chapter 1 State of the Market

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From pure telco to platform player: how the telco needs to evolve

The shape of the telecommunications company (telco) is changing. Today, it should be defined by digital – by the network and organisational DNA and how it leverages digital to interact with external stakeholders and customers.

This digital telco is powered by connectivity and capability that extends beyond the limitations of the past toward more inclusive and dynamic service provision across multiple touchpoints. The network infrastructure of the digital telco is focused on a service-based architecture that caters to the increasingly sophisticated requirements of customer, technology and use case alike.

The modern telco

The modern telco must be capable of catering to simple voice and data delivery while equally meeting the demands of bandwidth-hungry services such as 4K streaming, augmented reality and virtual reality. It must also provide customers with a network that can handle the demands of automation, the Internet of Things (IoT), and artificial intelligence (AI).

In addition to seamless delivery of evolving services, telcos need to fully digitise network operations with AI-enabled functionality. This ensures that they can deliver real-time network visibility, predictive maintenance, self-optimisation, and zero-touch provisioning alongside the rapid and dynamic allocation of resources. With this level of granular control, telcos can gather insights from customers and fundamentally transform

"The modern telco must be capable of catering to simple voice and data delivery while equally meeting the demands of bandwidth-hungry services such as 4K streaming, augmented reality and virtual reality."

their experiences across the network while using the insights to launch new and innovative services that are both relevant and timeous.

The innovation lifecycle isn't the typical one to two years anymore. Digital telcos can launch products and innovations in a matter of months, if not weeks. Billing models in a digital telco are not rigid so pricing can be adapted to suit consumption patterns, usage behaviour, or, for complex enterprise deals, business use cases and end-user value.

Shifting to digital

This shift from traditional to digital within the telco environment is directly linked to the rapid digital transformation revolution taking place across the globe.

IDC predicts that 65% of the global gross domestic product (GDP) will be digitised by the end of 2022 which is a fundamental and transformative shift in terms of how business is done, how digital services are consumed, and how those services are procured. Customers across the enterprise, consumer and government segments want service providers that not only deliver digital services, but that can curate end-to-end digital service experiences that are relevant and customisable.

Companies that lag on digital maturity will see a continuous and marked decline in their core service revenues and will start losing market share to competitors with networks that resemble digital service delivery platforms. Companies that have digitised, automated and AI-enabled operations will gain ground on the global stage as they can actively engage with, and connect, customers to the services they want to consume. Digital transformation within this sector is closer to organisational transformation – enabling agility and dynamic responsiveness to market forces.

Preparing for business disruptions

The latest 2022 IDC CIO Digital Transformation survey found that 62% of CIOs identified digital capabilities as their key investment objective when it comes to preparing for future business disruptions, and this has never been more relevant than it is to the telco today. The digital telco is in a unique position to become a trusted partner that's relied on by CIOs across all industries and that can provide collaborative input and services for projects, PoCs and innovations that drive digital initiatives and solutions.

Ecosystem players also want to deal with the digital telco when it comes to forging strategic partnerships that allow for the development of new products and services that are unique and that leverage deep industry and vertical insights.

As the global economy becomes increasingly digitised alongside the accelerated digital transformation introduced by the pandemic, customers around the world have adopted a digital-first strategy. If the telco is prepared and ready to initialise its digital-first operations and approaches, then it gains a competitive advantage. The ability to scale globally while meeting changing needs on the local stage.

The future of enterprise

This is the future of the enterprise, the future of work and the future of ecosystems.

This is where the cloud-native business model that enables access to digital services, skills, and revenue from anywhere in the world comes into its own. And this is where the telcos stuck in traditional ruts will come to a slow end as the digital native and digital explorer takes the lead and transforms the sector and its capabilities. ■

Spectrum policies for rural connectivity in Africa

Survey on Spectrum Policies for Rural Connectivity in Africa - ATU

Rural connectivity in Africa

In October 2020, the African Telecommunications Union (ATU) established a task group to develop spectrum recommendations to improve rural ICT connectivity. This project aims to develop proposals based on best practises in Africa and worldwide on how spectrum policy, regulations and methods can promote rural ICT connectivity in Africa.

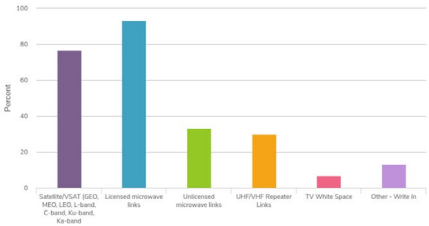
The task group sent questionnaires to the ATU member countries to assess spectrum challenges of rural connectivity on the continent. By the response deadline in January 2021, 30 out of 48 member countries submitted their responses. This report - Survey on Spectrum Policies for Rural Connectivity in Africa - presents the results on spectrum policies and other regulatory tools for rural connectivity in the member states.

Coverage of telecommunication/ICT services

The study found a median of three mobile network operators (MNOs) and ten internet service providers (ISPs) exist in each respondent country. 83% of the MNOs and 70% of the ISPs provide services in remote/rural areas in their countries. Only one country indicated that it had a dedicated rural service provider.

Wireless backhaul technologies

The respondent countries use wireless backhaul technologies to provide services in rural areas; many of the countries use multiple technologies. 93% use licensed microwave links as the backhaul technology, while 77% confirmed using satellite. In addition, 33% and 30% of the respondents indicated using unlicensed microwave links and UHF/VHF repeater links, respectively. Elsewhere, 7% of the respondents used TV White Space (TVWS).

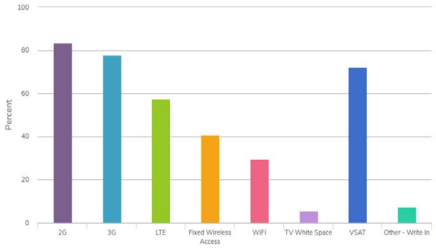


Value	Percent	Responses
Satellite/VSAT (GEO, MEO, LEO, L-band, C-band, Ku-band, Ka-band	76.7%	23
Licensed microwave links	93.3%	28
Unlicensed microwave links	33.3%	10
UHF/VHF Repeater Links	30.0%	9
TV White Space	6.7%	2
Other - Write In (click to view)	13.3%	4

Wireless backhaul technologies used to connect rural areas

Access network technologies

The survey evaluated the wireless access technologies used to connect rural and remote areas. 2G mobile (82%), 3G mobile (74%), and VSAT (71%) were dominant, while LTE has grown to almost 60%, and TVWS stood at about 6%.



Access network technologies used to connect rural areas

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Assignment of frequency bands identified for IMT

The survey considered frequency assignments in the IMT bands within Africa. All the respondent countries have assigned 900MHz (Band 8/FDD), 1800MHz (Band 3/FDD), and 2100MHz (Band 1/FDD).

73% of the respondents have frequency assignments in the 800MHz (Band 20/FDD), while 53% have assignments in the 2300MHz (Band 40/FDD) and 2600MHz (Band 7/FDD). Less than 30% stated that they had assignments in the other IMT bands except for the 3500MHz (Band 42/TDD), where 47% of the countries indicated that they had assigned the frequency bands.

	700 MHz / B28 / FDD	800 MHz / B20 / FDD	900 MHz / B8 / FDD	1800 MHz / B3 / FDD	2100 MHz / B1 / FDD	2300 MHz / B40 / TDD	2600 MHz / B41 / TDD	2600 MHz / B7 / FDD	2600 MHz / B7 / TDD	3400 MHz / B38 / TDD	3500 MHz / B22 / FDD	3500 MHz / B42 / TDD
Number of countries surveyed with assigned spectrum	7	22	30	30	30	16	8	16	6	6	7	14
Percentage of countries surveyed with assigned spectrum	23%	73%	100%	100%	100%	53%	27%	53%	20%	20%	23%	47%

Details of the frequency plans

Spectrum recommendations

Spectrum licensing is a strong statutory instrument that aligns the use of radio frequency spectrum with the national information and communications technology (ICT) policy objectives to the benefit of all citizens.

Frameworks are a critical component to maximize spectrum resources to ensure that they enhance the capacity and coverage of mobile and broadband networks for end users, helping bridge the digital divide. Besides ensuring that spectrum is made available in low, mid, and high frequency bands, how spectrum is made available is equally important.

High quality mobile services are vital for consumers and businesses and deliver major socioeconomic benefits. They rely on increasing amounts of spectrum to support faster broadband speeds and rapidly growing data demand. Given that there is a limited supply of mobile spectrum, it is vital that governments and regulators ensure it is awarded to operators who will use it most efficiently, as technology improvements alone cannot deliver the required capacity.

To this end, the development of guidelines that address maximizing spectrum availability, implement long-term spectrum licenses to maximize regulatory certainty, take a technology-neutral approach to licensing, and make innovative licensing options available while ensuring the protection of existing services is recommended.

Spectrum licencing

An examination of previous spectrum auctions/assignments in several countries suggests that many could be viewed as problematic. In many cases, auctions have failed because reserve prices were set too high and because the amount of spectrum on offer was limited.

However, Nigeria has been able to find a middle ground. The Nigerian Communications Commission (NCC) has organized and executed several spectrum auctions which include the digital mobile auction of the 900MHz and 800MHz band in 2001, the 2GHz 3G auction in 2006, the 2.3GHz wholesale wireless access in 2014 and the 2.6GHz spectrum auction in 2016. It also auctioned two slots of 27MHz in Lagos state in 2016 just before the 2.6GHz auction.

Moreover, Nigeria's Spectrum Trading Guidelines, published in 2018, allow for NCC licensees to share and trade spectrum, whilst putting in place measures to guard against exploitation of the principles of the guidelines. For instance, the guidelines allowed spectrum to be traded by eligible licensees that had held spectrum for up to two years and achieved at least

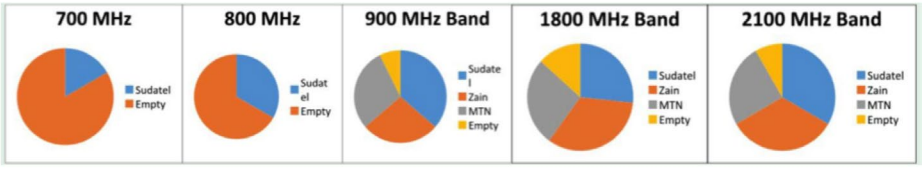
25% of rollout obligations specified in the licence.

Historically, Tunisia's spectrum was assigned on a technology specific basis, however as a measure to improve mobile broadband connectivity during the COVID-19 pandemic, Tunisia granted technology neutrality, on a temporary basis initially, so operators could use their spectrum for LTE. Soon after, the decision was made permanent by the ICT minister, as it concluded it is more appropriate to aim for technological neutrality for these licenses and leave the field for operators to choose the appropriate technology and the most appropriate timing for the adoption of future generations of technology.

Meanwhile, in Sudan the license each operator was issued depended on market requirements, with agreements signed between the TPRA and the licensee. Spectrum was awarded taking into consideration the economic status at that time, and the upfront fees were a portion of the total license fees. An annual usage fee is applicable for all operators for the use of access and transmission frequencies. The main mobile and broadband operators in Sudan are mobile operators Zain and MTN; fixed broadband operator Canar; licensee with unified licensing, Sudatel.

In licensing for telecom operators, the term of agreements should always include the reframing of spectrum when needed. This was very useful for Sudan when reframing was used to gain access to the valuable 850MHz band by granting the operator a replacement in the 700MHz and 800MHz bands instead.

For fixed broadband, four ISPs have been licensed to provide services in dedicated areas to increase the penetration of fixed broadband services in Sudan using the 3.5GHz, 28GHz and 5.8GHz bands. For delivering connectivity in rural areas, the main operators have agreed to include a universal service obligation, which provides a specific amount to be funded to the universal services treaty to cover the cost of connecting the unconnected. Moreover, the license and annual fees take into consideration (and encourage) the coverage of rural areas. ■



Spectrum assignment for Sudan's operators

Mobile economy developments in MENA

The Mobile Economy Middle East & North Africa 2022 - GSMA

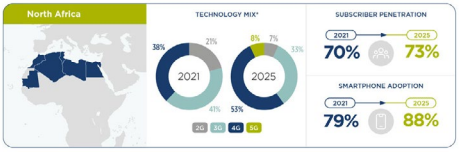
Market overview

Since the emergence of COVID-19, mobile networks have been instrumental in delivering reliable connectivity to sustain social and economic activities. As countries bring the pandemic under control, a priority for governments in MENA and elsewhere is to drive economic recovery and promote sustainable development. Digital services and technologies will be crucial to realising this objective, by stimulating economic growth, mobilising the workforce, and enabling industrial efficiencies.

The number of mobile internet users in MENA

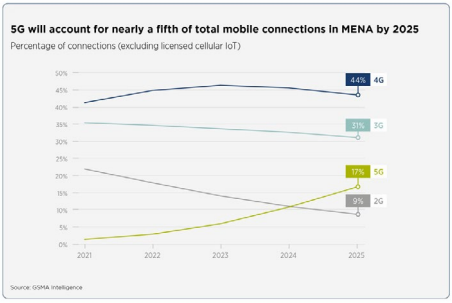
exceeded 300 million in 2021, with penetration due to reach 50% of the population by the end of 2022. Smartphone adoption is growing well and is set to increase most strongly in MENA's less advanced mobile markets over the period to 2025, underpinned by continued network investment from operators. Increasing user engagement with bandwidth-hungry applications such as video will lead to a surge in data consumption across the region, growing by 430% between 2021 and 2027.

4G is MENA's leading mobile technology, with

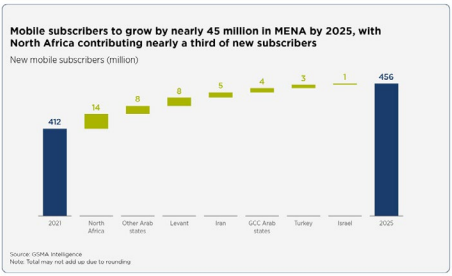


almost 270 million connections at the end of 2021. Take up has more than doubled over the past five years, driven by network expansion and efforts by MNOs to transition users from legacy networks. However, 4G adoption is projected to peak in 2023 as consumers increasingly migrate to 5G plans. At the regional level, 5G remains at a nascent stage. The current adoption rate of just 1% is expected to grow to 17% by 2025.

While the consumer market has been the focus



of early 5G deployments, B2B is the largest incremental opportunity in the 5G era, with a raft of digital transformation projects underway.



To fully exploit these opportunities, 5G leaders in MENA are investing in new capabilities, with edge computing a priority. This ties in with operators' efforts to grow revenues beyond core telecoms services. 5G fixed wireless access (FWA) has also garnered significant early interest from operators in MENA.

In a post-pandemic world, digital connectivity is expected to become even more vital to citizens, firms, and institutions alike. Regulatory frameworks that are conducive to investment will be crucial to incentivising the deployment of telecoms infrastructure. Such infrastructure will be key to economic recovery and future crisis resilience.

Operators step up their network transformation plans

The commercialisation of 5G has coincided with the introduction of network innovations such as open RAN, virtual RAN, and network automation. Combined with new market demand for energy efficiency and network security, operator decisions on network transformation strategies have never been so important.

In the Middle East and Africa, sustainability, network security and end-user security are the main priorities of operators' network transformation strategies, according to GSMA Intelligence's latest survey. This is unsurprising given the backdrop of rising security threats and demand for a greater focus on energy efficiency

from shareholders and customers.

There exists widespread interest in the use of cloud and IT technologies in the network, as well as automation of business functions and network operations. Combined, such technologies can help operators scale networks to match demand more easily, reduce costs and accelerate service innovation.

Operators in MENA have been working closely with leaders in cloud networks to deploy new capabilities and accelerate progress. In 2021, only around a quarter of operators in MENA claimed that the use of open networking technologies (including open RAN) was a very or extremely important priority. This points to the many competing priorities that need to be juggled and the fact that open RAN announcements until recently have hailed from other regions.

However, this is starting to change; open RAN momentum is building in MENA. In July 2021, e&, STC, Zain Group, Mobily and Du signed a MoU to progress the implementation of open RAN solutions in their respective markets. Batelco and Omantel were later added in March 2022. In the same month, the Open RAN MoU operators launched the first regional community lab in collaboration with Telecom Infrastructure Project (TIP) and Intel. This will help foster the open RAN ecosystem in MENA, enabling operators to accelerate the deployment of open networking technologies.

Operators look to diversify revenues

There is often scepticism about operator success beyond core telecoms services, but operators in MENA are providing a growing number of examples of revenue diversification. Revenue beyond core as a percentage of total revenues varies significantly among MENA operators, and there is no 'one size fits all' in terms of strategy or timeline for diversification, reflecting different regulatory environments and consumer habits.

Some operators offer a wide range of consumer services beyond core: Orange is one notable example. Consumer services still represent the largest contributor to revenues in MENA, but enterprise is the main growth driver as operators increasingly target the digital transformation of vertical industries.

Financial services and security represent key components of revenue diversification strategies for operators in MENA. Orange Money provides an example in financial services. As of June 2021, it had reached 23 million active customers across Africa and the Middle East.

The pandemic resulted in growing demand for security-related services provided by operators as enterprises pushed ahead with their digital transformation. Most operators consider investing in security very or extremely important to help achieve long-term enterprise revenue goals. According to the GSMA Intelligence Operators in Focus: Enterprise Opportunity Survey 2021, security was highlighted as the primary growth area by more by more than 50% of operators surveyed in MENA.

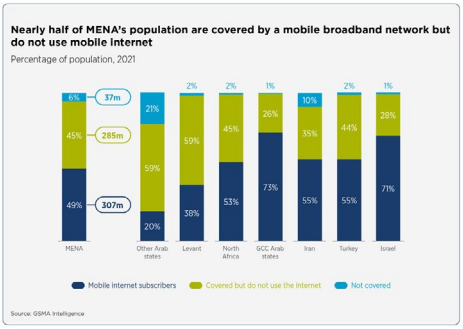
Enhancing digital inclusion

At the end of 2021, 307 million people in MENA were connected to the mobile internet – an increase of 14 million on 2020. However, 322 million people remain offline. Operators' investments mean only 6% of the population are not covered by a mobile broadband network, but a far greater proportion (45%) do not use mobile internet services due to various non-infrastructure limitations. These include affordability, knowledge and digital skills, relevance, safety and security, and access to enablers (such as electricity and formal ID).

Affordability remains a barrier to mobile

internet use for many in the region. Affordability of internet enabled handsets and mobile data worsened in MENA (and many other regions) due to the impact of COVID-19 on employment and income levels. Operators have been supporting customers through social tariffs and handset-financing models, such as payment instalment plans, subsidies, loans, leases, and rentals.

Efforts also continue to reduce the number of people not covered by a mobile broadband network. In November 2021, the Algerian telecoms



regulator awarded extra spectrum in the 900MHz band to the country's three network operators to help improve services and widen coverage.

Sustainability commitments and ambitions grow

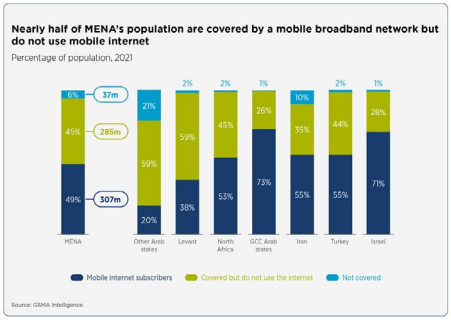
Sustainable transformation is gathering pace across MENA. Operators like MTN are implementing programmes to deploy base stations powered by renewable energy, hybrid solutions and advanced cooling solutions, while reducing dependence on diesel for base-station backup power. Countries with few or no natural energy resources are more exposed to global fluctuations in energy prices, so local operators have every reason to be ambitious with renewables.

MENA is home to some of the leading 5G markets globally. However, the rollout of new 5G networks has created upward pressure on operators' energy usage to power the new equipment. Being energy-efficient and using renewables economically is a necessity to avoid a competitive disadvantage; energy is a top three area of opex for operators, after labour and site rentals. Private sector commitments across the region on net zero are likely to accelerate during 2022–2024, while renewable electricity demand is expected to grow, driven by rising energy prices and the region's ample access to solar as a natural resource.

Diesel generators have traditionally been the most economical way to generate electricity in off-grid or bad-grid scenarios across MENA. However, solar has become a competitive option over the past few years, due to three main factors:

- Strong support for renewable electricity from local governments
- Operator aims to control energy costs
- Reduced prices of photovoltaic panels

MENA has an exceptional sunshine duration ratio, which makes solar a particularly promising option for network operators. They can deploy solar panels at their sites and store the unused electricity in batteries, and they can build larger, centralised solar farms. ■



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Transforming digital Africa

Amy Saunders,
editor, African Wireless Communications Yearbook

Addressing fixed wireless access on the continent

The GSMA has reported that in 2021, mobile internet users reached 307 million in MENA, with some 50% of the population expected to come online via mobile by the end of 2022. Meanwhile, in sub-Saharan Africa some 303 million people, 28% of the population, connected to mobile internet in 2021; this is expected to expand steeply by 2025 to 40% of the populace.

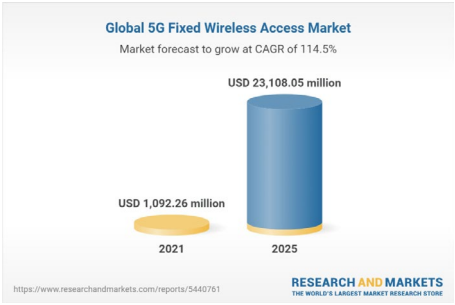
With new applications and use cases spreading fast throughout the African continent for government, enterprise, and consumers alike, faster connectivity speeds are required than ever before. 4G is MENA's leading mobile standard, accounting for 41% of connections in 2021, but again, sub-Sahara Africa is lagging with 4G accounting for just 17% of connections in the same year. With typical mobile 4G download speeds equalling 8-10Mbps, customers are seeking improvement to truly join the digital revolution.

Fixed wireless access (FWA) is considered a key enabling technology for the delivery of high speed, low latency, cost-effective connectivity for government, enterprise, and home use cases. 5G and FWA technologies go hand in hand, with the 5G FWA segment expected to expand at a compound annual growth rate (CAGR) of 114.5% to US$23,108 million over 2020-2025, as per Research And Markets. Indeed, 5G FWA is widely anticipated to deliver fibre-like services, affordably, helping to rapidly bridge Africa's digital divide.

Unlike the lengthy deployment times related to fibre installation, FWA installations are both extremely fast and simple to deploy; pre-existing telecommunications towers can be adapted to support FWA rollout, requiring low initial investment and fast return on investment for operators and service providers.

According to Ericsson, more than 70% of global service providers offered FWA in 2021, and connections are expected to exceed 180 million by the end of 2026. 5G FWA connections are expected to surpass 70 million by 2026, with installations focused on regions with low fixed broadband penetration like Africa.

The wider rollout of 5G FWA isn't without its challenges, though. High infrastructure costs, compatibility challenges, spectrum allocation standardisation, power dissipation in MIMO, and inter-cell interference are all potential roadblocks. Although 5G FWA will be unable to compete with fibre in those regions where extensive digging and laying makes sense, it is expected to play a valuable role in delivering connectivity in fibre-free areas. OMDIA has speculated that households in sub-Saharan Africa alone account for an addressable market of 142 million for FWA; a bright future indeed for those in the value chain. ■



Connecting Africa

Global Connectivity Report 2022 - ITU

The impact of connectivity

The impact of internet connectivity on businesses, governments and individuals is far-reaching, delivering significant economic benefits. Generating productivity gains and innovation, the internet contributes to job creation and economic development. Governments use the internet to deliver essential public services such as education and healthcare, some at reduced cost and with greater reach. The internet can also enable other government services such as business registration and tax collection, and to deliver benefits.

An ITU study shows that a 1% increase in fixed broadband penetration increases gross domestic product (GDP) in a country by 0.08%, while a 1% increase in mobile broadband penetration increases GDP by 0.15%. While the economic impact of fixed broadband is greater in more developed countries, mobile broadband benefits are maximized in developing countries, where mobile tends to be the way most people access the internet. In Africa, a 1% increase in mobile penetration is estimated to increase GDP by 0.25%. Mobile broadband penetration in Africa increased from just under 30% in 2018 to just over 40% in 2021; this 10% increase corresponds to an increase of 2.5% in GDP.

The benefits of connectivity are considerable for society. There exists a very close relationship between connectivity and human development, although the relationship works both ways: connectivity drives development and more development leads to more connectivity. The benefits of connectivity are considerable for the marginalized and vulnerable, typically the least connected populations. Connectivity can reconnect refugees with their communities and provide online services including education, employment, and financial support.

Fixed broadband access

Today, there exists high-speed fixed and mobile broadband networks that deliver always-on internet access in most countries.

Although more people use mobile networks than fixed networks for internet connectivity, the latter remains important. Fixed broadband networks generally have a higher data capacity than mobile networks, and download limits are higher than similarly priced mobile broadband plans. They are faster and are more reliable than 3G or 4G networks, making them more suited for high-bandwidth activities such as games and video calls.

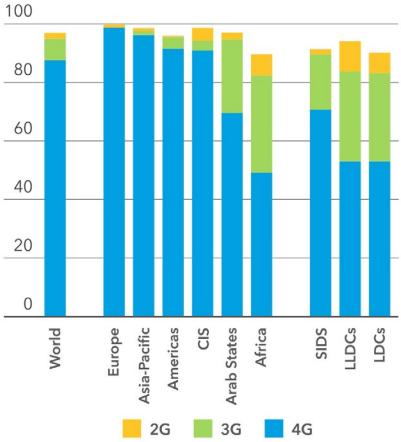
Fixed broadband networks are expensive to roll out, maintain and upgrade, depending on the geography and extension of the territory. The topology of many fixed broadband networks consists of fibre-optic rings with access points from which homes and businesses are connected. For efficient and profitable network deployment, there must be a high geographic concentration of households and businesses.

However, most people do not have access to fibre optic networks because of their location. Globally, only 2.3 billion people (29%) lived within 10km of a fibre-optic network in 2021 and living within 10km of a fibre-optic network is no guarantee of a connection for many reasons, including the absence of a point of presence (PoP), optical-line terminal or fibre-optic drop to connect the network to the home or office. In Africa, just 25% of the population lives within

10km of a fibre-optic network.

For a household to access a fixed network, a 'last mile' connection is needed. In Africa only 7% of households can potentially subscribe to a fixed network (for LDCs this figure is just over 1%). No access to a fixed network impacts the number of fixed broadband subscriptions. In Africa and in LDCs and LLDCs, few subscribe to fixed broadband services.

Percentage of the population covered by a mobile-cellular network, 2021



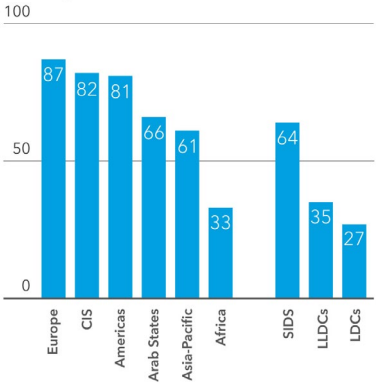
Connectivity divides

The COVID-19 pandemic has highlighted the importance of fast and affordable internet. In the first year of the pandemic, percentage growth of internet users was the highest in a decade.

In 2021, an estimated 2.9 billion people were still offline. Most of the global offline population, 1.7 billion people, reside in Asia Pacific, followed by Africa with 738 million people offline. In percentage terms, Africa was the least connected region in 2020, with 67% of the population offline.

The share of internet users is estimated to be twice as high in urban areas as in rural areas in 2020. In Africa, internet use in urban areas was

Percentage of the population using the Internet, 2021

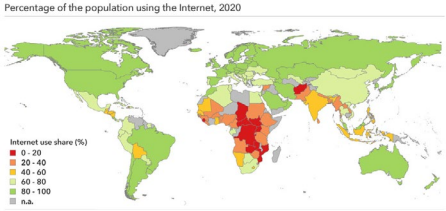


Note: CIS = Commonwealth of Independent States.
Source: ITU.

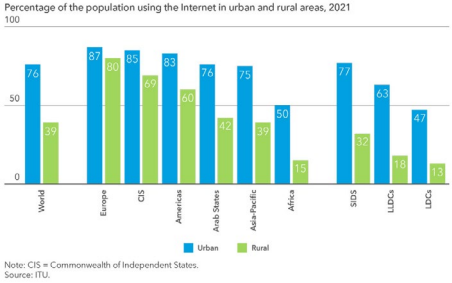
almost 3.5 times as high as use in rural areas. Lower rural usage is partly a result of a lack of infrastructure, but there are additional factors at play. Rural areas usually have lower income levels, and the population often has lower levels of education and lower levels of ICT skills, all of which are negatively correlated with internet use.

Combining data on coverage and internet usage makes it possible to distinguish between those not using the internet because of a lack of infrastructure, and those not using the internet for other reasons. In Africa, almost 30% of the rural population cannot access the internet, 18% of the rural population has no mobile network coverage, and another 11% only has access to 2G. In rural Africa, just 15% of the population

Percentage of the population using the Internet, 2020



Note: The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of ITU and of the secretariat of ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries. The base map is the UNmap database of the United Nations Cartographic Section.
Source: ITU.



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Source: ITU.

uses the internet and the coverage and usage gaps are almost the same size, whereas in Africa's urban areas, mobile broadband coverage is almost universal and only a usage gap exists.

Users judge their broadband quality on their experience of connection speeds. Speed is another dimension of the digital divide, reflected by median download and upload speeds. In low- and lower-middle-income economies, mobile broadband offers the faster alternative (this is the case across African countries), while in high-income economies, fixed-broadband speeds are 30-50% faster.

While mobile networks provide a comparable alternative to fixed networks in most parts of the world concerning download speeds, there is a clear gap between the upload speeds. Mobile upload speeds measured in the different regions are surprisingly similar, remaining around the global median of 10-12Mbps, with Africa scoring the lowest in 2020 at 8Mbps. Users on fixed networks, on the other hand, could benefit from 2-3 times faster upload speeds than those in the same region using mobile networks.

Affordability challenges

Device pricing is a significant barrier hindering digital adoption. Price reduction has its challenges, however. Very few countries manufacture and control pricing, and importing countries have no say in how the pricing is arrived at.

Governments affect device price by imposing import duties and sales taxes. The World Trade Organization (WTO) Information Technology Agreement (ITA) calls for countries to eliminate duties on IT products. Despite the initiative having 82 signatories, many of the world's poorest countries, particularly in Africa, have not signed.

A4AI reports that the average global smartphone price in 2021 was around 25% of monthly income, rising to 53% in LDCs. A4AI calls for using USF funding to subsidize the cost. Some operators are playing their part to lower handset costs. Working with Chinese manufacturers, MTN has introduced a handset that costs less than US$40 across its markets. In Zambia it is subsiding handsets, and in Uganda it offers customers an instalment plan amounting to US$0.17/day. China's mobile phone manufacturer TECNO has the highest mobile phone sales in Africa because it sells affordable handsets.

There are concrete measures that can make data more affordable in low- and middle-income countries. Governments can:

- Ensure provision of unlimited broadband access to community centres and schools, with access to those in the surrounding community who cannot afford it at home
- Ensure that temporary COVID-19 concessions that were established by operators in many countries (higher data allowances or providing free WiFi) are maintained for the poorest segment of the population, those needing medical support, and students
- Subsidize data use for the poorest segment of the population through social tariffs
- Apply zero ratings for critical services such as e-government, education, and health services
- Create charitable data donation schemes

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Achieving meaningful connectivity in Africa

Great strides have been made in the maturity of ICT regulation in recent years to achieve universal and meaningful connectivity. However, the weakness of institutions in many countries remains an impediment to the development of a robust and well-balanced market to connect the unconnected.

More effective regulation is needed to combat market dominance of incumbents in both fixed and mobile markets. It remains challenging for new players to enter the market, with barriers to entry including tariff-mediated network effects, anti-competitive measures taken by incumbents, and the high cost of building a network. Effective regulation would allow countries to apply necessary competitive levers such as interconnection, wholesale access regulation, infrastructure sharing, and pricing transparency.

Universal service funds have been largely unsuccessful on the continent, often sitting unused or misused, instead of connecting the unconnected. The effect has often been counterproductive. Extractive rents in mobile company taxation in some instances and secondary taxes through universal service funds have often increased prices of services and devices, constraining the take-up and use of broadband services.

There are several ways governments could address these challenges:

- Enabling environment for the entry of service providers with low-cost access business models
- Removing customs or excise tax on entry-level devices
- Scrapping regressive end-user taxes on social networking platforms, which are often the most cost-effective communication means for those in the subsistence economy
- Providing free public WiFi at all public buildings
- Exploring new forms of demand aggregation that will allow people to connect through public WiFi and mesh networks from their homes
- Exploring long-term public sector anchor tenancies to get adequate infrastructure to underserved areas

ITU has initiated several multistakeholder partnerships and is contributing to several initiatives.

Mobile- and fixed-network infrastructure. Fixed connectivity was initially provided by state-owned operators. Sector reform then liberalized telecommunication markets and allowed for competition; private operators have since expanded the availability of mobile services and competition in broadband services, built on spectrum allocated by ITU. However, gaps remain which stakeholders are working to fill and that governments are targeting through broadband plans, universal access and service funds. These plans are promoted by the Broadband Commission for Sustainable Development. The World Bank Group is supporting the Eastern Africa Submarine Cable system (EASSy), a regional first, with a novel open access model. The Internet Society is helping develop community networks. Meta is now investing in submarine cables and WiFi platforms.

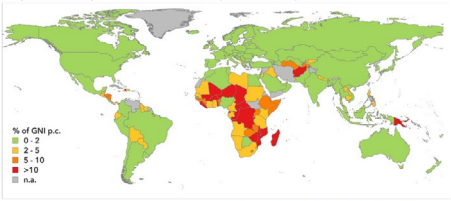
Affordability of connection and device. The Alliance for Affordable Internet works to reduce connectivity and device costs, setting an affordability target where 1GB of mobile broadband data costs a maximum 2% of average monthly income, also supported by the Broadband Commission. GSMA has a focus on meaningful connectivity, highlighting tax impact

on consumers and operators.

Access to mobile and fixed devices. Some companies seek increased availability of smart devices, lowering manufacturing costs and addressing taxation. Safaricom and Google are helping make devices more affordable by spreading the cost, while KaiOS offers an operating system that makes less expensive phones 'smart' for as little as US$10.

Digital skills. The International Labour Organization has a focus on digital skills for decent jobs, including the Digital Ambassador Program developed by the Digital Opportunity Trust, a Canadian non-profit organization that provides digital skills to people across Rwanda.

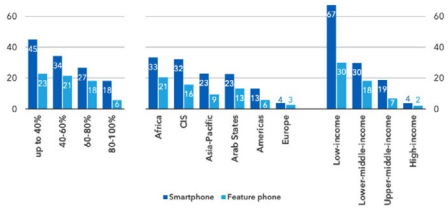
Entry-level data-only mobile-broadband basket prices (% of GNI p.c.), 2021



Notes: Refer to the methodology document, available at: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2021/ITU_ICT_Prices_Methodology.pdf, for a description of the basket.
The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of ITU and of the secretariat of ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries. The base map is the UNmap database of the United Nations Cartographic Section.
Sources: ITU and A4AI for price data, World Bank World Development Indicators for GNI per capita data (retrieved November 2021).

Affordability of smartphones and feature phones

Median price (percentage of monthly GNI per capita), 2021



Connection security and navigation safety. ITU has several initiatives to help build cybersecurity confidence including its Global Cybersecurity Index to help foster the capabilities of nations. The World Economic Forum helps improve digital trust, while the Internet Society has initiatives strengthening the Internet. Microsoft helped to set up the CyberPeace Institute and brokered the Cybersecurity Tech Accord. ■

Developments in the African telecommunications sector

Africa Telecommunications Sector 2021-2022 - EMIS

With the spread of COVID-19 in early 2020, the telecom sector became an anchor for economic activities to continue.

However, switching to working from home and online classes has been a challenge for Africa, where one third of the world's population lives without internet. In 2020, of the 3.2 billion people who don't have access to the internet, 871 million live in Africa, according to Visual Capitalist and DataReportal. It is important to account for the various challenges in the African industry such as access to electricity, lack of well-developed digital infrastructure and regulations, as well as the ability of the population to use digital solutions, where they are available.

Internet usage

According to the World Bank Report, African countries spend about 1.1% of their annual GDP on digital investment, while that share for advanced economies averages 3.2%. In terms of internet usage, Africa is at the bottom of the global ranking with only 28.2% of its population using the internet, below the world's average of 53.6% and well below the 82.5% in Europe, according to the ITU.

Africans log into the web mainly via their mobile phones with the number of mobile internet users at 335 million at end-2019. Just 10% of these subscribers use 4G technology. In the wake of COVID-19, meaningful participation in the

digital economy requires high-speed broadband connection to the internet. Cable.co.uk reports that 32 of the 50 slowest-performing countries in terms of broadband download speed are located in Africa. Northern Africa performed worse than sub-Saharan Africa with Algeria (1.83Mbps) and Libya (2.60Mbps) offering the slowest speeds, while the best performers are Madagascar (18.00Mbps), Réunion (16.35Mbps) and South Africa (14.04Mbps).

Mobile services

While most African countries have made rapid advances in mobile phone and mobile internet penetration, ICT infrastructure is not fully developed. The leading economies – Kenya, Nigeria, and South Africa – have developed next-generation mobile and digital networks, but smaller economies still rely on legacy network technologies like 2G. Infrastructure deployment in sub-Saharan Africa increased 3G coverage from 63% in 2017 to 70% in 2018, extending access to more than 80 million people.

Africa's telecommunication sector has been growing rapidly in recent years, driven primarily by the mobile services segment. Mobile telephone subscriptions grew at a CAGR of 8.3% over 2009–2019, the fastest in the world and above the global CAGR of 6%, according to ITU data. That helped Africa claim a share of 11.9% of all mobile users worldwide in 2019, second only to the Asia Pacific region, which accounted for a share of 57%. ITU estimates subscriptions in Africa, excluding the Arab countries, grew by 5.5% year-on-year (y/y) to 882 million in 2020. The growth was supported by the increased impact of the mobile economy during the pandemic. Post-pandemic growth drivers will include an increase in private consumption once the African economies recover, strong and growing developer and digital talent, coupled with investments in digital infrastructure.

The number of active users, however, stands significantly below the number of subscriptions (at 335 million as of end-2019), due to widespread multiple SIM card ownership. This practice is driven by the still insufficient quality of mobile services. Moreover, prepaid subscriptions still have the lion's share across the continent. In terms of users and revenues, the mobile segment is currently driven mainly by mobile data and mobile money services.

While 60% of Africa's population accesses the internet via mobile, most mobile connections are through 2G networks, with the affordability of 4G devices the main barrier to smartphone adoption. Though the average selling price of smartphones has reduced significantly recently, many Africans remain unable to afford the one-off upfront cost. Still, there has been an increasing demand for high-speed internet and GSMA Intelligence forecasts sub-Saharan Africa's 3G and 4G broadband connections will account for 54% and 31%, respectively, of all connections by 2025. The share of 5G connections is seen reaching a mere 3% in 2025.

Broadband strategy

Though internet access has improved significantly in recent years, Africa lags far behind global development. ITU reports that 299 million Africans were using the internet at the end of 2019, nearly five times more than 2009, but accounting for just 8% of the world's total users. The strong penetration of mobile services has contributed significantly to improved internet access. The number of active mobile broadband users in Africa expanded at a CAGR of 45.1% over 2009–2019, nearly double the 25% pace at which global subscriptions grew over the same period.

As part of efforts to support investments in

telecom infrastructure by the end of 2019, 50 African countries adopted a national broadband strategy. A significant milestone was also achieved in February 2020 when the Digital Transformation Strategy for Africa was adopted by the African Union Commission. Under these strategies, investments are directed towards terrestrial backbone fibre and undersea fibre-optic cable projects, among other things. In 2020, 25 backbone fibre projects were announced. Among these, the 'One Africa' fibre-optic network project stands out, as it is planned to connect Cape Town in South Africa with Cairo in Egypt. Undersea fibre-optic cable projects also saw development, the most notable being the launch of the South Atlantic Cable System, which provides a direct connection between Africa and South America (Angola and Brazil), offering alternative lower-latency routes to the Americas.

The digital economy

More pivotal for the growth of the telecommunications sector is the growing digital economy in Africa. The digital market has attracted more venture capital and has championed growth in many sectors, including maturing ones such as the mobile money market in Kenya. The digital economy has also bred new talent within the continent's youthful population. There are now over 618 tech development hubs across Africa.

The internet economy is also offering leapfrog opportunities to address challenges faced by informal businesses and workers. Informal businesses represent 92% of firms in Nigeria and 99% in Ethiopia. Businesses in Africa's informal sector have less access to finance and limited use of modern business practices, especially in accounting. They also face higher costs in dealing with suppliers or clients due to poor logistics, multiplicity of middlemen, and the prevalence of cash transactions. In the informal sector, access to electricity is less certain, especially in rural areas, and the overall business environment is unstable. However, most workers in the informal sector own a mobile phone, with ownership broadly correlating with access to digital connectivity at the national level. There are 1.2 million informal retailers in sub-Saharan Africa already engaged in the distribution of mobile services.

COVID-19 has highlighted how digital platforms addressing the informal sector can support societal resilience. In several markets, digital platforms were critical in supporting government responses to the outbreak, particularly in reaching the underserved, as they were able to quickly re-engineer their platforms. For instance, Twiga Foods has partnered with Jumia to deliver agricultural produce to consumers. The government of Nigeria is relying on payment service providers to provide cash transfers to 3.6 million impoverished households. Digital platforms have enabled the rapid deployment of social protection programmes and enabled some essential government services to remain operational.

In 2019 the number of registered mobile money accounts in sub-Saharan Africa increased by 12% y/y to reach 469 million, of which active accounts made up 181 million, according to GSMA Intelligence. A total of 23.8 billion digital transactions were made in the region in 2019 and their value stood at US$456.3 billion, up 27.5% y/y. For the Middle East and North Africa, the figures show that there were 51 million registered mobile money accounts (91 million active) in 2019, when 663 million digital transactions were made at the value of US$9.1 billion, up 37.4% y/y. ■

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Satellite in Africa

African Space Industry Annual Report 2022 – Space in Africa

The African space economy continues to grow at a higher rate than Africa's GDP and is fast becoming a strategic tool to boost the national economy and contribute toward achieving the Sustainable Development Goals (SDGs). The African space industry was valued at US$19.49 billion in 2021 and is projected to grow by 16.16% to US$22.64 billion by 2026.

Increasing financial investment from governments

African nations allocated US$534.9 million to national space programmes in 2022, a 2.24% increase from the revised US$523.3 million in 2021. National budgets consistently contribute to the industry valuation annually, and governments' contributions increased by 80.83% in 2021 from the revised US$289.33 million in 2019 to US$523.2 million. Many African countries are also improving their space application goals as different national priorities span space democratisation, propulsion and launch technology development, human capacity development, and local and international space partnerships, amongst others.

Growing satellite communication market

The satellite communication market, which includes fixed satellite services (FSS), mobile satellite services (MSS), and satellite TV services, accounted for a major share of the African space and satellite industry valuation in 2021.

There has been a paradigm shift from large to small satellites, primarily due to the high cost of manufacturing large satellites and the long development time. The possibilities for small satellites are endless, with several applications being explored to have a tangible impact and directly translate to socioeconomic and environmental development in Africa. These innovative small satellite applications include the Internet of Things (IoT), weather forecasting and early warning systems, crop and livestock monitoring for agricultural purposes, etc.

The ground segment market has massive potential in Africa. Many African countries want to develop and launch satellites in the next five years and since nearly all missions, including commercial, military, or scientific payloads, use space ground systems for launch and on-orbit operations, the ground segment is expected to boost the African space market.

However, there exists a downward trend within the satellite component manufacturing segment, attributed to the reduction in revenues of some companies, several companies closing down, while some are still working on marketing their first products and, as such, have not been generating revenues. With more companies growing their market base and others generating income from the sale of the new products, satellite manufacturing is expected to grow in the coming years.

Flourishing NewSpace industry

In 2022, Space in Africa estimates that 272 NewSpace companies are charting the course of space democratisation on the continent. These companies, domiciled across 31 African states, are innovating novel methods of leveraging space technologies and its derived data to develop cutting-edge technologies and solutions across several fields, including manufacturing, medicine, transportation and logistics, and much more.

These companies provide goods or services primarily to other private sector entities (B2B) and/or consumers (B2C), and sometimes, the government. Furthermore, in most African regions, private companies leverage space systems and infrastructures built by the government and/or foreign organisations to provide niched solutions/services, including decision-ready datasets, satellite and component manufacturing, and satellite communication services (e.g. internet services, DTH TV, satellite radio, etc.).

Increased investment in human capital development

Human capacity development is the bedrock of Africa's space ecosystem development and has prompted considerable investment from several African public and private actors. The long-term goal of any capacity development programme is to bring about a more robust national space ecosystem in African countries. However, the current landscape of the African space industry shows a lack of skilled human resources across all space industry sectors, making it difficult to take advantage of several technological advancements. Also, the lack of infrastructure at different levels of the education sector to support human resource development has slowed the progress across the continent.

Despite this, the continent is beginning to witness slow but consistent growth, especially with improved investment from all space actors to enhance the education and training of experts, creating the required testing and building infrastructure, enabling the environment to foster international cooperation and the necessary legal and regulatory frameworks. To this end, several capacity development initiatives have been organised to proffer solutions to the industry's human capital gap and establish a sustainable talent pipeline to meet future skills needs. ■

Amy Saunders,
editor, African Wireless Communications Yearbook

Critical communications go digital

The necessity of critical communications capabilities has never been more keenly felt than in recent years. With soaring environmental instability, geopolitical tensions and the first global pandemic in modern history, access to ensured, reliable and secure communications is an absolute must.

In times of crisis, critical communications, whether they be satellite, radio, TETRA etc. make all the difference in safeguarding personnel, wildlife, and property. Meanwhile, critical communications are also game-changing for a wide variety of everyday operations that happen to be located in remote, rural and often dangerous locations; mining, oil & gas, utilities, fishing, agriculture, etc., helping maintain employee safety and wellbeing, as well as smooth running of business activities.

The global critical communications market is booming, with Research And Markets' outlining a global market value of US$17.04 billion in 2022, which is expected to expand at a compound annual growth rate (CAGR) of 9.02% to US$26.24 billion by 2027. In the Middle East and Africa, meanwhile, the mission critical communications market is expected to expand from US$1,175.96 million in 2022 to US$1,876.11 million by 2028, a CAGR of 8.1%.

Wireless communications have become mission critical for a whole host of new applications in recent years, with remote monitoring of facilities, factories, networks, crops, and herds, all now essential to enterprise operations. This swing towards Industry 4.0 and the adoption of IoT technologies has played a major role in driving the critical communications market both globally and in Africa. The COVID-19 pandemic, too, further boosted critical communications demand among first responders, utilities, healthcare, government, and other essential services.

As with so many other spaces, critical communications are undergoing a digital transformation of their own, with the industry moving forwards on the conversion from analogue to digital. While analogue has historically proven extremely effective over the decades, the limits of innovation have been reached. OMDIA has forecast that by 2025, more than 80% of global critical communication radio installed base will be digital. Moreover, the Middle East and Africa region is expected to lead the pack with more than 95% of its land mobile radio (LMR) users converted to digital by 2024.

In the face of continually evolving threats and an ever-changing environmental and political landscape, critical communications systems exist in a state of constant evolution by necessity, to stay ahead of emerging developments and threats. This is likely to remain the state of play for the foreseeable future. ■

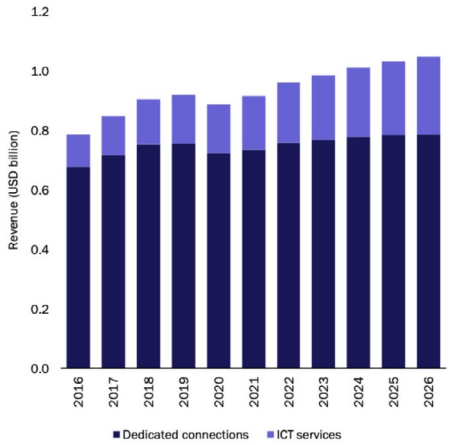
Developments in connectivity

sub-Saharan Africa telecoms market: trends and forecasts 2021-2026; 5G deployment tracker - Analysys Mason

Analysys Mason has forecast in its 'sub-Saharan Africa telecoms market: trends and forecasts 2021-2026' report that operator revenue for dedicated connection services will grow from US$734 million in 2021 to US$786 million in 2026. These services include uncontended data connectivity for businesses, such as dedicated internet access and point-to-point connections based on MPLS and Ethernet. Demand for dedicated connections is increasing to support the growing migration of business applications to the cloud.

Meanwhile, fibre infrastructure investment by operators is increasing the availability of such connectivity. However, revenue growth will be limited by price competition and the availability of alternative solutions based on high-quality broadband services coupled with SD-WAN, and other software-enabled network services.

Operator revenues from business ICT services will grow at a compound annual growth rate (CAGR) of 7.6% over 2021-2026 to US$261 million. ICT services include security, unified communications, co-location and hosting and cloud services such as SaaS and IaaS. The growing presence of hyperscalers across Africa - AWS, Azure, Google and Huawei Cloud - is helping



to stimulate demand. Many operators in the region have invested in partnerships with cloud players and IT vendors as well as developing their own capabilities to deliver ICT services.

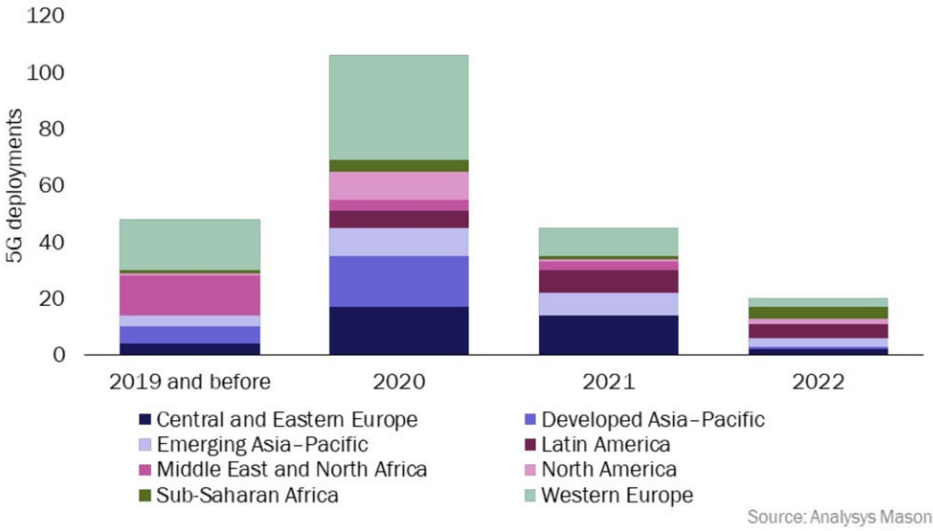
Deploying 5G

The latest version of Analysys Mason's 5G deployment tracker shows that an additional 62 operators are either planning their networks or are expecting to launch by the end of 2022 or at the start of 2023. Most 5G network launches between 2019 and 2020 took place in Europe and developed Asia Pacific.

However, from 2021, operators in sub-Saharan Africa (SSA), Latin America and emerging Asia Pacific (EMAP) have become increasingly active, despite regulatory barriers that have hindered deployment. To date, a lack of regulatory clarity regarding the price and availability of additional spectrum for 5G services has forced delays and the withholding of investment decisions in these regions.

Most operators in SSA have prioritised 4G network investment and the region had just six commercial 5G networks in 2021. Large parts of SSA are affected by a lack of clarity regarding long-term licensing of 5G spectrum bands and spectrum prices, which has hindered 5G development within the region. However, countries such as Réunion, South Africa and Zimbabwe have since made progress with deploying 5G.

Compared with other operators in SSA, South Africa has reasonable amounts of legacy 2G and 3G spectrum that can be re-farmed to 5G technology, and this has influenced the speed of deployment. The number of 5G connections in SSA is expected to increase at a CAGR of 160% between 2021 to 2024.■



Operational 5G network launches by region, 2019–2022

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Digitising agriculture – the slow spread of 4IR

Louise Fox,
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Overcoming the barriers to technology adoption on African farms

sub-Saharan Africa's agricultural sector is widely recognised to have vast, under-utilised potential. Land and labour productivity are low compared to other regions and have barely increased over the last 20 years. Low productivity has created widespread rural poverty and food insecurity.

Scholars, development organizations, and some entrepreneurs have identified digital technologies associated with the Fourth Industrial Revolution (4IR) as one potential path toward overcoming these productivity challenges.

Anecdotal evidence from well publicized start-ups - such as Hello Tractor, a tractor-sharing platform in Kenya; and Zenvus, a Nigerian soil mapping company - have fuelled a narrative that digital agriculture represents the key to delivering productivity gains to African start-ups. Yet as a recent FAO report admitted, hard evidence that digital agriculture is delivering on this promise is difficult to come by, as long-standing challenges persist in preventing to fully unlock the potential of these technologies.

The optimistic narratives around African farmers' adoption of technology often overlook the more long-standing challenges they face that are preventing the adoption of much older productivity-increasing technology, such as fertilizers and conventionally produced hybrid seeds. For digital agriculture to be effective and transformational in Africa, a concerted effort to address Africa's long-standing agricultural productivity challenges is needed.

What is the digital agriculture narrative about?

4IR technologies offer significant productivity and income-enhancing potential on the farm and post-harvest. Possible applications include:

- Farmer-tailored digital information platforms could help farmers quickly obtain knowledge, such as how to acquire and use new technologies (extension information), weather advisories, prices and buy offers from traders, and how to rent agricultural equipment.
- IoT technology could help farmers track soil composition, crop growth progress, weather effects, and the presence of disease, allowing farmers to react swiftly to problems such as a lack of water or nutrient deficiencies. IoT technology can also monitor post-harvest storage conditions to ensure that spoilage does not occur.
- High-productivity, disease-resistant seed varieties developing using CRISPR gene-editing technology could reduce risk to farmers while increasing yields.

These applications are currently in wide use in developed and emerging market countries in other regions, but aside from some technologies like mobile phones used to connect suppliers

and traders, most African farmers are not using contemporary technologies. Where they have been used, evidence has emerged that, although access to mobile phones has improved market performance in agriculture at the macro level, the impact at the micro-level is heterogeneous. At the micro level, mobile applications have not systematically improved farmgate prices or on-farm earnings for the average farmer, although they have in some cases reduced price dispersion, especially for perishable crops such as bananas, suggesting that some farmers, possibly in more remote areas, have benefited.

Why have 4IR technologies spread so slowly on African farms?

One reason for the slow pace of technology diffusion among the African agricultural sector is limited internet access. In rural areas, less than 30% of adults report having access, mostly to mobile broadband at 2G and 3G speeds, which is inadequate for many applications. Without access to information about technologies that might improve yields and without the internet speeds to run relevant applications, technological developments aren't reaching those who need them most.

Other perhaps more important obstacles to technology diffusion are agricultural policies and contexts that make technological adoption unappealing for farmers. Producers adopt new technologies when they solve a current, urgent production problem at an affordable cost. However, context-specific constraints lead many producers to conclude that the risks inherent in the new technology outweigh the benefits. These constraints include the cost of the technology, a lack of information on how to use the technology, poor access to markets, or expensive or lacking complementary inputs (such as energy, water, or transportation). According to recent surveys of the state of agricultural technology adoption in Africa, context-specific constraints have hindered the adoption of existing technology (such as fertiliser and hybrid seeds) and will probably limit the adoption of 4IR technology on the farm in the near future.

These challenges include:

- Limited supplies, high prices, and uncertain quality of modern inputs, increasing the risk associated with technology adoption.
- Uncertain and limited rainfall and lack of irrigation and other systems of water management.
- Lack of secure land tenure, which deters on-farm investment and is leading to declining soil fertility.
- Poor roads and minimal information and telecommunications infrastructure, resulting in high transportation costs and greater information frictions and marketing transaction costs, causing farmers to receive a smaller share of the final product price.
- Low public investment in agriculture, especially in R&D, so that there are few science-based options that can be tailored to sub-Saharan Africa's many microclimates.

The African agricultural productivity challenge is hard, and there are no easy solutions. Rural areas in Africa are less densely populated than in Asia, which contributes to the high cost of inputs and infrastructure expansion. Agro-ecological conditions show tremendous variation in Africa, increasing the need for local and context-specific agricultural research and

development, which is one reason why this has not yet been a 'Green Revolution' in Africa. Land tenure issues are tricky to resolve when so many rural households working on small plots of land depend on farm production for food security and income.

Green shoots of progress

The past 20 years have brought important changes to African agriculture. Africa recorded the highest average annual production growth rate of all regions in the world - nearly 4%. Although much of this increase was based on land expansion, several African countries recorded positive total factor productivity growth (that is, more output per unit of inputs), including Cameroon, Ethiopia, Ghana, Mozambique, Senegal, and Sierra Leone.

Meanwhile, where ICT infrastructure is available and service cost is affordable for rural households, research suggests that use of mobile phones and the internet have raised household incomes. However, this has occurred by raising incomes off the farm in small-scale nonfarm household enterprises, not by raising agricultural incomes.

What can be done?

Agriculture remains an important sector in African development strategies. Growth in agricultural production supports both sustained economic growth through structural change, as well as poverty reduction.

A recent survey of research on African agricultural technology use and productivity gains concluded that much more remains to be learned about how to increase technology adoption and productivity on African farms. The authors suggest that given the multiple constraints farmers face, multi-faceted interventions at the local and national level may be required. In thinking about how to encourage technology adoption on African farms, we suggest that:

Governments need to continue to support agricultural R&D. Donors and supporters should work with research institutes to help deploy technology advances such as CRISPR to speed up the process and allow the effective development of high-yielding and disease resistant seeds.

Energy and transportation infrastructure investments in rural areas should remain a high priority. Whole supply chains are disrupted when power is unavailable, or perishable items are not able to reach their destination in a timely manner.

Given the heterogeneity of farmer conditions and needs, NGO- and private sector-led farmer-tailored programs may be required, whether related to land and farm management, access to markets, access to finance, value chains, among others. Local governments can help support this approach. Stakeholder attention should be directed at fostering, evaluating, and, if successful, scaling up these programs.

Innovators and entrepreneurs need to develop and scale appropriate technologies that address the most urgent challenges faced by farmers and are affordable enough to be systematically used in a productive manner.

Expanding access to ICT services in rural areas should be a priority even if the benefits for farm incomes are elusive for now. Helping households to shift their working hours into more lucrative activities off the farm has widespread, long-term benefits. If more intensive, context-specific, local agricultural research is able to achieve new breakthroughs, ICT platforms can help spread the message. Eventually, when other farm productivity constraints are reduced, and the cost of new technologies is reduced as well, the digital revolution could eventually benefit African farmers. ■

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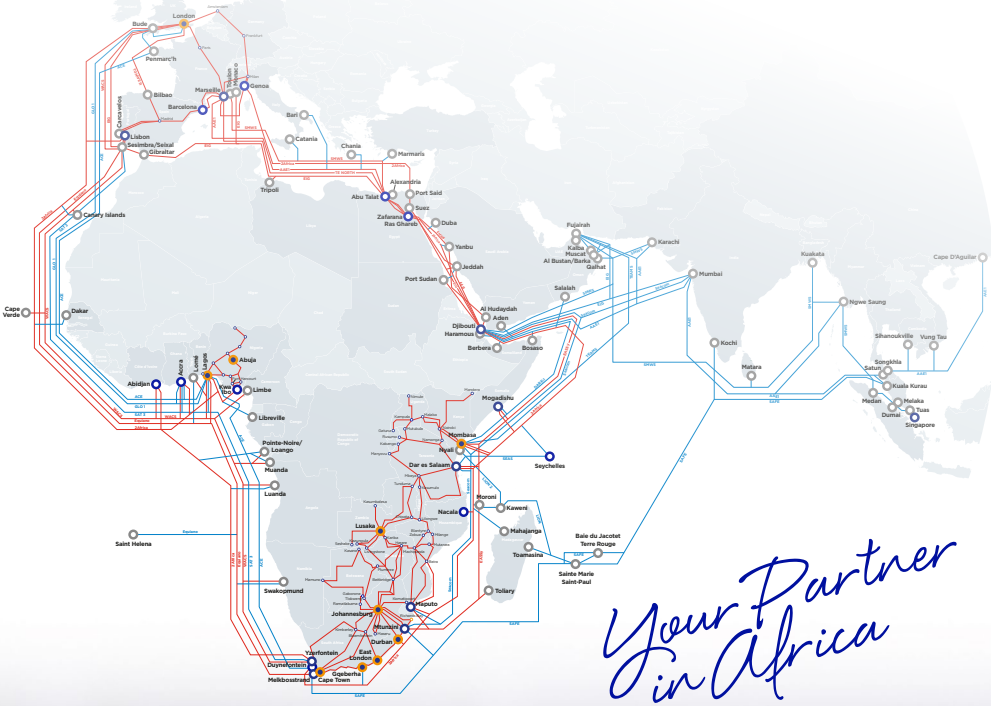
Africa's Digital Backbone



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Maagatha Kalavadakken,
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Telcos under pressure

The past ten years have been both transformational and disruptive to the telecom companies' business model. This trend has been driven by gains in broadband penetration and growing internet adoption. As the COVID-19 pandemic began to spread, demand for traditional phone calls and SMS had already been declining and was being radically substituted and displaced by instant messaging and internet-enabled voice and video calls.

The African telecommunication sector has matured and has positively and significantly impacted the growth of the economies on the continent in many ways. From enabling access to banking via mobile phones to connecting the formal and informal economies that exist in the region. However, the COVID-19 pandemic highlighted the need for a more robust and inclusive telecommunication sector in the face of national lockdowns.

COVID-19 has had a significant impact on the global economy as whole. Many countries instigated a form of lockdown, with the strictest level allowing only essential services to operate while the rest were encouraged to work from home. Consequently, many business including telcos have been disrupted amidst the economic slowdown. For African countries, while both the public and private sector rose to the challenge by increasing the bandwidth as demanded by the increased data traffic due to people working from home, existing challenges saw the majority excluded.

The pandemic has put telcos under immense pressure to accommodate increased network traffic, which required additional spending on critical infrastructure and digitalisation. This, coupled with reduced consumer spending has exerted added cashflow pressure and depleted margins for telcos.

Looking forward, as the economies recover so will demand for mobile internet services, as the use of WhatsApp, Facebook, and video call services will continue to dominate the market, providing telcos with opportunity to grow revenues. The three main telecoms in Africa – MTN, Orange and Airtel – have all revealed their strategies to expand their 3G and 4G coverage across the continent. This move is expected to diversify and grow their revenues in future. ■

"The pandemic has put telcos under immense pressure to accommodate increased network traffic, which required additional spending on critical infrastructure and digitalisation. This, coupled with reduced consumer spending has exerted added cashflow pressure and depleted margins for telcos."

Amy Saunders,
editor, African Wireless Communications Yearbook

Modernising data management

Africa's data centre market is small but growing rapidly, with revenues expected to expand at a compound annual growth rate (CAGR) of 12% between 2019 and 2025 to reach US$3 billion. Demand is booming for cloud services and modular data centre solutions from government and enterprise, with more than 70% of African organisations forecast to move to the cloud by 2025. In 2021, Africa accounted for less than 1% of global colocation supply, but Xalam Analytics expects this to reach 25% by 2023.

MNOs on the continent are experiencing exponentially growing voice and data volumes across their networks as a result of wider mobile adoption, increased geographical coverage, 5G and IoT. The market is also expected to be boosted further by data sovereignty regulations, which require localised data storage. Accordingly, Africa's MNOs are rapidly turning to data centres to keep pace with data storage, processing and dissemination demands. Indeed, the third quarter of 2021 saw almost 78 exabytes of data traffic pass through global telecommunications networks, up from 55 exabytes in the same quarter of 2020, as per Statista.

Africa's data centre capacity – currently standing at 140,000 square metres in more than 100 facilities – is unevenly distributed, with South Africa boasting more than 66% this year. A mixture of factors has led to this situation, including the large economy, the location of subsea fibre optic cables, the proximity to NAPAfrica – the country's largest internet exchange · and of course a well-established telecoms market. Kenya, too, hosts a large volume of the continent's data centre capacity. The country is conveniently cited on four major subsea cables and boasts several strong cross-border fibre connections.

"Africa's MNOs are rapidly turning to data centres to keep pace with data storage, processing and dissemination demands."

The State of the African Data Centre Market report from Oxford Business Group and the African Data Centre Association states that some 15 African nations have populations and economies large enough for the development of data centres and cloud service ecosystems.

The International Data Corporation has forecast cloud computing subscriptions to expand from US$370 million in 2019 to US$1.7 billion in 2024 – for South Africa alone. Government and banks are particularly interested in migrating operations to data centres as they expand their digital offerings.

The future for African data centres looks bright; however, with global data centre facilities consuming up to 3% of power produced, and consuming massive quantities of water for server cooling, more focus on creating climate neutral data centres is required. ■