding for smaller providers remains a challenge. For example, banks typically accept only traditional guarantees such as real estate to access loans, and banks also usually reject business cases with which they are unfamiliar.

4.2.5. Internet provider's associations

There is no formal industry association or advocacy group in Nigeria specifically for WISPs. However, two broader industry groups, the Association of Licensed Telecoms Operators of Nigeria (ALTON) and the Association of Telecom Companies in Nigeria (ATCON) have Internet providers of various sizes as members.

ALTON is a registered corporate entity in Nigeria that focuses on advancing the interests of telecommunications service providers and related businesses.[184] Its membership includes all major telecommunications licensees providing voice and data services (such as MTN and Airtel) and numerous value-added service providers. ALTON works to foster productive engagement between the telecom

[183] Interview with Mike Jasen and Josephine Miliza, APC. March 23, 2023.
[184] ALTON, About Us, https://www.alton.org.ng/about.html

sector and regulatory authorities, as well as among the telecom providers themselves.[185] The association hosts trainings, workshops, and conferences on telecommunications policy issues. Additionally, it provides support for companies in managing Nigeria's telecommunications regulatory requirements and in accessing funding sources.

ATCON is a non-profit organization formed in 1993 to promote the growth of the Nigerian telecom industry. It serves as a convening organization for the ICT sector that fosters strategic policy advocacy on key issues of interest to its membership. ATCON has worked cooperatively with ALTON, the NCC, and other stakeholders on initiatives such as a 2021 event celebrating the 20th anniversary of the liberalization of Nigeria's telecommunications market.[186]

Despite the progress made by these institutions, a gap remains in the advocacy landscape regarding WISPs' particular interests. Bigger associations sometimes experience challenges tied to the diversity of their members' interests, leading them to remain silent about certain issues. Examples of strong WISP associations can be found in South Africa with the Wireless Access Providers Association of South Africa (WAPA) and the South African Black Internet Service Providers' Association (SIBISPA). The Indonesian Internet Service Provider Association (APJII for its acronym in Indonesian) is also a good example. In the case of Indonesia, APJII even develops projects such as deploying and managing Internet exchange points (IXP) that facilitate local traffic exchange, reducing latency and costs for ISPs.

4.3. Regulatory framework status

Nigeria has adopted what is referred to as a technology-neutral Unified Licensing Framework (ULF) for ICT networks and services. However, in practice, the framework functions as a hybrid multi-service and service-specific licensing regime with multiple license categories and sub-categories.

4.3.1. Telecommunications regulatory framework

In Nigeria, the licensing framework for Internet providers and other telecommunications service providers is governed by the NCC under the Nigerian Communications Act 2003. NCC is responsible for issuing licenses to ISPs, including WISPs, as well as regulating the broader telecommunications industry in the country.[187]

Licensing for Internet providers in Nigeria falls under the category of individual licenses. As opposed to class licenses, where terms and conditions are common to all license holders, individual licenses are specific to the service being provided.

The fees associated with licensing include an NGN 1,000 (~USD 2) application fee and an NGN 500,000 (~USD 1,100) validity fee for a 5-year license. A 5% licensing fee is assessed on submission of the form. There are extensive information requirements when applying for a license that may pose a challenge for small providers.[188]

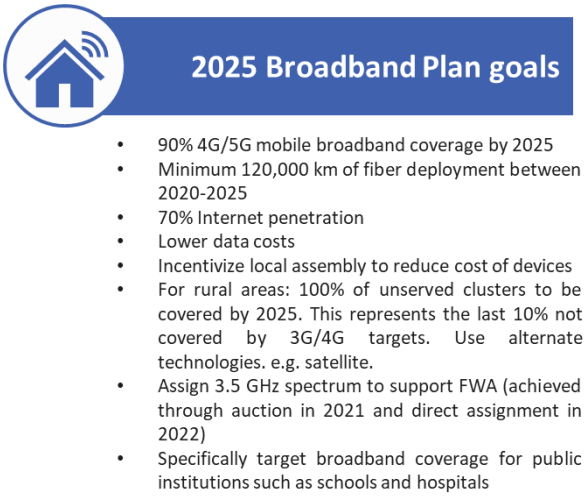
In addition to the license fees, Internet providers are also required to pay annual regulatory fees to the NCC, which are based on the number of subscribers and the type of license held. Furthermore, they are

[185] ALTON, Objectives, https://www.alton.org.ng/objectives.html
[186] Vanguard, ATCON, ALTON partner DigiVation Network on telecom revolution @ 20, October 5, 2021, https://www.vanguardngr.com/2021/10/atcon-alton-partner-digivation-network-on-telecom-revolution-20/
[187] Nigerian Communications Act 2003, https://www.ncc.gov.ng/licensing-regulation/legal/nca-2003.
[188] NCC, Form AP.01/IL, https://www.ncc.gov.ng/docman-main/licensing-application-forms/881-individual-license-application-form-4/file

also required to comply with technical and operational standards, as well as adhere to consumer protection regulations.

National Digital Economy Policy and Strategy 2020-2030

The previous Federal Ministry of Communications was redesignated as the Federal Ministry of Communications and Digital Economy (FMoCDE) in late 2019 to reflect the government's growing focus on fostering growth driven by digital tools and technologies. One of its first activities in this regard was the development of a comprehensive ten-year National Digital Economy Policy and Strategy spanning from 2020-2030.[189] The policy includes sections focused on the key pillars of infrastructure deployment, digital inclusion, and support for small- and medium-sized enterprises (SMEs). In line with the Digital Economy Policy and Strategy, the NCC published the Nigerian National Broadband Plan, which outlines specific goals to increase nationwide connectivity and coverage.[190]



4.3.2. Spectrum regulatory framework

In Nigeria, the NCC is responsible for the spectrum management framework and spectrum regulation. It is responsible for the assignment of the country's radio frequency spectrum, and issues licenses to operators for the use of specific frequencies.

The NCC assigns spectrum to mobile operators through a combination of auctions, beauty contests, and administrative allocation. The Nigerian government has highlighted the importance of identifying and assigning new spectrum for next-generation telecommunications services through various policy

3.5 GHz assignments

In December 2021, the Nigeria held a spectrum auction offering 2x100 MHz blocks in the 3.5 GHz band. Two of the three qualified bidders (Mafab Communications Limited and MTN Communications Nigeria Limited) were awarded 100 MHz each. MTN began offering commercial 5G services in September 2022, while Mafab received a five-month extension on its deployment commitments and began offering 5G services in January 2023.[191] The NCC had also intended to offer two remaining 100 MHz blocks in the 3.5 GHz band through a second auction process in December 2022, however, only one bidder (Airtel) qualified within the designated timeframe.[192] As a result, Airtel was awarded one of the blocks without going through the auction process. All spectrum rights-holders have committed to specific rollout obligations and timelines in an effort to advance the government's goal of expanding 5G connectivity across the country.

[189] See: https://www.ncc.gov.ng/docman-main/industry-statistics/policies-reports/883-national-digital-economy-policy-and-strategy/file

[190] NCC, National Broadband Plan 2020-2025, https://www.ncc.gov.ng/documents/880-nigerian-national-broadband-plan-2020-2025/file

[191] Comms Update, Mafab rolls out 5G services in Abuja, January 23, 2023, https://www.commsupdate.com/articles/2023/01/25/mafab-rolls-out-5g-services-in-abuja/?utm_source=CommsUpdate&utm_campaign=75462a5c2f-CommsUpdate+25+January+2023&utm_medium=email&utm_term=0_0688983330-75462a5c2f-11667217.

[192] Comms Update, Airtel is sole bidder in Nigeria's second 3.5GHz auction, December 8, 2022, https://www.commsupdate.com/articles/2022/12/08/airtel-is-sole-bidder-in-nigerias-second-3-5ghz-auction/.

documents and activities such as the recent 3.5 GHz 5G spectrum assignment processes (see breakout box below).

The NCC also enforces strict regulations to ensure that operators are using the allocated spectrum efficiently and that there is no interference among different operators.[193] Operators are required to comply with technical standards set by the NCC and provide regular reports on their spectrum usage. The NCC has the power to revoke licenses or impose fines on operators that violate spectrum regulations.

In 2021, in response to a request from the telecommunications industry, the NCC introduced the Proof of Concept (PoC) trial license to allow a three-month, non-commercial operation that aims to demonstrate the viability of new technologies and services in certain frequency bands.[194] PoC trial licenses also incur associated spectrum fees.

4.3.2.1. Unlicensed spectrum use

In Nigeria, WISPs report extensive use of the license-exempt 2.4 GHz and 5 GHz bands. The NCC has developed guidelines for the use of those bands for the deployment of wireless access systems (WAS) in the country.[195] In Nigeria, the use of the 5.47-5.725 GHz band is designated for unshared, coordinated, and protected use of WAS, while the frequency ranges 5.25-5.35 GHz and 5.725-5.8 GHz are unlicensed. Neither the NCC nor the Internet providers have expressed any difficulty with the use of the unlicensed bands.[196]

In 2019, the NCC presented a draft with proposed updates to the guidelines for the use of the 2.4 GHz and 5 GHz bands aiming to accommodate technical parameters that allow the use of drones in such bands.[197]

WISPs have stated that using the full range of the 6 GHz band, including for standard power applications, would provide room for future growth both in the subscriber base and their capacity to compete by improving their offers to consumers.[198] Estimates suggest that the cumulative economic value between 2021 and 2030 associated with enabling license-exempt access to the 1200 MHz in the 6 GHz band in Nigeria would amount to USD 72.14 billion, comprised of USD 49.89 billion in GDP contribution, a USD 10.51 billion producer surplus to Nigerian enterprises, and USD 11.74 billion in consumer surplus to the Nigerian population.[199]

For comparison, countries such as Brazil, Saudi Arabia, and United States made the entire 5925-7125 MHz band available for unlicensed use, starting with the LPI and VLP use cases. Regulation of the use of standard outdoor power is under development as regulators continue exploring the technical

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[193] NCC, Frequency Spectrum General Conditions, https://www.ncc.gov.ng/docman-main/licensing-documents/909-frequency-spectrum-general-conditions/file

[194] Nigeria Communications Week, NCC provides insight over PoC trial license application, April 23, 2021, https://www.nigeriacommunicationsweek.com.ng/ncc-provides-insight-over-poc-trial-license-application/

[195] NCC, Regulatory guidelines for the use of 2.4 GHz ISM band for commercial telecom services, https://ncc.gov.ng/accessible/documents/64-guidelines-for-deployment-of-wifi-services/file and NCC, Regulatory guidelines for deployment of broadband services on the 5.2-5.9 GHz band, https://ncc.gov.ng/accessible/documents/59-guidelines-for-deployment-of-broadband-services-on-the-5-2-5-9ghz-band/file

[196] NCC, Regulatory guidelines for deployment of broadband services on the 5.2-5.9 GHz band, https://ncc.gov.ng/accessible/documents/59-guidelines-for-deployment-of-broadband-services-on-the-5-2-5-9ghz-band/file

[197] NCC, NCC Consults Stakeholders on Drones Deployment Regulation in Nigeria, 2019, https://ncc.gov.ng/accessible/media-centre/news-headlines/757-ncc-consults-stakeholders-on-drones-deployment-regulation-in-nigeria

[198] Interview with Joe Onwubuya, CEO Cyberspace. February 22, 2023.

[199] Dynamic Spectrum Alliance, Assessing the economic value of unlicensed use of the 6 GHz band in Nigeria (September 2021), https://dynamicspectrumalliance.org/wp-content/uploads/2022/02/Assessing-the-economic-value-of-unlicensed-use-of-the-6GHz-band-in-Nigeria.pdf

measurements to protect incumbent services. The capacity of implementing Wi-Fi 6E and Wi-Fi 7 in both indoor and outdoor environments would increase options for consumers and enterprises to develop or access advanced Internet solutions that will complement the offers from mobile technologies such as 4G and 5G.

4.3.2.2. Other frequency bands used by WISPs

Cyberspace, one of the biggest corporate ISPs in Nigeria, recently migrated from the 3.5 GHz band to the 2.3 GHz band.[200] Currently, Cyberspace reports more than 2,000 clients connected using wireless solutions in 2.3 GHz, although the band's migration was a long process as the operator claimed they did not have any support from the government.

Also, Tizeti, a provider that describes itself as a pioneer solar-based Internet provider, is rolling out its FWA LTE network in the 3.5 GHz band.[201] Tizeti will deploy an LTE Fixed Wireless Access (FWA) solution to deliver premium Internet and Virtual Private Network (VPN) services to residential customers as well as SMEs.[202]

In March 2020, the NCC published an addendum to the proposed guidelines for the use of Television White Spaces (TVWS) for rural broadband connectivity in Nigeria.[203] Such guidelines were developed in conjunction with the National Broadcasting Commission (NBC). In particular, the guidelines provide the regulatory framework to allow the use of TVWS in the 470-694 MHz UHF band, allocated to broadcasting services on a primary basis. The framework allows white space devices (WSDs) to access the 470-694 MHz UHF band on a non-protected, non-interference basis.[204] However, to date, there is no formal issuance of the final guidelines from NCC.

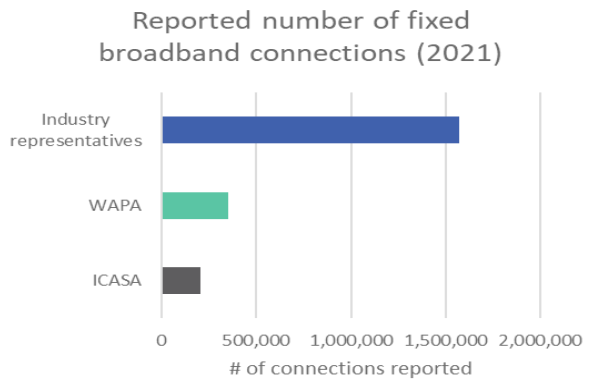
[200] Interview with Joe Onwubuya, CEO Cyberspace. February 22, 2023.
[201] See https://developingtelecoms.com/telecom-business/operator-news/14537-tizeti-brings-lte-to-ten-more-nigerian-states.html
[202] See https://www.tizeti.com/tizeti-selects-nokia-lte-fixed-wireless-access-solution-for-high-speed-internet-services-in-nigeria/
[203] NCC, Addendum to the Draft Guidelines on Use of Television Whitespace (TVWS) in Nigeria, https://www.ncc.gov.ng/docman-main/legal-regulatory/guidelines/draft-guidelines/879-addendum-to-the-draft-guidelines-on-use-of-television-whitespace-tvws-in-nigeria/file
[204] Ibidem, p. 1.

5. South Africa

5.1. Introduction

South Africa is a key market in Africa, with the third largest nominal gross domestic product (GDP) on the continent.[205] However, based on predicted growth rates from the International Monetary Fund (IMF), South Africa is expected to grow only 1.4% in 2023. This is the second lowest in the Sub-Saharan region, above only Equatorial Guinea, while the highest projected GDP growth in the region is for Rwanda and Senegal (projected growth rates of 7.4% and 9.22% respectively). Poverty has reached levels not seen for more than a decade in South Africa, while inflation has increased to a 13-year high.[206]

South Africa's ICT sector continues to grow despite the broader economic slowdown, with an overall increase of 0.3% in total sector revenue, according to the 2022 State of the ICT Sector report published by the telecom regulator, the Independent Communications Authority of South Africa (ICASA).[207] Between 2020 and 2021, fixed broadband Internet connections decreased by 10.3% (from 232,108 to 208,152), resulting in a total penetration rate of 0.34%, trailing significantly when compared to OECD levels (OECD average is 34.4%), but consistent with the average of the Sub-Saharan region (0.6%) and similar countries such as Kenya (1.6%) and Nigeria (0.13%).[208] Notably, the data cited in official reports are far from the industry-provided numbers. According to industry players, fixed broadband connections are around 1.57 million, almost five times the reported connections in ICASA's latest report.[209] Further, data for 2021 from the Wireless Access Providers Association (WAPA, discussed further in section 3.2.5) industry group show an estimated 350,000 connections, 72% more than reported in ICASA data.[210]



The relatively low fixed broadband penetration rate observed in South Africa contrasts with a significantly higher rate of overall Internet use (68.2% of the population). ICASA reports that 4G mobile broadband coverage reached 97.7% of the population in 2021, with 5G already covering 7.5% of the population.[211] However, the same reports state that only 8.3% of households have Internet access at home.[212]

[205] IMF, World Economic Outlook database, https://www.imf.org/en/Publications/WEO/weo-database/2022/April
[206] World Bank, South Africa country overview, https://www.worldbank.org/en/country/southafrica/overview
[207] ICASA, State of ICT Sector Report March 2022, https://www.icasa.org.za/legislation-and-regulations/state-of-the-ict-sector-in-south-africa-2022-report
[208] OCDE data, Fixed broadband subscriptions, https://data.oecd.org/broadband/fixed-broadband-subscriptions.htm; data from the Sub-Saharan region from the Word bank data https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=ZG-KE-NG-ZA; Data from Kenya from the CA's Sector Statistics Report Q4 2021-2022, https://www.ca.go.ke/document/sector-statistics-report-q4-2021-2022/ ; and data from Nigeria from the NCC's Industry statistics, https://www.ncc.gov.ng/statistics-reports/industry-overview#view-graphs-tables-4
[209] See for example the Ookla report "South Africa Fixed Broadband Speeds Up as Fiber Takes Off", 2022, https://www.ookla.com/articles/south-africa-fixed-broadband-performance-fiber-q3-2022
[210] WAPA, Census report, October 2021.
[211] ICASA, State of ICT Sector Report March 2022, section 4.4 https://www.icasa.org.za/legislation-and-regulations/state-of-the-ict-sector-in-south-africa-2022-report
[212] Ibidem, section 2.

This fact is consistent with industry statements indicating that over 90% of homes in South Africa only access the Internet via mobile data, and that such connections are relatively expensive when considering the average income.[213] Even after South Africa's largest Internet service providers (ISPs) reduced prices by 50% in March 2020 due to a finding that data prices were some of the highest on the continent, the cheapest unlimited 4G broadband plan in the country still costs around ZAR 399 (USD 23.4), which is close to total monthly income for millions of South Africans who live at or below the poverty line.[214]

In this context, South Africa provides good examples on the importance of the ISPs. Some ISPs, in addition to providing connectivity via fiber, also use spectrum to provide the service. This type of provider is considered a wireless ISP (WISP). This case study examines the challenges and opportunities for developing the WISP market in South Africa, providing recommendations to foster future growth given their importance in supporting the overall broadband market in expanding coverage, increasing affordability, and enhancing competition.

5.2. WISP market analysis

This study integrates the research conducted with the results of several stakeholder interviews including government institutions, as well as ISP and WISP industry associations and providers (from medium size companies to small community networks). These interviews provide unique insights into the WISP market in South Africa, specifically regarding different business models, technological trends, and the challenges facing providers.

The ISP ecosystem commenced in South Africa after operators Vodacom and MTN launched their mobile networks in 1994. These networks proliferated and, in only three years, surpassed the number of subscribers of Telkom, the state-owned telecommunications company. Over the years, Telkom's fixed network using ADSL started becoming obsolete and incapable of meeting the demand for increased Internet speeds and availability. In this context, emerging ISPs saw an opportunity to replace deteriorating ADSL networks in towns and metro areas.

The ISP and WISP markets have also benefited from a relatively slow rollout of mobile broadband networks in South Africa. 4G networks were launched in 2013, only reaching nationwide coverage in 2017. For some time, WISPs were offering uncapped broadband access, which the mobile operators were unwilling to offer.

5.2.1. Market and business model review

WISPs have filled the gap left by the decommissioning of ADSL networks, most notably by deploying fiber-to-the-home (FTTH), particularly in and around major metropolitan areas. This focus on these areas is logical since South Africa is one of the most urbanized countries in Africa, with around 67% of its population living in urban areas and projected to increase to about 80% by 2050.[215]

Reliability is a persistent issue for mobile (and even fiber) networks in South Africa, especially during electricity load-shedding, and is impacted by widespread battery theft from base stations. WISPs have

[213] Tim Genders, Chief Executive of Isizwe and Small WISP. https://www.globalinnovation.fund/tackling-the-digital-divide-in-south-africa/

[214] According to the Southern Africa Labour and Development Research Unit (SALDRU), 21% of households have a monthly income of ZAR 496 or less. Using the A4AI metric of 5% of household income for internet connectivity, only 8% of households would find the ZAR 399 data plan affordable. See the income comparison at https://www.saldru.uct.ac.za/income-comparison-tool/ and the A4AI affordability metric at https://a4ai.org/affordable-internet-is-1-for-2/

[215] Urbanization in South Africa. UN Habitat. https://unhabitat.org/south-africa

effectively addressed these problems thanks to their knowledge of, and relationships with, local communities. In addition, WISPs are able to focus service and maintenance on fewer local sites, compared to larger competitors.

To be competitive with offers from larger telecommunications providers, many WISPs have shifted their business model from capped to uncapped data offerings.[216] Although uncapped, WISP data plans can be time based for residential customers (e.g., daily, or weekly), while a monthly subscription is typical for small and medium enterprises (SME) and other corporate customers. A WISP's average download data speed offer is between 5 and 20 Mbps with some offerings available for lower throughput plans, down to 2 Mbps. The differences in offers depend mostly on the community being served.

WISPs typically serve less densely populated areas that are not fully dominated by direct fiber subscriptions, filling the gap for customers and enterprises where fiber is absent. In dense urban areas, WISPs have limited ability to compete with offerings from large providers given difficulties in accessing fiber backhaul, especially from the pricing perspective, and problems related to congestion due to intensive use of the 5 GHz band.

Illegal providers

One aspect that WISP providers highlighted is the difficulty that they are having with unlicensed providers. WISPs of all sizes claim that ICASA has been ineffective in enforcing regulations to stop unlicensed providers. WISPs complain that these illegal providers create distortions in the market, by providing unrealistic offers to customers, using spectrum and other infrastructure (e.g., ducts) outside the regulation, crowding the spectrum (both licensed and unlicensed), and limiting the capacity for licensed providers to offer services and grow.

A key trend is that large providers (e.g., Vodacom and MTN) are starting to compete in the WISP market. For example, MTN Supersonic, the MTN fixed broadband business unit, has begun offering services in smaller towns and has the financial capacity to use state-of-the-art Fixed Wireless Access (FWA) equipment to reach markets previously served by WISPs to provide an improved offer for potential customers on a national basis.

Another business model gaining popularity is providing Internet services using Wi-Fi hotspots in areas of high population concentration, such as malls or taxi stands. This business model uses anchor locations, such as shops and small businesses, to sell daily low-price vouchers for accessing Internet services. For customers who spend time in these populated areas, this business model offers an affordable option to access to the Internet for at least part of the day.

WISPs and community networks have been able to compete in the South African market by providing customers with personalized service compared to the generic price-driven offerings made by large national competitors. Personalized offerings create a sense of exclusivity and attachment as customers (many of them SMEs, an essential target in this strategy) feel that they are an important client of a small company instead of being just one among thousands of clients of a bigger Internet provider.

5.2.1.1. Consolidation of the WISP market

The ISP and WISP market in South Africa is undergoing a significant consolidation phase. Perhaps the best example of concentration of the smaller ISP/WISP networks is the case of HEROTEL. Starting in 2015, HEROTEL has acquired over 33 smaller ISPs and WISPs, increasing its position in the market to over 100,000 subscribers, 80% of which are served by a fiber network.[217] Further to this process, in February

[216] Mobile operators offer Internet plans with a limited amount of data (cap) per period of time (typically a month). Fixed broadband Internet plans do not limit the amount of data and the differentiation occurs in the connection speed (Mbps).
[217] Interview with Eldred Ekermans, Chief Technology Officer, HEROTEL, October 12, 2022.

2022, Vumatel purchased 45% of HEROTEL and in August 2022, announced its intention to purchase 100% of HEROTEL. As a group (consolidating the HEROTEL subscriptions), Vumatel provides services to over 200,000 subscribers in South Africa.[218]

5.2.1.2. Neutral networks

Privately-owned neutral fiber optic networks are gaining in popularity and inspiring innovative business models in South Africa. Neutral networks allow various local providers, including WISPs, to access shared fiber infrastructure, presenting new opportunities for the supply of wholesale fiber capacity in the market. Current wholesale fiber networks providing capacity for WISPs in South Africa include OpenServe (a subsidiary of Telkom) and Liquid Telecom.

Telkom established OpenServe as a wholesale fiber subsidiary in 2015 to compete more effectively with an existing fiber network that expanded in metro areas. OpenServe was established as part of a settlement between Telkom and South Africa's competition commission in 2013. It operates more than 160,000 km of fiber, and recently underwent a legal and structural separation from Telkom.[219]

Liquid Telecom operates in various countries in Africa and owns the largest independent fiber network in the South Africa, with over 100,000 km of fiber deployed. Liquid's networks offer connectivity to all the main subsea cable systems that connect Africa. It was also the first company to establish a direct terrestrial communication link between Cape Town in South Africa, and Cairo in Egypt.

Other examples of privately-owned neutral networks include Rush, which provides services in many densely populated areas, and jenny.Africa, which offers services in smaller rural areas and across borders.[220]

To supplement these privately owned and operated networks, in May 2021, the government announced the merger of public entities Broadband Infraco (BBI) and SENTECH to create the State Digital Infrastructure Company (SIDC). SIDC will provide wholesale telecom and broadcasting services to the South African market. According to the government, the merger will be concluded at the end of 2023.[221]

From publicly available data and the information obtained through interviews, it is possible to conclude that ISPs have enough offerings and possibilities to access fiber wholesale backhaul in urban and suburban areas. The challenges remain around access and pricing in rural areas, as discussed further in section 3.2.3.

5.2.2. WISP coverage

The Wireless Access Providers Association of South Africa (WAPA) maintains data on their members' coverage and service areas.[222] Most WISPs are focused in suburban areas and major cities. This market reality is consistent with the urbanization trend in South Africa and the persistent income gap between rural and urban areas.[223] This coverage concentration could also be a consequence of the limited capillarity of existing fiber optic networks.

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[218] See https://vxfiber.com/projects/south-africa-vumatel/
[219] See https://mybroadband.co.za/news/fibre/455229-openserve-to-separate-from-telkom.html
[220] See more information at http://jenny.africa/
[221] See https://pmg.org.za/committee-meeting/32617/
[222] See https://wapa.org.za/members-list
[223] Statistics South Africa, Inequality Trends in South Africa A multidimensional diagnostic of inequality, 2019, Table 4.1.6, https://www.statssa.gov.za/publications/Report-03-10-19/Report-03-10-192017.pdf

5.2.2.1. WISPs and their use of fiber networks

Numerous stakeholders have noted a migration trend from wireless solutions to fiber. This trend could be explained by a number of factors, such as the concentration of the population in urban areas, the difficulties and cost of obtaining spectrum licenses in bands suitable for FWA, the capacity of fiber optics to improve offers to customers with minimal investment when compared to wireless solutions, and the difficulty of accessing unlicensed spectrum given the congestion and aggregate interference that WISPs experience.

According to several WISPs, fiber has become the technology of choice even for localities with 300-500 potential customers. Most of these companies are focusing their expansion efforts on fiber networks. In fact, one WISP noted that, although it is possible to obtain funding for FTTH-based network expansion, it is almost impossible to find funding for wireless-based networks.

5.2.3. Targeted support for WISPs

Our research found no evidence of government initiatives specifically designed to support and promote the growth of WISPs in South Africa. The Universal Service and Access Fund (USAF), managed by the Universal Service and Access Agency of South Africa (USAASA), has historically faced difficulties in dispersing its funds. USAASA was first created in 2005, with modifications to its duties in 2014 mainly to facilitate the distribution of the USAF funds. Since then, WISPs have not seen specific USAF projects or initiatives to support the growth and development of their market.

According to various stakeholders, it would be beneficial for the USAF to target funding to small, medium, and even large providers. The funding to date has been focused on subsidizing initial capital expenditure (CAPEX) for deploying the networks. Sometimes, such subsidies might mask sustainability issues such as the business outlook, competition in the area, and other threats to the business that funded operators might miss.

It would be helpful for the ecosystem for USAASA to consider expanding USAF subsidies to service provision rather than simply network deployment. For example, one of WISP's main target markets is SMEs. SMEs tend to be more stable, creating a long-lasting relationship with their ISPs, and value the quality and stability of the service, an aspect where mobile networks struggle to compete. USAASA could consider providing funding to WISPs by subsidizing the SME's connections. These subsidies can significantly impact the SMEs' performance and ability to create new business and service models.

USAASA could also allocate USAF resources to rural WISPs and community networks while looking for productive projects (e.g., agriculture) to benefit specific economic sectors and facilitate the growth of ISPs in areas where the market might not be large enough for providers to grow.

Government provision of mobile data

According to local news reports, the Minister of Communications indicated that the government intends provide a free 10 GB Internet connection for every household in South Africa, regardless of income.[224] The Minister compared Internet access with access to other utilities such as electricity and water.

The project of delivering 10 GB of free data to citizens could be done using small ISPs in individual contracts around the country. Having multiple contracts to provide free Internet services may carry an administrative burden but will aid in establishing a sustainable WISP ecosystem. Still, the benefits of improving competition in the market, promoting local economies (including Black-owned entities, as per

[224] https://mybroadband.co.za/news/broadband/434032-free-wi-fi-and-internet-grants-south-africas-big-broadband-plans.html

government policy), and creating local jobs could be greater than the costs, given WISPs local and community focus in South Africa.

SA Connect Phase 2

SA Connect Phase 2 aims to connect government facilities at 10 Mbps, with upgrades to 100 Mbps and up to 1 Gbps for specific locations, and to provide public Wi-Fi hotspots to underserved communities that provide a minimum throughput of 5 Mbps. South Africa's Department of Communications published a presentation highlighting the economic opportunity for SMEs with the implementation of SA Connect Phase 2. It identifies WISPs as part of achieving the plan's goals, aiming to connect communities and public institutions within the next three years. The main objectives of the project are:

- Telecom operators licensed by ICASA will connect 18,036 schools, 3,873 health facilities, and 8,241 tribal authority sites within 36 months from the date of licensing;
- Broadband Infraco (BBI) and Sentech (SDIC), working with the (SITA) and the ICT industry under an Open Access Principle, will facilitate the connection of South African communities and homes to the Internet; and
- BBI, Sentech (SDIC) will provide 840 Open Access Base stations and 33,539 community Wi-Fi hotspots to serve 5,830,208 households, via WISPs, other ISPs, and MVNOs;[225]

5.2.4. Community Networks

One type of WISP that can bring both economic and social benefits is community networks. A key defining characteristic of community networks is that is that they seek sustainability over profitability, targeting their services to the bottom of the pyramid in rural and remote areas. Almost all community networks are WISPs, as rural communities are often separated from fiber infrastructure where wired solutions are more expensive. Community networks have not seen targeted support from municipalities to provide connectivity. According to some stakeholders, municipalities could play a more active role in facilitating and promoting the entry of WISPs and community networks as an important component of the local economy.

One of the main challenges identified by rural providers is that the cost of access to fiber increases with the distance from fiber nodes typically located in urban areas. This is not a problem for most WISPs, given that their focus is on urban and suburban areas. However, for community networks and WISPs providing services in remote areas, the incremental cost due to the distance to the fiber nodes impacts the price for the end user and strains the financial sustainability of WISPs in such remote areas. Backhaul connectivity remains a significant challenge for most rural WISPs and community networks.

On the access side, community networks usually rely on Wi-Fi as the access layer. Such networks may struggle with limited range when trying to reach wider areas in rural and remote localities. Solutions such as mesh Wi-Fi networks can help solve the coverage problems, though these in turn add complexity to network deployment and maintenance. Still, the use of unlicensed spectrum (such as the 5 GHz and 6 GHz bands) has the potential to significantly benefit current and future connectivity offers to rural communities.

[225] According to their mandate, the State Information Technology Agency (SITA) will provide services to 14,742 public buildings based on existing initiatives and new services to 949 libraries and Thusong Centres.

Another key challenge faced by community networks in comparison with WISPs more broadly is a lack of technical skills and training. To address this skills gap, universities, institutes, associations, and even WISPs could work to provide resources to develop the technical and business skills of community network staff without the need for formal training courses.

5.2.5. Access to funding

For most small WISPs in South Africa, access to funding is a core challenge to their business model. Without targeted public support for WISPs from the Universal Service Fund or specific banking products, their only option to date beyond self-funding has been foreign intervention or ICT funds. For example, in 2021, Isizwe, a WISP and community network, obtained a grant of USD 460,000 from the Global Innovation fund, which works to fund community impact projects around the world.[226] Isizwe offers unlimited Wi-Fi access in townships and informal settlements on a low-cost, pay-per-use basis. Users pay ZAR 5 (USD .29) for 24 hours of Internet access, far lower than the average cost in South Africa of ZAR 85 (USD 4.97) per gigabyte).[227] The company has 80 Wi-Fi zones, including zones for specific purposes such as education, and expects to deploy more than 25,000 Wi-Fi zones by the end of 2022.

Other than those particular cases, funding for WISPs remains a challenge. For example, to access loans, banks typically accept only traditional guarantees such as real estate. Banks also typically reject business cases with which they are unfamiliar. Our research shows that some investors are willing to invest in specific ISP projects; however, such investors generally are more comfortable with fiber-based operators rather than wireless-based operators.[228]

5.2.6. ISP associations

In South Africa, two associations are specifically targeted to WISPs. The Wireless Access Providers Association of South Africa (WAPA) is the larger and older of the associations. At the same time, the South African Black Internet Service Providers' Association (SIBISPA) is focused on improving the ICT ecosystem for Black ISPs in the ICT sector in South Africa.

WAPA

WAPA was established in 2006 to promote the wireless industry's growth by facilitating self-regulation, promoting best practices, and educating members and the market about new wireless technologies and business models. It has over 250 members between WISPs (171), vendors (57), and associate members (29). WAPA offers its members regulatory advice, and technical training, and acts as an interface between the ICASA, network operators, service providers, and consumers. It regularly makes submissions and presentations to the government on wireless industry regulations. WAPA advocates for more progressive and efficient spectrum management in South Africa.

It organizes an annual event (WAPALOZA) where international and local speakers provide information and recommendations for WISP businesses.

SABISPA

SABISPA was established in 2018 mainly by Voimar, a Black-owned WISP. Its primary purpose is to unlock economic opportunities for Black-owned WISPs. SABISPA conducts regulatory oversight to promote fair policies in the marketplace for Black-owned WISPs, advocates for Black-owned business unity,

[226] See https://www.globalinnovation.fund/
[227] See https://disrupt-africa.com/2022/01/03/sa-connectivity-startup-isizwe-raises-460k-from-global-innovation-fund/
[228] Interview with Eldred Ekermans, Chief Technology Officer, HEROTEL, October 12, 2022.

collaboration, education, and empowerment for Black-owned WISPs. It also works to promote high standards and exceptional quality of service from the Black WISP industry.

SABISPA focuses on leveraging public projects to find economic opportunities for Black-owned WISPs. For example, in the SABISPA strategy, outsourcing and support for big telecommunications providers and participation in the ICASA project to connect public schools, are considered priorities. Also, SABISPA advocates for access to nationwide IMT spectrum licenses to create a shared network for small WISPs to compete with offers from larger providers. SABISPA seems particularly concerned about the lack of access to nationwide spectrum licenses for Black-owned WISP activity.

5.3. Regulatory framework status

South Africa's regulatory framework includes separate procedures to obtain a license to provide service and access to spectrum, respectively. This section highlights critical aspects, opportunities, and limitations of these frameworks in the context of WISPs.

5.3.1. Telecommunications regulatory framework

In South Africa, the Electronic Communications Act 36 of 2005 ("the ECA") covers a wide range of topics related to the provision of ICT services, including licensing, access to services, infrastructure access, spectrum management and assignment, markets and competition, and universal service.

The ECA requires a license to provide telecommunication services, and ICASA is in charge of the registration and granting of electronic communications licenses.[229] The last update of the ECA was in 2014, primarily focused on broadband policy, facilitating access to the Universal Service Fund, and aligning the Act with broad-based Black economic empowerment legislation.[230] Two main categories of service licenses are available under the ECA.:

Electronic Communications Network Service (ECNS) licenses: These licenses authorize the holder to deploy and operate a physical network. ECNS licensees can also enter into commercial arrangements with other licensees to allow them to use the electronic communications network owned and operated by the ECNS licensees.

There are two categories of ECNS license: class, and individual. The main difference is that class ECNS (CECNS) licenses are limited to a local or district municipal scope and entitle the licensee to provide commercial electronic communications network services within a particular geographical area (for example, the City of Cape Town), while individual ECNS (I-ECNS) licenses authorize operations for commercial purposes on a provincial and/or national scope.

ICASA issues an Invitation to Apply (ITA) for the case of individual ECNS licenses. Through the ITA, ICASA describes the license conditions and associated fees. For class ECNS licenses, ICASA accepts applications on an ongoing basis by completing the forms available on the authority's website. There is a non-refundable application fee of ZAR 13,283 (USD 781.28) for all ECNS license applications.

Electronic Communications Service (ECS) licenses: These licenses allow the holder to provide services to customers. The services may be offered over the licensee's own network, or another ECNS licensee's

[229] Electronic Telecommunications Act. 2005, https://www.gov.za/documents/electronic-communications-act
[230] Electronic Communications Amendment, Act 1 of 2014, https://www.gov.za/documents/electronic-communications-amendment-act-0

network. ECS licenses are typically granted to an ISP that does not operate its network or network facilities.

Licensees are further required to pay a contribution to the Universal Service and Access Fund (USAF) of 0.2% of annual revenue derived from licensed services. Licenses may be assigned, ceded, or transferred after the approval of an application to ICASA, and a transfer application fee applies.

Typically, WISPs require both an CECNS and ECS license to provide Internet services. Notably, some services are able to apply for a license exemption to ICASA. According to ICASA regulation, non-profit organizations, resellers, small networks (those that are intended to provide services to a limited area, by a specific group, under a non-district, local or municipal scope), and private networks are eligible for an exemption.[231]

5.3.1.1. Other licenses

Service licensing is separate from other licenses, such as spectrum use licenses and type approval. An ECNS license is required before a licensee can apply for radio frequency spectrum licensing. For type approval licenses, the application fee is ZAR 5.109 for user equipment and other radio equipment.[232] The type approval process usually takes 30 days, and operators report that the process works well. Spectrum license requirements are described in section 3.3.2.

5.3.2. Spectrum framework

In September 2022, the DCDT published a draft Spectrum Policy for comments. The draft spectrum policy includes specific sections focused on WISPs and community networks.[233]

- Section 20, "Spectrum for Community Use," instructs the regulator to review conditions for licensed spectrum to include *"spectrum for community use."*
- Section 21, "Alternative Network Infrastructure," of the draft policy highlights that alternative network infrastructure deployment will be used to prevent Internet market dominance and address transformation objectives.
- Section 21.2, "Community Networks," instructs the regulator to develop a licensing framework for community networks that allows the participation of new entrants, commercial viability, and the coverage expansion of companies. Also, this section states that ICASA will study a new licensing framework for community networks, including services, access, and licensing fees or exemptions that can be implemented to facilitate the launch and growth of community networks. It further mentions IMT spectrum as a mean to develop small and community networks, which is consistent with the SABISPA approach suggesting the use of IMT spectrum to provide services such as free basic Internet access to all households.

Regarding spectrum assignment, ICASA has issued regulations setting out bands that may be used without a frequency license, subject to certain technical restrictions. This category includes the 2.4 GHz, 5.4 GHz,

[231] ICASA, Licence Exemption Regulations, 2008, http://thornton.co.za/resources/1-31289%2029-7%20ICASA.pdf
[232] ICASA, Type approval, https://www.icasa.org.za/pages/type-approval
[233] Ministry of Communications and Digital Technology, Invitation to provide written submissions on the proposed next generation radio frequency spectrum for economic development, https://archive.gazettes.africa/archive/za/2022/za-government-gazette-dated-2022-09-08-no-46873.pdf

and 5.8 GHz bands, which are used extensively for the provision of Wi-Fi services in South Africa. The relevant bands and applicable restrictions are set out in Annex B to the Radio Frequency Spectrum Regulations 2015.[234]

For cases where demand exceeds supply (typically mobile service bands), ICASA issues an ITA to open the process. The ITA contains all technical and financial conditions for the assignment. IMT Spectrum assignment has been a point of controversy for a long time. The last auction for IMT spectrum was in 2022, but it was first planned in 2009. There are plans for a second round of auctions in 2023. Some WISPs and SAPISBA believe that access to the mobile spectrum on a regional and local basis will foster WISPs' growth by providing additional opportunities to compete.[235]

For other cases, such as frequency bands for point-to-point links, ICASA follows a first-come-first-served approach where applications may request the use of these frequencies at any time, following the application procedure as detailed in Annexes C and D of the spectrum regulations.[236]

5.3.2.1. Unlicensed spectrum use

Given the limitations to the access and costs associated with licensed bands, especially those suitable for FWA applications, WISP operators are actively moving towards using fiber and unlicensed spectrum in the 2.4 GHz and 5 GHz bands.[237]

WISPs see a disadvantage in accessing the key FWA spectrum that, given relatively recent technological convergence, is the same spectrum used for mobile applications. In this sense, many providers who base their business model on wireless access use the 2.4 GHz and 5 GHz unlicensed bands for both backhaul links and the access layer. If limitations on accessing FWA suitable spectrum continues, the designation of additional spectrum for unlicensed use (e.g., the full 6 GHz band) could help WISPs to grow by improving the offers to customers and fostering competition with operators that can offer both fixed and mobile services.

5.3.2.2. Other frequency bands used by WISPs

Some WISPs report the use of microwave links in the 7 GHz, 17 GHz, 18 GHz, and 20 GHz bands for backhaul purposes. Other providers have also noted an opportunity to use TV white spaces (TVWS) in the 470-694 MHz band.[238] In 2018, ICASA published the regulations for the use of the TVWS, providing a ground for using such bands.[239] TVWS could be an interesting solution for WISPs and community networks serving rural and remote areas where the use of the 470-694 MHz band by broadcasting applications is limited.

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[234] ICASA, Radio Frequency Spectrum Regulations, 2015, https://www.icasa.org.za/uploads/files/Radio-Frequency-Spectrum-Regulations-2015.pdf

[235] Interview with SABISPA, Zuko Rabotapi COO Voimar Telecom and Exec Member at SABISPA, November 3, 2022

[236] ICASA, Radio Frequency Spectrum Regulations 2015 https://www.icasa.org.za/legislation-and-regulations/radio-frequency-spectrum-regulations-2015

[237] Interviews Interview with Eldred Ekermans, Chief Technology Officer, HEROTEL, October 12, 2022. Interview with Dominic Cull and Rolf Blom from Ellipsis, October 13, 2022.

[238] Interview with SABISPA, Zuko Rabotapi COO Voimar Telecom and Exec Member at SABISPA, November 3, 2022.

[239] ICASA, Regulations on the use of Television White Spaces, 2018, https://www.icasa.org.za/uploads/files/Regulations-on-the-use-of-Television-White-Spaces-2018.pdf

6. Looking ahead

6.1. Best practices identified

Understanding that every country has its own legal, market, and cultural landscape, as well as state of market evolution for the fixed broadband markets, the analysis provided in previous sections enables identification of good practices to consider when developing public policies and projects to energize the Internet market and help close the digital gap across all dimensions (coverage, service, affordability). The following subsections summarize the best practices that the surveyed countries have adopted for the growth and development of WISPs.

6.1.1. Targeted support increases WISPs' market viability (Brazil)

Brazil has the most mature fixed broadband market of the surveyed countries, primarily due to policies to support and foster the WISP ecosystems. Apart fromspecific regulations for small providers (see next subsection), ANATEL and MCOM have established projects and policies to assist the creation and sustainability of WISPs.

With initiatives such as Coolab, WISPs can access specific credit lines from MCOM, the National Bank for Economic and Social Development (BNDES) for fiber networks, the Fund for the Technological Development of Telecommunications (FUNTTEL), and most recently, the Fund for the Universalization of Telecommunications Services (FUST). (See sections 1.2.2.2 and 1.2.2.4)

6.1.2. WISP-specific regulatory framework promotes market access (Kenya and Brazil)

Brazil created a licensing category for small providers called small-scale providers (*Provedores de Pequeno Porte* - PPP) on which the small providers (less than 5,000 subscribers or 10% of the market share in a region) have some reduced regulatory obligations and license fee exemptions in the regulatory framework when compared to larger traditional operators.

Another example is the regulatory and licensing framework for community networks published by Kenya's CA. The regulation defines a community network as a non-profit Internet service provider managed directly by communities. For example, the license application fee is KSH 1,000 (USD 7), with an annual renewal fee of KSH 5,000 (USD 35), a substantial reduction when compared to the KSH 200,000 (USD 14,000) license application fee for non-community operators (including both large- and small-scale networks). The community network license is valid for 10 years, and the community network's scope is limited to a sub-county. Although the regulation is for non-profit networks, it is an important precedent for developing regulation specifically targeting small for-profit WISPs in Kenya.

6.1.3. Development of WISP industry associations (South Africa)

In South Africa, WAPA and SABISPA represent small ISPs, which gives them more freedom to advocate for regulation or projects that promote WISPs . In contrast of the industry associations in Brazil (ABRINT) and Indonesia (APJII) are strong with good communication with the government, but do not exclusively advocate on behalf of small ISPs.

In a dynamic and competitive broadband market, WISPs will need to advocate for their interest, and such advocacy may eventually conflict with large operator interests. In this sense, WAPA and SIBISPA might be better positioned to advocate for small WISP operators' interests than ABRINT and APJII.

6.1.4. WISPs require spectrum access in both licensed and unlicensed bands (Brazil and Indonesia)

Unlicensed spectrum is crucial for the initial rollout of small WIPSs, particularly in rural and remote areas. To help solve the remaining gaps in rural and remote areas, regulators are moving toward a regulatory approach that promotes the shared use of the spectrum, such as TV white spaces (TVWS) and unlicensed spectrum bands. Brazil and South Africa were one of the first countries in their respective regions to provide a TVWS regulatory framework, followed by Kenya, while it is under study in Indonesia and Nigeria.

Unlicensed band includes using the 2.4 GHz and 5 GHz for point-to-point access links and Wi-Fi applications. For example, the Indonesian government is constantly working with industry association APJII to find better ways and technical measures to use unlicensed bands due to complaints about interference and overcrowding.

In addition, making the full range of the 6 GHz band available for unlicensed use would support WISPs of all sizes to continue improving their offers over the years, which allows them to better compete with emerging technologies, such as new satellite constellations and generations of mobile networks (i.e., 5G and newer generations). Brazil is leading the efforts in South America to make this band available for indoor and outdoor applications.

In terms of licensed spectrum, as a consequence of the success of policies to promote and strenghten small ISPs, Brazil is a good example. Small operators benefited from such policies and are now competitive enough to have won IMT spectrum in the past 5G auction.

6.2. Conclusions and recommendations for each surveyed country

6.2.1. Brazil

As demonstrated by the competitive Internet services market, thousands of small providers, active industry associations, regulatory considerations for small providers, and non-governmental initiatives have focused on building local networks, leading Brazil to achieve a highly developed WISP ecosystem. This is partially by design, but WISPs in Brazil also benefit from broader efforts to simplify and lower barriers to competition in the telecommunications sector.

ANATEL has in place several regulatory tools to promote small operators with satisfactory results. This has stimulated competition and expanded the broadband market through the adoption of significant market power criteria defining small operators, the regulation of the wholesale markets, and other competition measures for asymmetric regulation.

Brazil's WISP market seems to be entering a stage of consolidation that should be analyzed carefully by ANATEL to avoid excessive concentration and anti-competitive practices. MCOM should also analyze these matters as input for reviewing the policy and regulatory mechanisms to foster the WISP ecosystem, especially to strengthen the small WISP position in a rapidly changing environment. In addition, demand-related issues in more isolated areas and supply to the poorer populations could be beyond the scope of public policies and challenge regional providers' growth.

Based on the research and stakeholder interviews, the following conclusions and recommendations highlight measures to ensure that Brazil remains a leader in fostering WISPs as a means to expand connectivity.Table 2. Conclusions and recommendations in Brazil

Conclusion	Recommendation

Organized advocacy by industry has been a key factor in the success of WISPs in Brazil to date.	Regulators should continue to engage with representatives from the different associations to ensure that future efforts at regulatory simplification and reform consider the specific needs of these operators.
While WISPs have benefited from overall regulatory simplification and government financing schemes, there are no programs targeted specifically at WISPs.	MCOM can make funding available specifically for WISPs to provide connectivity in remote or underserved areas.
Large operators' advocacy against measures for small operators pose a risk to the WISP ecosystem.	MCOM and ANATEL should resist calls to roll back provisions for small operators or consider establishing more specific categories to identify providers in need of regulatory flexibility.
Operational costs associated with physical and cybersecurity can be a challenge for WISPs.	The Brazilian government should prioritize legislation increasing penalties for theft or destruction of telecommunications infrastructure, as well as cybercrime.
Market consolidation can change the landscape leading to the market dominance of WISPs in specific locations.	Existing asymmetric measure can be further improved to ensure adequate competition with the growth of some of the existing regional Internet providers. In addition, it could be possible to review the granularity of the WISP definition. For example, the regulator can use the same current values (5,000 subscribers, or 5% of the market share) but comparing it in the state/city level. This would make the analysis more granular and support the resources and regulatory actions for to small WISP facing challenges to compete and provide services in rural and remote areas.

6.2.2. Indonesia

As shown by the relatively high costs and low quality of service in the Internet services market, lack of competition among large providers, and regulatory burdens on ISPs, several opportunities exist to support the development of the WISP ecosystem in Indonesia. While WISPs have benefitted from recent broad reforms and initiatives, there is still a need for more initiatives specifically targeted to support them.

Indonesia's WISP market currently faces numerous barriers, including congestion in unlicensed frequency ranges, high costs to access fiber, and regulatory burdens related to licensing requirements. Kominfo and other governmental bodiescan focus on resolving these issues when reviewing policy and regulatory mechanisms to foster the WISP ecosystem, especially to strengthen the position of small providers in a rapidly changing environment.

Based on desk research and stakeholder interviews, the following conclusions and recommendations can be highlighted to promote the development of WISPs as a means to expand connectivity in Indonesia.

Table 3. Conclusions and recommendations in Indonesia

Conclusion	Recommendation
Access to spectrum remains a challenge for providing backhaul and, in some cases, last-mile connectivity by WISPs.	Indonesia's government should continue to identify additional spectrum for unlicensed use and consider expanding the use of the 5150-5250 MHz range for outdoor use, to benefit Internet services provided by WISPs. Further work should be done to make the 6 GHz band available for unlicensed services in indoor and outdoor use cases.
Spectrum congestion and illegal Internet provision are urgent issues requiring attention in order to foster	The government should increase efforts to identify and prevent illegal spectrum use. In addition to regulatory improvements to enforce compliance, Kominfo can work with industry representatives to cooperate on identifying instances of illegal use of spectrum.

competition and growth of the WISP market.	
Organized advocacy by industry has been a key factor in successful regulatory engagement on a broad scale.	Kominfo should continue to engage with representatives from industry associations, such as APJII, to ensure that future efforts on regulatory simplification and reform consider the specific needs of small operators.
While WISPs have benefited from overall regulatory simplification and government financing schemes, there are few or no programs available that are targeted specifically at WISPs.	Kominfo and other government sources can make funding available specifically for WISPs to provide connectivity in remote or underserved areas. For example, a portion of the universal service fund could be reserved to foster and promote the growth of WISPs.
Large operators' resistance to infrastructure sharing presents a risk to the WISP ecosystem.	Kominfo should establish and implement enforcement mechanisms, including potential fines or other remedies, to ensure compliance with regulations mandating infrastructure sharing in the telecommunications sector.

6.2.3. Kenya

Kenya's relatively low penetration of fixed broadband services, along with the planned expansion of fiber optic networks, provide an opportunity for both the government and WISPs. For the government, it is also an opportunity to promote competition and add options for consumers and SMEs, leading to lower prices and better services. While community networks have benefitted from recent regulatory reforms and initiatives, there is still a lack of targeted efforts to support small, for-profit WISPs.

The government and CA can design policy and regulatory incentives to foster the growth of WISPs and increase competition in the Internet services market. The table below summarizes some conclusions and recommendations for actions that could help foster the WISP ecosystem, which is a key actor in helping reduce the digital gap and improving the quality of Internet services in Kenya.

Table 4. Conclusions and recommendations in Kenya

Conclusion	Recommendation
WISPs would benefit from designation of the full 6 GHz band (5925-7125 MHz) for unlicensed use.	WISPs are already experiencing interference issues in the 2.4 and 5 GHz bands. In addition to using the lower part of the band for LPI and VLP devices, opening the full 6 GHz band for unlicensed use, including its use by standard power applications, would help foster the WISP market by assuring spectrum for its future growth and improving its ability to compete. Additionally, companies that are building their business model on Wi-Fi hotspots will find support for their future growth and sustainability by using advanced Wi-Fi applications.
The nascent WISP ecosystem business model would benefit from overall regulatory simplification, service license availability, and greater spectrum access, both licensed and unlicensed.	Similar to the efforts made by developing a particular regulatory framework for community networks, the CA can also consider developing a regulatory framework for WISPs to create adequate conditions to allow small companies to grow and compete in the broadband market. Such a specific regulatory framework would be aligned with the objectives of the Kenya Micro and Small Enterprises Policy and the work of the Micro and Small Enterprises Authority (MSEA).
Organized advocacy by industry is necessary to build a long-standing relationship with WISPs that would ultimately benefit the market.	Government agencies, including the CA, should facilitate and promote the creation of a specific association to ensure that future efforts at regulatory reform consider WISPs' specific needs. The CA can benefit

	WISP owners' market knowledge to advise their plans and programs and update relevant regulations to foster the WISP ecosystem.
Even with high levels of coverage and mobile network penetration in Kenya, challenges remain regarding affordability, adoption, and effective usage.	Given Kenya's highly concentrated broadband market, all efforts to promote competition in the market should be considered. Competition can be a factor in driving down Internet access costs and promoting the adoption of ICTs in Kenya.
WISPs would benefit from the use of public infrastructure (e.g., public buildings and water towers) to deploy their networks.	The ministry and CA could create a strategy to facilitate the deployment of telecommunications infrastructure and collaborate with municipalities on the best ways to facilitate this deployment. WISPs can benefit from accessing public buildings to deploy networks in their communities and townships.
Information requirements and platforms to report data for providers are hard to use and antiquated.	CA should review the existing procedures and tools for obtaining information from operators. Also, operators would be more engaged in the information reporting if the process were simplified with more updated and user-friendly interfaces.
Further detail on the statistical report would be beneficial to understand the actual connectivity challenges in Kenya	The statistical report could improve the level of detail regarding the broadband subscriptions profile (prepaid/postpaid) and the type of customer (home/enterprise). This level of detail would help found identify improvement areas and target specific initiatives. For example, Identify Broadband household/enterprise penetration and hopefully disaggregating by rural and urban areas will help better understand the market gaps and launch particular initiatives/projects.

6.2.4. Nigeria

Nigeria's very low penetration of residential fixed broadband services, along with the planned expansion of fiber optic networks on a ward (county) level, provide an opportunity for both the government and WISPs considering the significant room for growth. For the government, it is also an opportunity to promote SME in the country, foster competition in the Internet services market, and provide consumers and SMEs with more connectivity offerings, leading to lower prices and better services.

Regulatory conditions, such as the licensing framework and the relationship between operators and the regulator, seem to be sufficient to facilitate the creation and growth of WISPs in Nigeria. Along those lines, access to unlicensed spectrum is crucial to allow existing and new providers to improve their offers and the quality of services over time.

The available data and the data analysis from the NCC are a valuable resource to track the evolution of the market. NCC has a good compilation of information that would help the regulator to understand the evolution of the nascent WISP ecosystem. Improvements to the data collected and the way of presenting such data would provide NCC and interested parties with more tools to understand the evolution of the market in the upcoming years.

Finally, community networks can benefit from regulatory initiatives as NCC could develop a targeted regulatory environment to support and foster community networks. Such specific regulation should focus on facilitating access to backhaul networks and passive infrastructure.

The table below summarizes some conclusions and recommendations for actions that could help foster the WISP ecosystem, which can play a key role in reducing the digital gap and improving service quality, as well as increasing Internet services adoption in Nigeria.

Table 5. Conclusions and recommendations in Nigeria

Conclusion	Recommendation
The nascent WISP ecosystem business model would benefit from targeted support and greater spectrum access, both licensed and unlicensed, and in particular the designation of the full 6 GHz band (5925-7125 MHz) for unlicensed use.	The NCC should consider developing a regulatory framework for WISPs in rural and remote areas to create adequate conditions to allow small companies to grow and compete in the broadband market. Regarding targeted support, simplification, and extension of the Universal Service Provision Fund (USPF) projects and the Micro, Small and Medium Enterprises Development Fund can also be used to provide financial support to the nascent WISP ecosystem. This specific regulatory framework would be aligned with the objectives of the Nigeria Small and Medium Enterprises Policy and the work of the Small and Medium Enterprises Development Agency (SMEDAN). In terms of access to unlicensed spectrum, WISPs are already experiencing interference issues in the 2.4 and 5 GHz bands. In addition to using the lower part of the band for low power indoor devices, opening the full 6 GHz band for unlicensed use, including its use by standard power applications, would help foster the WISP market by ensuring enough spectrum for its future growth and improving its ability to compete. Additionally, companies that are building their business model based on Wi-Fi hotspots could have support for their future growth and sustainability by using advanced Wi-Fi applications.
Even with the increased coverage of mobile networks in Nigeria, challenges remain regarding affordability and adoption.	Given Nigeria's highly mobile-focused broadband market, all efforts to promote competition should be considered. Competition can be a factor in driving down Internet access costs and promoting the adoption of ICTs in Nigeria. This should also aim at reducing cost of devices to access the Internet.
WISPs would benefit from the use of public infrastructure (e.g., public buildings and water towers) to deploy their networks.	Along with the growth of WISP in Nigeria, the NCC could create a strategy to facilitate the deployment of telecommunications infrastructure and collaborate with municipalities on the best ways to facilitate infrastructure deployment. WISPs can benefit from accessing public buildings to deploy networks in their communities and townships.
Targeted support to nascent WISPs is necessary to create momentum for the Internet provider's ecosystem.	The WISP ecosystem would benefit from the creation of incubators for WISPs, especially in rural and remote areas. RUBI program aimed to provide wholesale services to WISPs faced challenges in its implementation. NCC and the Ministry can also leverage on the SMEDAN SME policy (2021-2025) focus on digitalization and the use of e-commerce tools to facilitate the expansion and sustainability of SMEs, and todevelop regulation and programs that use the potential of WISP to help the rural SMEs digital transformation process.
The WISP ecosystem needs easy and affordable access to backhaul andfiber networks to flourish.	There are still open discussions regarding the management of the fiber networks that the Nigeria's Broadband Plan aims to develop. The experience from other markets, in some cases, shows that the biggest challenge of a wholesale fiber network is not necessarily its coverage but its network management. An adequate network management system would allow WISP to access them in a reliable and equitable way.
Further detail on the NCC statistical report would be beneficial to	The statistical report could improve the level of detail regarding the broadband subscriptions profile (prepaid/postpaid) and the type of

understand the actual connectivity challenges in Nigeria.	customer (home/enterprise). This level of detail would help to identify improvement areas and to target specific initiatives. For example, the identification of the broadband household/enterprise penetration, as well as more detailed information on rural and urban areas would help to better understand the market gaps and the launch of particular initiatives/projects.

6.2.5. South Africa

The low penetration of fixed broadband services is an opportunity for both the government and WISPs, as there is significant room for growth. For the government, it is also an opportunity to promote competition and add options for consumers and SMEs, leading to lower prices and greater choice.

The government and ICASA can design policy and regulatory incentives to level the playing field for WISPs. The table below summarizes some conclusions and recommendations for actions that could help foster the WISP ecosystem, which are important actors to reduce the digital gap and improve the quality of Internet services in South Africa.

Table 6. Conclusions and recommendations in South Africa

Conclusion	Recommendation
WISPs would benefit from the designation of the full 6 GHz band (5925-7125 MHz) for unlicensed use.	WISPs are already experiencing interference issues in the 2.4 and 5 GHz bands. Opening the full 6 GHz band for unlicensed use (including its use by standard power applications) would help the market by assuring spectrum for its future growth and increasing its ability to compete. Additionally, companies that are building their business model on Wi-Fi hotspots will find support for their future growth and sustainability by using advanced Wi-Fi applications.
The current WISP business model would benefit from overall regulatory simplification, service license availability, and greater spectrum access, both licensed and unlicensed.	This is consistent with the proposed approach on the draft spectrum policy published by the government in September 2022. Particularly, small WISPs would benefit from a simplified regime. Such simplification can also provide adequate conditions to resolve the issue of illegal unlicensed operators, facilitating them the process to become licensed.
Organized advocacy by industry is necessary to build a long-standing relationship with WISPs that would ultimately benefit the market.	Government agencies, including ICASA, should continue to engage with representatives from the different associations to ensure that future efforts at regulatory reform consider WISPs' specific needs. ICASA can benefit from WAPA and SABISPA's market knowledge to advise their plans and programs and update relevant regulations to foster the WISP ecosystem.
Current WISP business models in rural areas would benefit from regulation regarding a controlled price for fiber access independent of the distance to the fiber node.	A regulation regarding flat tariffs for accessing fiber networks for WISPs and community networks in rural and remote areas could benefit users in these geographic areas.
Market consolidation is changing the WISP market. This could have implications for the market competition in specific locations.	ICASA should conduct a market review in the fixed Internet market and analyze the possible future emergence of competition limitations in specific markets.
No USAF programs are targeted specifically at WISPs.	Using USAASA funds to finance connectivity projects using WISP networks and their knowledge of the communities is a powerful tool to help reduce the digital gap. These funds can be made available specifically for WISPs to provide connectivity in remote or underserved

	areas. Further, these funds could be used to advance the SA Connect goals in the future.
USAF's current focus on CAPEX funding can mask the sustainability challenges of WISPs and community networks. Funding should also be made available for **In**ternet services to public entities and SMEs.	A full review of the focus of the USAF is necessary. Participation for WISPs in the provision of school or other public building connections in the SA Connect program may be considered. Funding for SME connectivity can have a significant impact on their particular businesses and the WISPs business model at the same time.
WISPs would benefit from the use of public infrastructure (e.g., public buildings, water towers) to deploy their networks.	The Ministry and ICASA could create a strategy to facilitate the deployment of telecommunications infrastructure and collaborate with municipalities on the best ways to facilitate this deployment. WISPs can benefit from accessing public buildings to deploy networks.
Industry information gaps can be closed by updating and simplifying the information requirements and platforms to report data.	ICASA should review the existing procedures and tools for obtaining information from operators. Also, operators would be more engaged in the information reporting if the regulation simplifies the process.