



Data Centres in Africa Focus Report

In collaboration with



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Foreword



Ayotunde Coker,
Chairman, Africa Data
Centres Association
(ADCA)

Many of the necessary ingredients to drive scale in the data centre industry in Africa are beginning to come together. A large, young population, combined with growing network penetration, is expanding access to higher-speed telephony. Mobile telephony will remain the dominant access point to the internet across Africa, where consumers continue to buy products and consume content primarily via mobile phones. As a result, we are seeing strong fundamentals that favour Africa as a destination for data centres. The region has demonstrated its ability to innovate and technologically leapfrog mature markets: it happened with telephony, and it is happening with financial technology and countless other technological innovations.

We have multiple data centre clusters emerging already, including South Africa, Kenya, Ghana and Nigeria. Ethiopia is a particularly interesting market, as it has significant opportunity for deregulation and growing broadband availability, as well as many competitive advantages that put it in a strong position to expand, although recent local developments have added some uncertainty regarding the country's stability. Nigeria also offers standout opportunities for growth and is expected to be a global data centre powerhouse. The country has a large population, of which approximately 150m people use the internet, a broadband penetration of nearly 45%,

and an advantageous geostrategic location. Indeed, geography is an important element to consider when constructing data centres: North Africa's data centre development is likely to be constrained due to its proximity to European data centre clusters, particularly Marseille, whereas Ghana, Nigeria, Kenya and South Africa are far enough from other continents that they can be competitive in terms of both speed and reliability.

Cloud services stand to be a huge market in Africa. The continent's tendency to consume products in sachets has a direct bearing on data consumption: pay-as-you-go and pay-for-what-you-use models are ideal for cloud services. In the post-pandemic era, broadband access at competitive rates is necessary to enable all Africans to participate in the digital economy. However, with these opportunities come challenges that will need to be addressed to unlock the continent's full digital potential: more fibre must be laid and satellite internet access developed as a viable alternative for rural Africans. Finding investors with the patience and foresight to capitalise on long-term opportunities is therefore paramount. ADCA is pleased to partner with Oxford Business Group on this report, and we hope it will increase awareness of the dynamism of the data centre sector on a continent that requires investment in such infrastructure to underpin future economic development.

Overview

Data centres (DCs) are the lifeblood of the global digital economy. Consisting of large groups of networked computer systems and servers, they remotely store, process and distribute vast troves of data, and have been widely referred to as “the new gold”. Companies need DCs to monitor and improve performance, while governments require them to deliver essential public services. Increasingly, DCs also host the cloud-based applications consumers rely on for day-to-day services such as banking and work collaboration, entertainment and navigation. Indeed, DCs helped to facilitate remote work during the Covid-19 pandemic, even amid strict lockdowns.

Market research firm Gartner estimates that the global market for DC provision will reach \$200bn in 2021, up 6% on the previous year. As of mid-2021 Africa accounted for less than 1% of global co-location DC supply, but that is forecast to grow by 25% by 2023, according to advisory

and research firm Xalam Analytics. Revenue from the African DC market, meanwhile, is expected to expand at a compound annual growth rate of 12% from 2019 to 2025, to reach \$3bn. Increasing demand for cloud-based services and modular DC solutions from organisations, particularly small and medium-sized enterprises, and government agencies, will underpin the market, with more than 70% of African organisations estimated to shift to the cloud by 2025.

In mature markets the world’s largest technology companies maintain hyperscale DCs that house upwards of 5000 servers, in which one tenant leases several megawatts of space. Microsoft hosts the largest, in Chicago, with almost 200 MW available. In Africa demand has only recently justified the rollout of multi-tenant facilities in major markets. Late adoption has left a massive supply gap – Africa as a whole needs up to 1000 MW and 700 facilities to meet demand and bring capacity density

up to par with that in South Africa, the continental leader. Launching a DC can be challenging in Africa, where access to the resources necessary to run reliable services, such as power, land, water and connectivity, are often scarce. Even so, a combination of multinational and African tech and telecoms companies, often with significant venture capital backing, are quickly rolling out new facilities, each one reducing latency times, and enriching the digital economy in which they operate.

Governments and pan-African organisations are also playing an important role in nurturing the industry through supportive policy-making, while protecting the environment and critical infrastructure. For its part, the Africa Data Centres Association, the industry trade organisation for the continent, connects equipment suppliers with DC operators, and ensures the industry’s voice is heard among the region’s top decision-makers.



The strong growth of Africa’s digital economy will drive demand for DCs

iGDP* for selected African countries

| | 2020E | | 2025F | | 2050F | |
|---------------|-------|----------|-------|----------|-------|----------|
| | \$ bn | % of GDP | \$ bn | % of GDP | \$ bn | % of GDP |
| Kenya | 7.4 | 7.7 | 12.8 | 9.2 | 51.1 | 15.2 |
| Morocco | 7.8 | 6.8 | 12.1 | 7.8 | 48.1 | 12.9 |
| South Africa | 21.6 | 6.5 | 31.5 | 7.9 | 125.1 | 12.9 |
| Senegal | 1.5 | 6.2 | 2.9 | 7.1 | 11.6 | 11.7 |
| Nigeria | 24.6 | 5.7 | 36.5 | 6.9 | 145.3 | 11.3 |
| Algeria | 9 | 5.6 | 11.9 | 6.2 | 47.4 | 10.1 |
| Cameroon | 2.1 | 5.4 | 3.3 | 6.2 | 13 | 10.2 |
| Côte d'Ivoire | 3.2 | 5.3 | 5.5 | 6 | 22 | 9.9 |
| Egypt | 15.4 | 5 | 26 | 6 | 103.3 | 9.8 |
| Rwanda | 0.5 | 5 | 1 | 6 | 3.9 | 9.8 |
| Ghana | 3 | 4.4 | 5 | 5.3 | 19.9 | 8.7 |

*iGDP measures the contribution of the internet to GDP

Part 1: Introduction

Case Study



MainOne established a presence in West Africa in 2010 with its 7000-km submarine cable from Portugal to Nigeria and commissioned its first data centre (DC) in the African country in 2015.

The company has developed an interconnected ecosystem of telecoms operators and internet service providers, internet exchanges, content providers and other major institutions across the region, co-located in its DCs.

MainOne has increased the capacity of its DCs, which reached 5 MW in the key markets of Nigeria, Ghana and Côte d'Ivoire, with services delivered to a total of 10 countries across West Africa. The most recent addition to its portfolio is the Tier-3 Appolonia DC facility (see photo) in Accra, Ghana, which was launched in June 2021.

The company also began an expansion project in Lagos, Nigeria, with the goal of increasing its

600-rack facility to over 1200 racks by 2023, and further investment has also been directed towards the expansion for its DC in Côte d'Ivoire.

Through these investments, MainOne continues to deliver services via the company's interconnection ecosystem, access to submarine cable system landings, the West African Internet Exchange in Nigeria and support for the entry of hyperscale players to the region.



Viewpoint

Funke Opeke, CEO, MainOne

Access to affordable, reliable and environmentally sustainable sources of electricity is a pressing issue for the growing number of data centre (DC) operators across Africa. These facilities need to ensure a high availability of power to mitigate downtime, but many African countries face frequent power outages. Existing DCs have relied on diesel-fuelled generators to fuel operations during power outages, a practice that could exacerbate carbon emissions in the future. Indeed, the deployment of hyperscale DC capacity is expected to increase emissions through further diesel-generator utilisation.

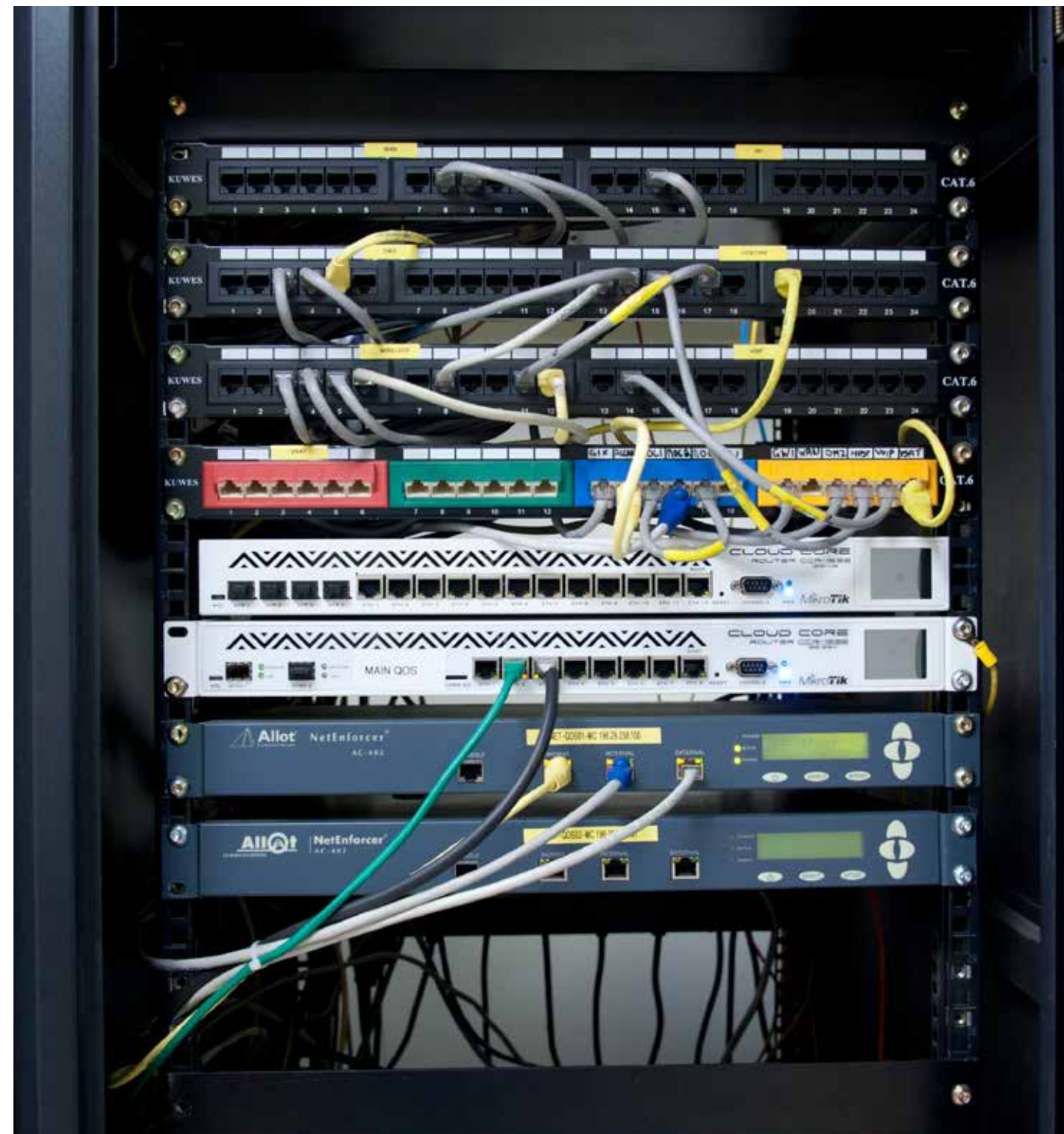
Power distribution networks are facing frequent shortages, but there is an adequate supply of electricity in the region's national grids. By strategically locating DCs close to sources of power, partnerships can be made with local power distribution companies to build direct connections to the national grid. This will ensure high power

availability and reduce the utilisation of diesel-fuelled power generation.

Energy efficiency is also key to the sustainability of DCs. Operators can build energy-efficient facilities by optimising airflow, using sensors and artificial intelligence to manage operations, and installing energy-efficient hardware. Taken together, these actions will go a long way towards reducing the carbon footprint of DCs.

Africa is experiencing some of the fastest growth in internet access seen around the world, largely due to its young population. As such, data consumption will continue to grow for the foreseeable future. This will fuel further investment in submarine cables and DCs to bring data closer to consumers. However, without sustainable power strategies, the industry will continue to contribute to global warming in a region that can least afford the consequences.

Definitions



Internet infrastructure housed inside DCs include internet exchanges, cloud exchanges, cloud providers, web-hosting providers, internet backbone carriers, content delivery networks, internet access providers and fibre operators. DCs are non-descript buildings that contain vast banks of server racks, connectivity and storage systems, as well as redundant or backup power, redundant data communications connections, cooling installations, fire safety systems and security devices.

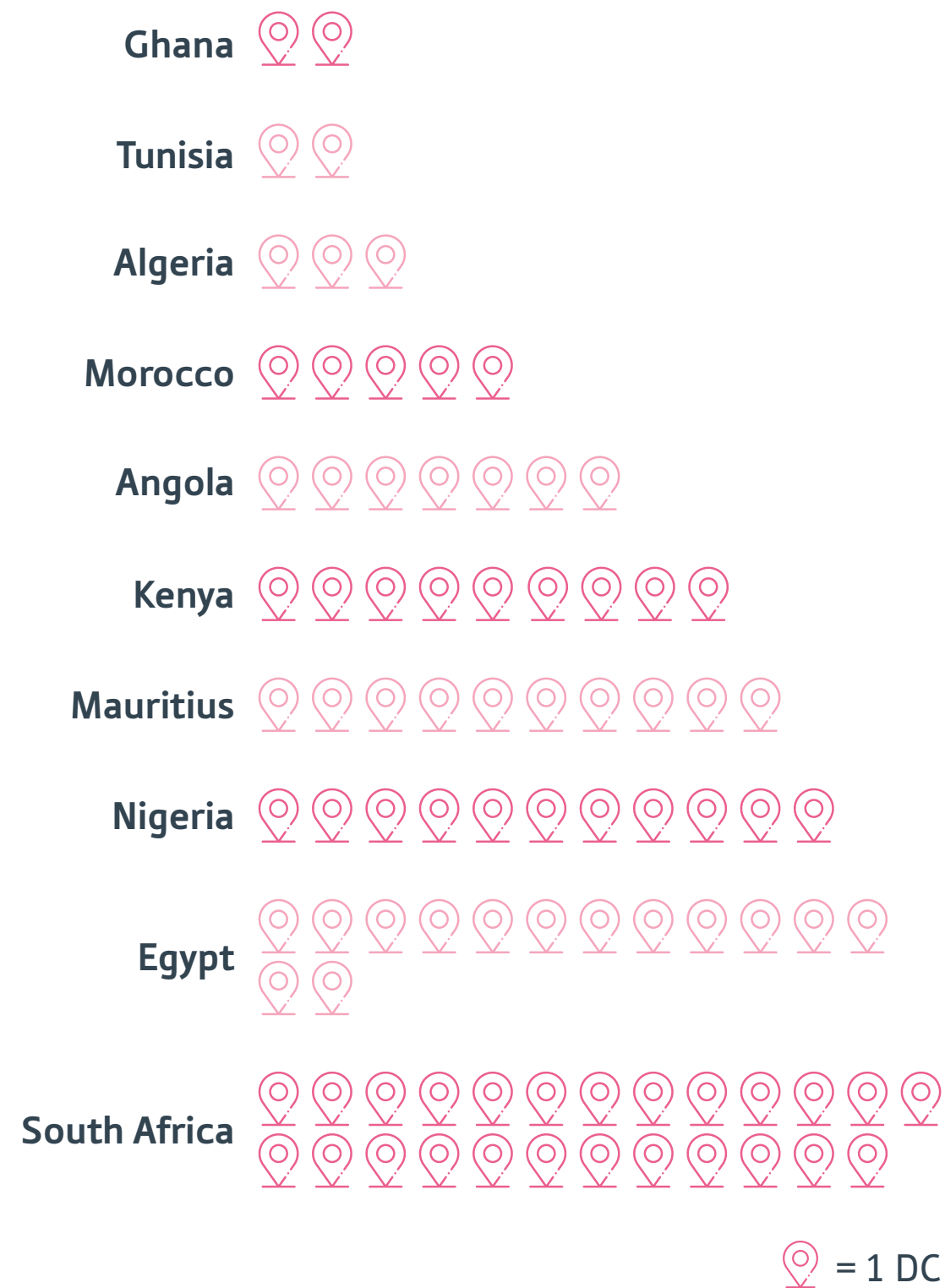
Maintaining such facilities independently is very costly, but co-location DCs operate lean business models by renting to multiple clients at the same time. Tenants are charged for space and provide their own hardware, allowing them to scale seamlessly, rather than having to estimate the cost of their business' future IT requirements. Conversely, single-tenant, or enterprise, DCs only facilitate the needs of their own companies, such as a telecoms firm, bank or government that has its own in-house IT infrastructure. Carrier-neutral facilities, meanwhile, allow for interconnection between many carriers and are therefore wholly independent of any network provider, ensuring diversity and flexibility, and a level playing field for domestic and international clients alike. Edge DCs are smaller facilities located near the populations they serve, while hyperscale DCs are large facilities that can scale up efficiently.

Hosting IT systems in co-location DCs offers several advantages. Chief among these is reliability: DCs are classified across four tiers that increase according to their level of redundancy and expected annual uptime. Tier-1 DCs, for example, have a single path for power and cooling, and few, if any, redundant and backup components. They also have an expected uptime of 99.67%, equivalent to 29 hours of downtime annually. Tier-2 DCs have a single path for power and cooling, and some redundant and backup components. They have an expected uptime of 99.74%, or 22 hours of downtime annually. Tier-3 facilities have multiple power and cooling paths in place to limit downtime to 1.6 hours annually. Tier-4 DCs, of which there are now a handful in Africa, are built to be entirely fault tolerant, with redundancy for every component, and an expected downtime of just 26 minutes each year.

Tenants can thus be assured that they will not lose business due to connectivity outages, which would have significant consequences for always on-demand services such as health care, for example. Moreover, energy costs are lower, as DCs tend to use more efficient equipment – including chilled water systems – than on-premise operations. Lastly, as facilities are purpose-built to protect clients' data and infrastructure, DCs offer a higher level security than in-house operations.

Part 1: Introduction

Number of co-location DCs in selected African countries, 2021



Case Study



PCCW Global is an international IT company that offers mobility, voice and data solutions to multinational enterprises, telecommunications partners, and cloud and application service providers. With a network reaching over 3000 cities in more than 160 countries across five continents, the firm built international connections between locations spanning Africa, the Americas, Asia-Pacific, Europe and the Middle East.

The company's network includes more than 18 points of presence in Africa, linking the continent to the rest of the world via multiple subsea cable routes along its east and west coasts. PCCW Global provides automated and on-demand access to its global network through its network-as-a-service platform Console Connect. The firm is looking to leverage it to help African businesses connect more easily to public cloud providers and data centres inside and outside of the region. As a consequence of the swift adoption and growing use of cloud connectivity – especially after the Covid-19 pandemic – continued expansion in the African data centre industry appears inevitable to many stakeholders in the region. There is considerable urgency to address rising data usage by building data centres, particularly with the arrival of hyperscale cloud service providers and a growing number of internet users on the continent.



Viewpoint

Silvio Do Carmo, Managing Director for the Southern African Development Community and East Africa, PCCW Global

The African data centre industry has undergone a rapid transformation since the start of 2020. The arrival of hyperscale providers, falling smartphone prices, the democratisation of data, and the Covid-19 pandemic that led hundreds of thousands of Africans to go online in more meaningful and habit-forming ways have all stimulated the industry. While data centre and network infrastructure has improved across the continent in recent years, there is still much work to be done. In order to fully embrace digital transformation, businesses need more reliable and affordable internet access, which will require further investment in new networks and data centres. Many businesses in Africa accelerated their digital transformation journey in order to help them operate during the Covid-19 pandemic, and a lot of these companies are now looking beyond the short term to explore how cloud-based services can help them drive efficiencies in the future. Fortunately, as Google Cloud, Amazon Web Services and Microsoft Azure further penetrate the African market, enterprises are able to host more of their data on the continent itself. Advancements in network automation technology will further support the development of Africa's cloud and data centre ecosystem, with interconnection platforms such as Console Connect providing new levels of network speed, agility and security for businesses as they connect to more cloud servers and data centres both inside and outside the region.

Installed Digital Infrastructure

Africa has 140,000 sq metres of DC space shared among a little more than 100 DCs – figures similar to that of Switzerland alone. However, rapid digitisation and the rollout of 4G and 5G infrastructure across the continent mean that supply is poised to increase by 50% between 2021 and 2026. More than 30 Tier-3 and above multitenant facilities have already come on-line since 2016, approximately doubling the continent’s data hosting capacity to roughly 200 MW as of the end of 2019.

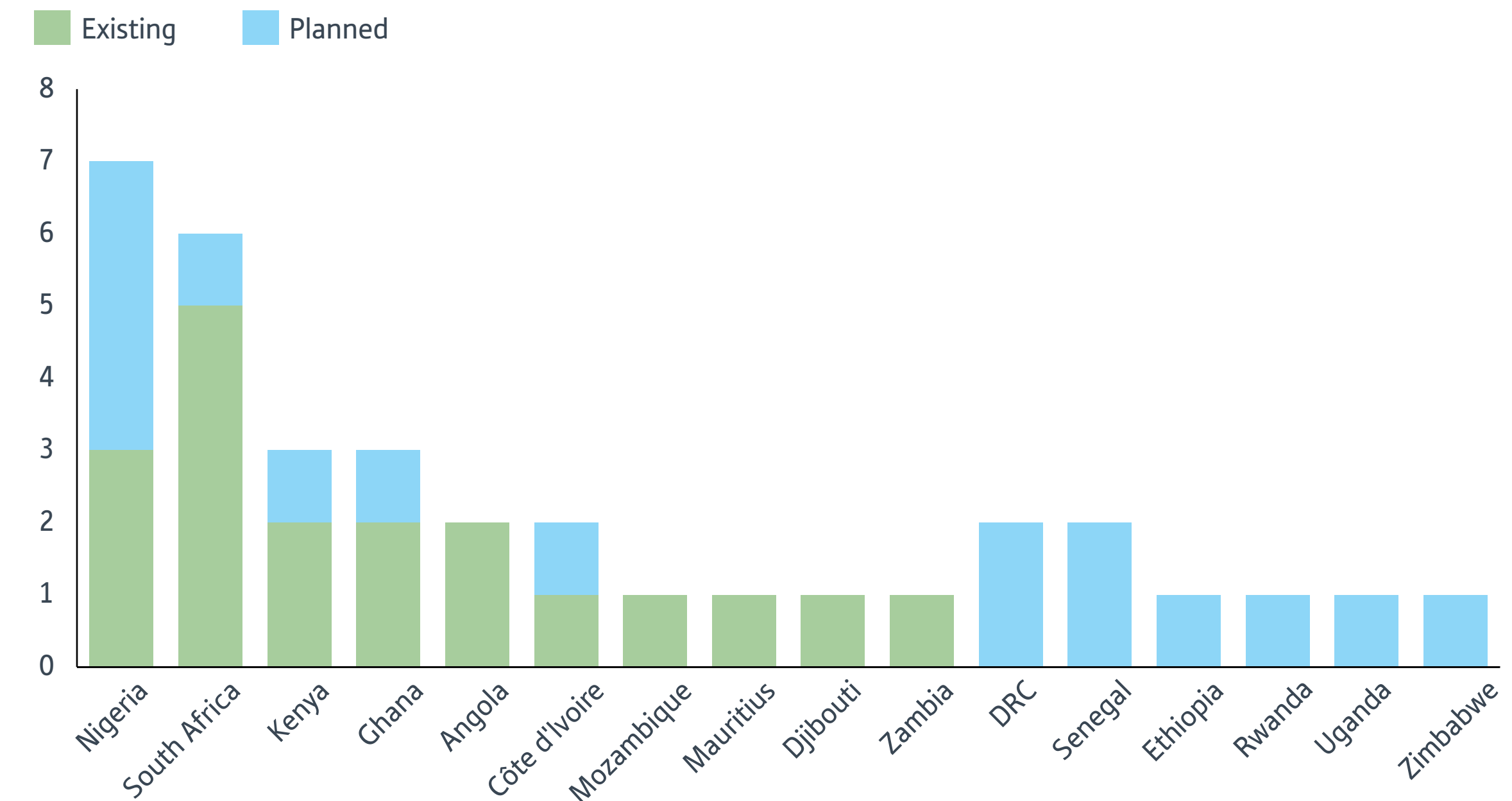
However, capacity is unevenly distributed, with more than two-thirds based in South Africa. This is due to several factors, including the size of its economy (\$351.4bn in 2019), links to subsea fibre-optic cables and a long-standing liberalised telecoms market. It is also the locus of Africa’s largest internet exchange, NAPAfrica, which retains the largest number of peering connections on the continent, and provides international and regional telecoms carriers, content delivery networks, cloud providers and other stakeholders a gateway to over 20 southern African countries.

Johannesburg, the centre of DC provision in South Africa, hosts 55 MW of capacity, compared to 796 MW and 728 MW in Dublin and London, respectively. That said, South Africa’s largest city is already ahead of other up-and-coming DC markets, such as Madrid, Warsaw and Marseille.

Another leading market in Africa is Nairobi, which hosts 19 MW of capacity. Though the figure is about one-third of Johannesburg’s volume, Kenya sits on four major subsea cables, and boasts strong cross-border fibre connections and a vibrant stock exchange, making it well placed to become a regional centre. Elsewhere on the continent, Nigeria and Côte d’Ivoire boast similar advantages, as do Ghana and Senegal.

According to Xalam Analytics, 10% of the existing DC capacity serves nearly half of sub-Saharan Africa’s economic output and broadband connections. Moreover, one-third of Africa’s 80 or so cities with a population of more than 1m people have a DC rated Tier-3 or above, demonstrating the scale of the distribution gap.

Number of carrier-neutral DCs in sub-Saharan Africa, 2020



Africa’s current DC capacity is heavily skewed towards South Africa



Part 1: Introduction

Case Study



Viewpoint

Patrice Tano, Group COO, Databridge

Databridge is a pan-African provider of data centre (DC) services that operates via telecommunications operators and cloud service providers through carrier-neutral centres. A founding member of the Africa Data Centres Association, the group is Payment Card Industry Data Security Standard-certified. It has operations in Côte d'Ivoire and Benin, and hosts all West African telecoms operators and several international carriers.

Databridge constructed Côte d'Ivoire's first Tier-3 DC facility, which is internationally certified for information security. The group works to enable professionals in electronic, credit card and debit card payments to streamline the accreditation process. This has driven demand, as well as work with companies in sectors such as telecoms, cloud, media and finance that require critical infrastructure, as well as hosting and interconnection services. The DCs in Côte d'Ivoire and Benin are connected to four subsea cables that link Africa to other continents. The density of connectivity in West Africa allows customers to interconnect directly with the provider that matches their price and performance needs. Looking to the future, countries in West and Central Africa will develop internet and DC infrastructure quickly due to each market's proximity, supported by the cloud.

While the international data centre (DC) industry has grown significantly in recent years, only 1.3% of its facilities are located in Africa. Conversely, the continent is projected to have 1bn internet users before 2025. This has made the continent an attractive option for hyperscale providers such as Google, Amazon, Facebook, Apple and Microsoft.

Africa has been able to recover from the Covid-19 pandemic, with positive GDP growth projected for 2021. This has helped the continent accelerate its industrial and technological development. The arrival of new submarine cables to the African coasts will offer hyperconnectivity opportunities to telecoms operators and DCs. This will facilitate future growth, with the African DC market forecast to be valued at \$3bn in 2025.

Cloud service providers will benefit from the rapid development of DC facilities on the

continent, and will be able to offer customers better connectivity and data security.

DCs played a key role in the response to the pandemic by facilitating connectivity and the exchange of information via video-conferencing platforms. Indeed, applications such as Zoom and Microsoft Teams have increased their user base by over 44m individuals since April 2020, when much of the world shifted to remote work. The pandemic underscored the fact that companies must adapt their digital processes and expand their digital reach in order to connect with customers. Africa has a large, youthful consumer base and is an attractive proposition for operators looking for opportunities.

While the DC industry has matured relatively slowly in developing markets such as those in Africa, the continent has been given the advantage of learning from the first mover –

more developed countries with established infrastructure. As a result, new players looking to enter the African market are able to easily build facilities that meet international standards. Africa can and will get ahead of other regions that are struggling with old and obsolete technological infrastructure. The continent can quickly adopt new technologies. As Africa's DC infrastructure nears maturity, digital advancement could bolster other economic segments and greatly benefit local businesses. With supportive legislation that governs the activities of DCs and private cloud solutions, the best-equipped countries will be able to meet the growing demand for hosting data in local or sub-regional DCs. This is particularly the case in Côte d'Ivoire, where a new digital economy is emerging. Databridge aims to leverage its experience to establish itself across the Economic and Monetary Community of Central Africa and the West African Economic and Monetary Union.

Growth Potential

Analyst estimates for the growth of the DC market in Africa are based on a confluence of driving factors, not least a rapidly growing population. The UN forecasts that more than half of the global population growth between 2020 and 2050 will occur in Africa. The sub-Saharan population is estimated to double over the next 30 years to 2.5bn, led by Nigeria, which will overtake the US as the world's third-most populous country. The organisation also predicts that more than half of Africa's population will live in cities by 2040, eight of which will be mega-cities of 10m-plus inhabitants. Presently, 15 African countries have economies and populations large enough to develop DC and cloud service ecosystems.

Some 40% of the African population had access to the internet in 2019. This figure is set to increase by 11% over the next decade, when Africa is estimated to account for around 16% of the global internet user base. The rise in internet uptake is expected to foster an increasingly digitised African economy. The internet economy is projected to be worth \$180bn by 2025, growing to \$712bn by 2050.

Meanwhile, data sovereignty regulations demanding that data is stored in-country, or at least within the five sub-regions that partition the continent, will help drive demand for localised data storage services. Research company International Data Corporation estimates that annual cloud computing subscriptions in South Africa alone will grow from \$370m in 2019 to \$1.7bn in 2024.

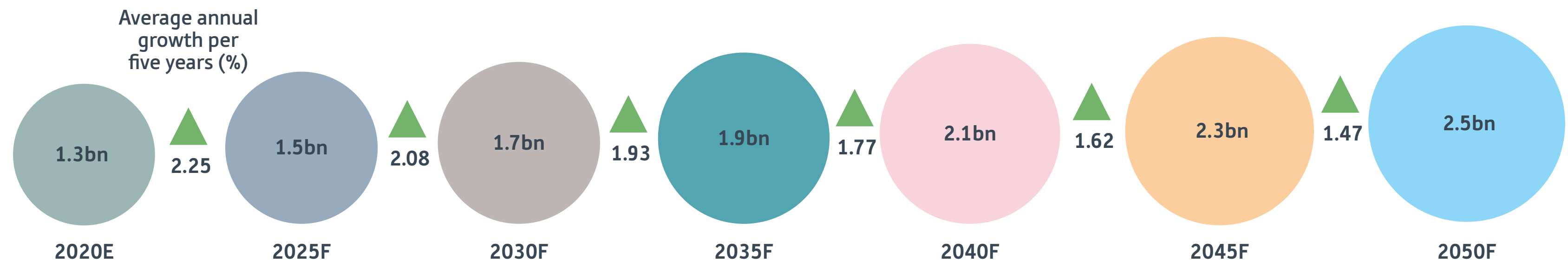
Indeed, governments themselves are increasingly driving demand for DC capacity. Senegal, for example, will transfer all government data and

digital platforms from foreign servers to a new national DC, maintained by Huawei, in an effort to strengthen its digital sovereignty. China is supporting Senegal's shift to e-governance by establishing a national broadband network in the West African country and funding a "Smart Senegal" e-infrastructure project.

This enticing mix of growth drivers has attracted major international cloud service providers such as Amazon Web Services (AWS), Google, Microsoft and Huawei. As cloud providers proliferate, they

will create a virtuous circle of DC demand by enabling an increasing proportion of businesses to move their operations to the cloud. Both AWS and Microsoft were early entrants into the African market, and are now seeking additional DC capacity, indicating that their ventures have been rewarded with successful business cases. Multiple international hyperscale providers, including Alibaba's Whale Cloud Services and Huawei Cloud, already maintain a presence in South Africa, while Nigeria and Kenya host several US providers, including Microsoft, which is also present in Angola.

Africa's population is forecast to increase significantly over the next decades



Part 1: Introduction



More than half of Africa's population will **live in cities by 2040**, eight of which will be mega-cities of **10m-plus** inhabitants



15 African countries have economies and populations large enough to develop DC and cloud service ecosystems



Growth in internet uptake is expected to foster an **increasingly digitised African economy**; the internet economy is projected to be worth **\$180bn by 2025** and **\$712bn by 2050**

Case Study



ONIX Data Centre (ONIX DC) designs, builds, manages and operates carrier-neutral co-location data centres, and aims to establish a pan-African platform to deliver high-speed and secure data centre services. The first of the company's data centres – ONIX Accra 1 – is located in Accra, Ghana. It is the only certified Tier-4 facility in West Africa and complies with hyperscale service-level requirements. ONIX Accra 1 was acquired by African Infrastructure Investment Managers in March 2021 and will work to unlock potential in markets where demand outstrips supply.

ONIX Accra 1 has multiple energy supply systems in place: solar power is used during the day, and the electrical grid is relied upon thereafter. In compliance with the Tier-4 requirement of 99.995% uptime, back-up generators are on site in the event of a power outage. As a result, ONIX Accra 1 ensures its uptime satisfies its Tier-4 designation, enabling cloud computing services to operate without interruption. While power supply has been a challenge for data centres in the region, Ghana's electrical grid is more reliable than those in neighbouring countries. "Accra is an attractive location for data centres due to political stability and low sovereign risk. There are also a number of subsea cable landing stations in Accra to ensure that the facility is accessible to organisations worldwide," Michael Nahon, CEO of ONIX DC, told OBG.



Viewpoint

Ed Stumpf, Investment Director, African Infrastructure Investment Managers (AIIM)



Africa is witnessing an explosion in data volume, with some of the highest data traffic growth rates in the world. Data volumes are benefitting from the compounding effects of a growing mobile subscriber base, at a rate of roughly double the global average; a rapid rise in smartphone adoption, from just over 50% of subscriptions today to an estimated 75% by 2026; and rising content and media demand from African consumers. These factors are necessitating significant investment in terrestrial fibre, towers and co-location capacity in the region. Latency and the need for local data storage are growing priorities given the increased interest from international cloud and content players, but the potential for local enterprise and financial institution demand should not be overlooked. The Covid-19 pandemic has accelerated the number of African organisations looking to migrate to dedicated data centre facilities, but most African markets remain critically undersupplied when current rack capacity is benchmarked against factors such as the number of urban enterprises, the volume of IP traffic and regional economic growth. At the same time, synergies exist between digital infrastructure opportunities and the energy transition. Power system constraints in the region are declining in importance as falling renewable energy tariffs and distributed energy solutions – such as AIIM's Starsight Power platform – increasingly enable cost-efficient alternative and redundant power supply to major digital assets.

Key Players

Africa's largest DC players are in South Africa, led by Teraco, which is backed by international investment companies Berkshire Partners and Permira. Teraco was the first provider to offer carrier-neutral services in sub-Saharan Africa, and has consolidated its leadership by investing in hyperscale carrier- and cloud-neutral co-location DCs, several of which are located in Johannesburg (which has a capacity of approximately 55 MW) and serve as the on-ramp for AWS, Google and Microsoft's Azure cloud services. Teraco's smaller facilities in Cape Town (5 MW) and Durban (3 MW) allow direct access to the continent's largest internet exchange, NAPAfrica.

Other major players in South Africa include Business Connexion; MTN Business, which operates both enterprise and co-location DCs across the continent; and Dimension Data, a unit of global operator NTT Communications.

While some co-location DC providers are content to focus on a single market, others target pan-African penetration. Africa Data Centres (ADC), for example, operates facilities in several South African cities, including a Tier-4 DC in Johannesburg and a 5.5-MW DC in Cape Town. ADC also maintains the largest DC in Kenya – a 7.5-MW facility in Nairobi – and is building a 10-MW DC in Nigeria.

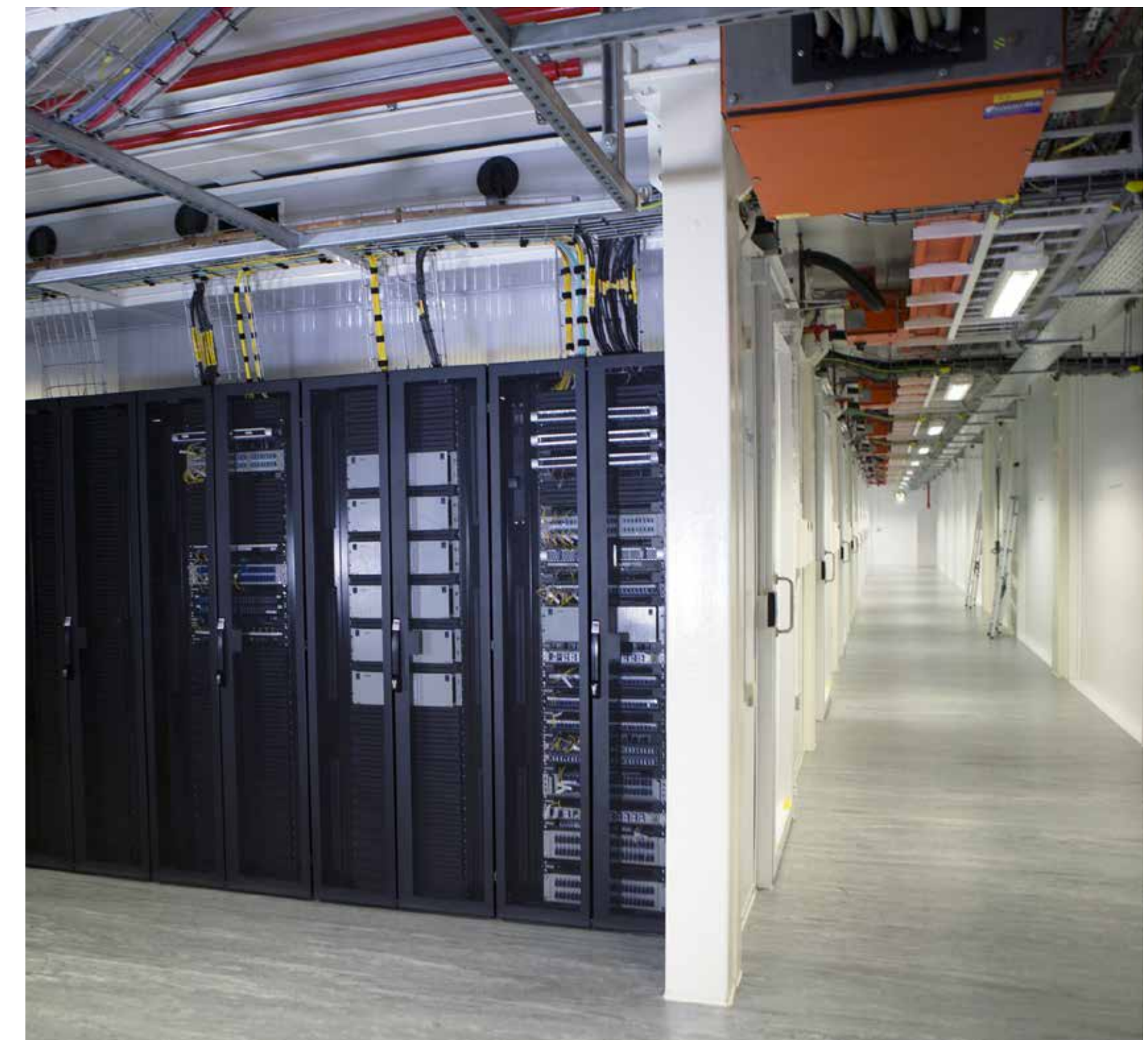
Other companies with continental expansion plans include PAIX and icolo, with the latter acting as the African vehicle for global market leader Interxion via a controlling interest.

Meanwhile, Raxio Group, part of the US-based Roha Group investment firm, seeks to establish 10 to 12 DCs in underserved areas by 2023. Having already established a DC facility in Kampala, Uganda, Raxio Group announced in March 2021 that it plans to construct another in Kinshasa,

the Democratic Republic of the Congo, and a 3-MW, Tier-3 facility in Addis Ababa – one of several DCs due to be built in the city as providers seek to take advantage of an anticipated liberalisation of the Ethiopian telecoms market.

Elsewhere on the continent, Nigeria is an emerging hotspot, with two providers vying for early leadership: Rack Centre's Tier-3 DC has at least 40 carrier connections, while broadband infrastructure company MainOne's unit MDXi boasts 26 facilities at its Lagos operation. MDXi also operates DCs in Abidjan, Côte d'Ivoire and Accra, Ghana.

The fragmented picture of DCs on the continent is changing rapidly as new players enter the market. IXAfrica, for example, broke ground on a DC in Kenya in April 2021 as part of broader plans for a 42.5-MW rollout in East Africa, which is estimated to cost approximately \$250m.



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Broadband Deployment

Broadband internet access is a critical enabler of the digital economy, and the relative lack of it throughout Africa is a strong indicator that demand for data centre (DC) services will take off in the medium term. Africa's broadband user base is set to double between 2020 and 2030 to over 500m amid infrastructure and connectivity improvements. Markets beyond South Africa account for 85% of the continent's broadband subscriber base, but only around 30% of the co-location supply.

Active mobile broadband subscriptions per 100 inhabitants on the continent reached 33.1 in 2020, but trailed the global average of 75 by a considerable margin. Less than 20% of countries in Africa recorded rates above the worldwide average.

As for fixed broadband, the continent's subscription rate was 0.5 per 100 inhabitants in 2020, well below the worldwide average of 15.2 – a consequence of the absence of legacy infrastructure and the comparatively lower cost of wireless networks.

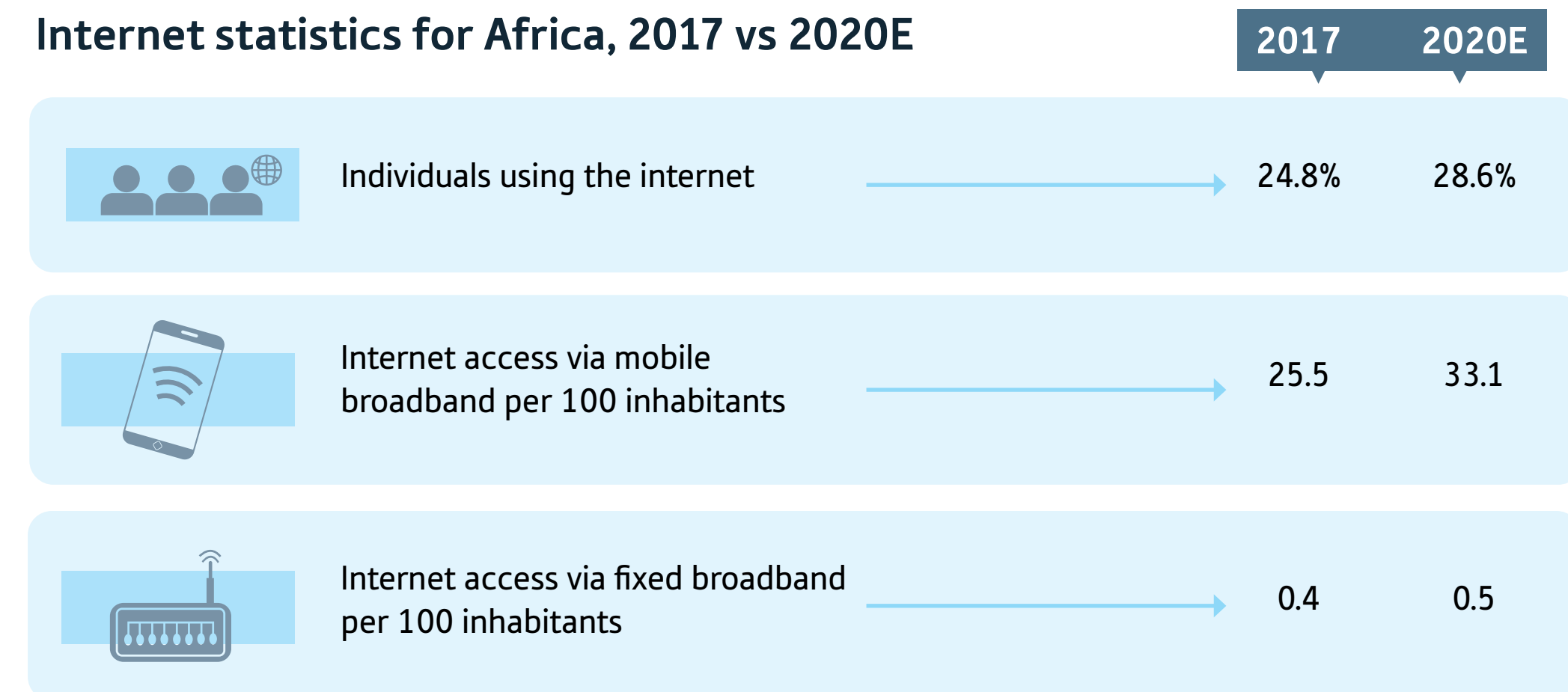
Several internet providers offer satellite broadband, which is essential for various industries working in

remote parts of the continent. The presence of satellite broadband is most notable in Tanzania, Zimbabwe, Nigeria, South Africa and Kenya.

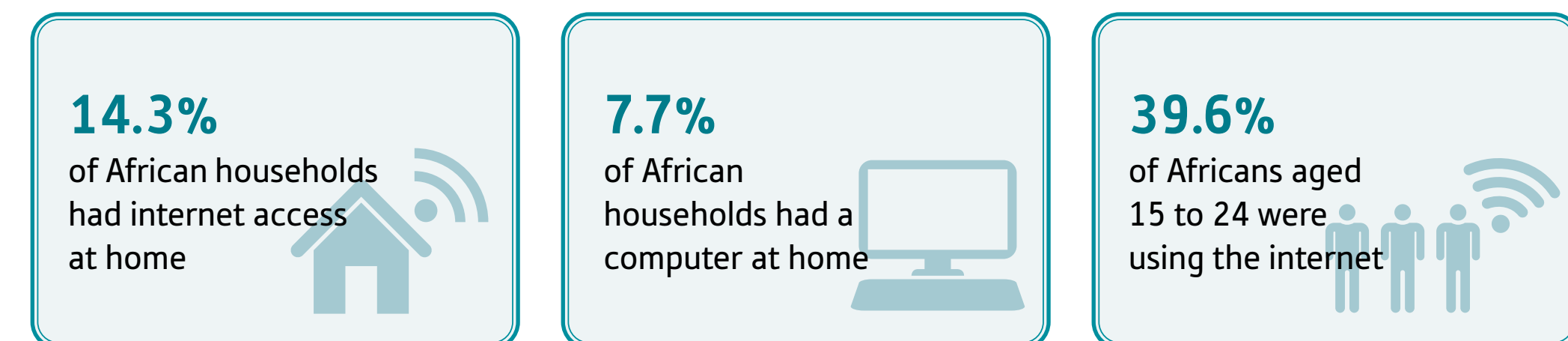
While international bandwidth across Africa jumped from 5 Tbps in 2017 to 11 Tbps in 2020, it represents only 1.5% of the world total. Kenya has the continent's highest international bandwidth per internet user rate, at 566.41 Kbps, which rose at a compound annual growth rate (CAGR) of 52% between 2015 and 2019. Other countries that saw a CAGR of over 40% are São Tomé and Príncipe, Benin, Botswana, Burundi, Ghana, Togo, Zambia, Namibia, Nigeria, Zimbabwe, Angola, Mozambique, Mali, the Central African Republic and Liberia.

A 2019 World Bank report suggested that it would cost \$100bn to achieve universal broadband connectivity in Africa by 2030 across infrastructure, skills training and maintenance needs. Tackling the infrastructure requirement is already well under way: as of June 2020 Africa's operational fibre-optic network reached 1,072,649 km, up 4.6% on the previous year. A further 119,496 km was under construction, with 95,057 km planned and another 69,702 km proposed.

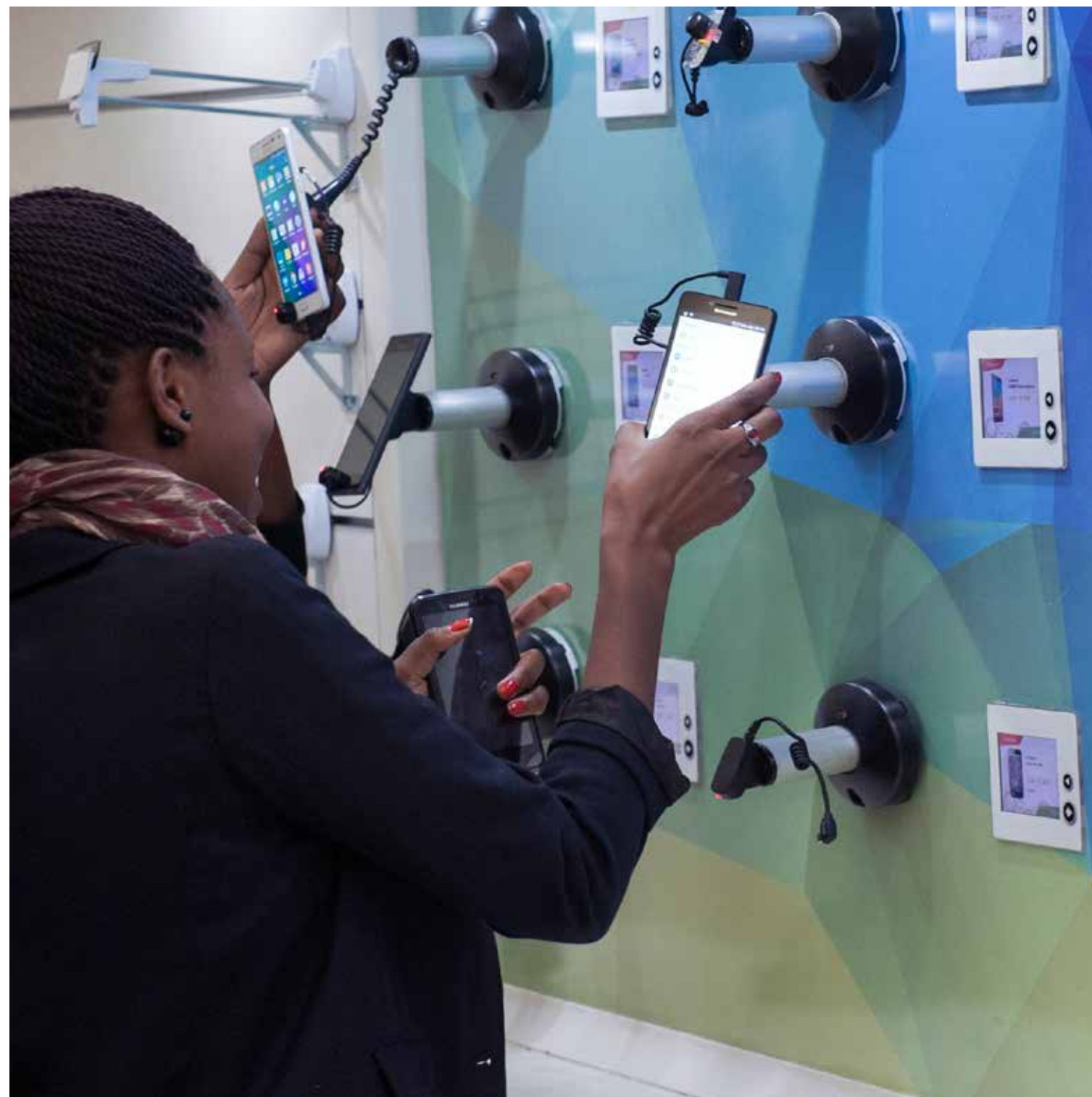
Internet statistics for Africa, 2017 vs 2020E



In 2019



Mobile Market



The vast majority of Africans connect to the internet via mobile devices, as less than 10% of households have a home computer, and the use of handsets will continue to drive data consumption going forwards. In June 2020 Swedish multinational telecoms company Ericsson forecast that mobile data traffic in sub-Saharan Africa would grow 12-fold to reach 4 EB per month by 2025 – equivalent to 7.1 GB per device.

As it stands, the GSM Association estimates that some 26% of sub-Saharan Africa's population, or 270m people, use mobile internet, while half the population has coverage but do not connect and one-quarter remain outside the reach of services. That considerable usage gap of approximately 520m people is due to poor mobile literacy, unaffordable handsets and data packages, and issues such as a lack of relevant content. Interestingly, 2019 was the first year in which there were more mobile broadband (3G and 4G) connections than 2G in the region, as operators continued to upgrade infrastructure and consumers benefitted from more affordable devices. Smartphones, which are critical enablers of mobile internet use, now account for half of all mobile connections, and their uptake has expanded at a CAGR of 28% since 2015. This has driven adoption of smart feature phones, which carry popular apps and connect to 4G networks but are available at a lower price

point. Operators are expected to invest \$52bn in sub-Saharan Africa's network infrastructure between 2019 and 2025, helping lift smartphone penetration to 65% across 678m connections.

Looking forwards, with 3G network coverage in Africa at 77.4% and 4G network coverage at 44.3% in 2020, according to the International Telecommunication Union, the stage is set for the rollout of 5G connectivity across the continent. Telecoms providers Vodacom and MTN launched the first commercial 5G networks in the sub-Saharan region in 2020, offering 5G mobile and fixed wireless access in South Africa.

While the low uptake of 4G services had previously cast doubt on whether Africa was ready for 5G technology, the Covid-19 pandemic has changed this mindset and sped up the companies' plans. The global health crisis triggered a surge in demand for data-heavy services as people turned online for entertainment, education and work amid movement restrictions. For example, Vodacom reported a 40% increase in mobile traffic and a 250% jump in the use of fixed wireless during the initial lockdown period in spring 2020. 5G trials are now under way in Gabon, Kenya, Nigeria and Uganda, laying the groundwork for what Ericsson suggests will be the first discernible penetration of 5G subscriptions in 2022, which is forecast to reach 3% by 2025.

Driving Data Consumption

Economic growth is the primary factor that will drive data consumption in Africa, and the positive news is that the continent is forecast to recover from the Covid-19-induced contraction experienced in 2020 to see GDP expand by an estimated 3.1% in 2021. Digital financial inclusion will play a leading role in that recovery. For example, countries including Benin, Côte d'Ivoire, The Gambia, Lesotho, Madagascar, Namibia, Togo, Uganda, Zambia and Zimbabwe improved their social protection efforts over the course of the pandemic through mobile money platforms, electronic cash transfers and other virtual engagement. Improved digital financial inclusion will drive demand for DC capacity as institutions seek to store and protect rising levels of sensitive customer data.

Sub-Saharan Africa is forecast to experience the globe's fastest growth in mobile money technology through to 2025. Mobile banking is key to driving the digitalisation of the informal sector, which the World Bank estimates to account for more than 35% of output and

60% of employment across the region. For example, more than 1m citizens signed up to Togo's social welfare programme Novissi in April 2020, which used digital cash transfers to help informal workers during the pandemic lockdown periods. Mobile money transfers also delivered emergency income support in Namibia and unemployment benefits in Zambia.

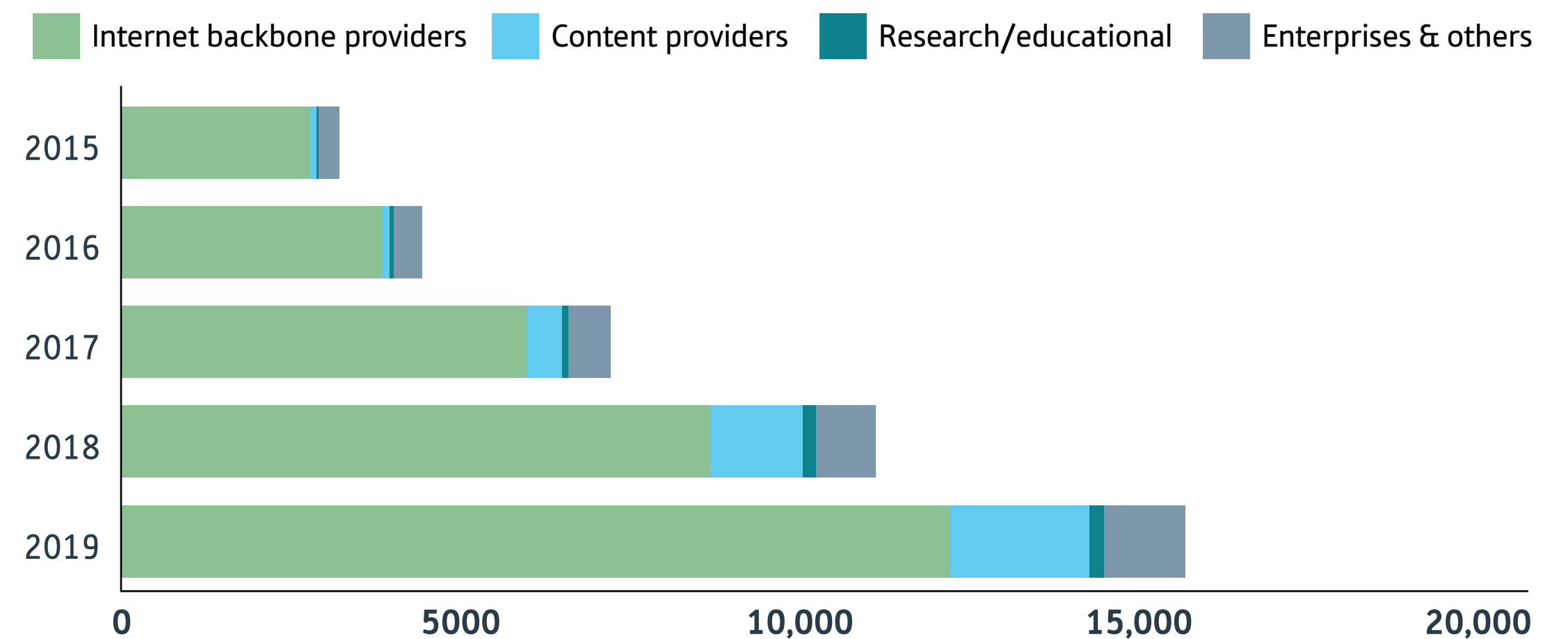
Meanwhile, traditional financial institutions are migrating their operations to DCs and will continue to do so as they look to expand their digital offerings. First Bank of Nigeria and KCB Bank, Nigeria and Kenya's largest banks, respectively, both have mobile apps with more than 1m users, while Kenya's Equity Bank allows free bank-to-mobile wallet transfers.

Financial technology (fintech) will indeed be a driver of data consumption, and WeeTracker estimated that \$679m was invested in African fintech start-ups in 2019, primarily in Kenya and Nigeria. In response, DC providers like MainOne are building additional storage capacity.

Governments will also drive demand, as competition heats up among cities seeking to position themselves as DC leaders in the region. Importantly, several governments are pursuing digital transformation agendas as a means to diversify their economies and streamline processes for both individual residents and

business investors. While South Africa accounts for nearly half of all cellular internet-of-things connections in sub-Saharan Africa, use cases are emerging across the region and could help address region-wide challenges in energy, water management, agriculture, transportation and logistics, manufacturing and health care.

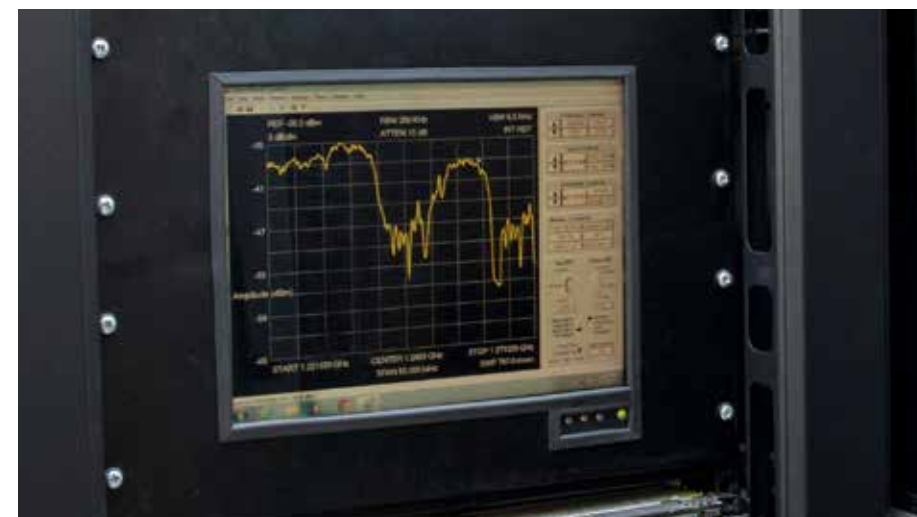
International bandwidth usage by source in Africa, 2015-19 (Gbps)



Part 2: Recent Developments

Notable Investments

African DC players are expanding to cater to demand for cloud services and applications, and new entrants are racing to establish a foothold in emerging markets. In May 2020 Teraco announced that it would invest \$220m to build an 80-MW DC in Johannesburg, South Africa, which will be the largest standalone facility on the continent once it is completed in 2022. Africa Data Centres is part of the Liquid Intelligent Technologies Group, which announced in October 2020 that it had obtained \$307m in financing from the US government's International Development Finance Corporation to fund



an expansion that includes five new DCs. This is part of Africa Data Centres' plan to house a total of 54 MW of data capacity on the continent by 2025. Meanwhile, Dimension Data, the second-largest provider in South Africa, began building a 6000-sq-metre facility in Johannesburg in September 2020, adding to its existing 9400 sq metres of combined floor space.

More recently, in March 2021 IXAfrica Data Centre broke ground on what will be a 42.5-MW DC complex in Nairobi, Kenya. The first phase includes three DCs for a total of 18.9 MW of capacity, with the first of these – at 4.5 MW – to be ready in early 2022. Two months later icolo, in which European DC provider Interxion holds a controlling stake, announced that it would construct a third, 1.6-MW DC in Mombasa, Kenya, where several subsea cables make landfall. Raxio Group's expansion plans include a \$48m partnership with French firm Meridiam that will see a new DC

built in Kinshasa, Democratic Republic of the Congo. Private equity firm Actis is backing a \$250m ICT infrastructure partnership with Convergence Partners alongside its investment to expand the presence of West African DC provider Rack Centre. In East Africa, wingu.africa has begun construction of Ethiopia's first hyperscale DC in the Ethio ICT Park in Addis Ababa, with plans to build a second facility in Adama City. Morocco-based N+ONE has unveiled plans to build three DCs in the Digital Technologies Park of Dakar, Senegal, while Togo has launched the country's first carrier-neutral DC in Lomé, a \$23.7m project funded by the World Bank. These examples provide a snapshot of the overall investment being deployed across the continent. While international players have largely limited their engagement to equity investment, budding competition between US, UK, French and Chinese companies is anticipated to lead to many new projects.



Viewpoint

Guy Willner, Co-Founder and Chairman, IXcellerate and IXAfrica Data Centre



The African data centre (DC) industry is growing quickly, supported by the surge in online activity during the Covid-19 pandemic and the shift to more digital processes. Growth in certain markets is facilitated by deregulation, which allows for easier market access, and other government actions that are creating an enabling environment for innovation. It is important for African nations to understand the necessity of deregulating their ICT sectors, as many countries move towards digitalisation and DC competition heats up over the next decade.

Kenya has a rapidly growing digital economy and is a prime example of the importance of deregulation in the telecoms market. The government understands the power of digitalisation, demonstrated by ICT being a primary focus of its Vision 2030 agenda. As Nairobi is the birthplace of M-Pesa, the continent's first mobile payment system, the country is also accustomed to disruptive and progressive technologies. Kenya has strong connections with both the East and the West, with a large cosmopolitan and multicultural population that grasps the importance of data sovereignty. Unlike most West African countries, Kenya has affordable green power. It generates 85% sustainable energy and the Kenya Power and Lighting Company has made huge progress to make power more reliable, especially in the Nairobi industrial area. Sustainability is a very important factor to IXAfrica as we work to reduce our carbon footprint.

Part 2: Recent Developments



The size of the African DC market by investment was **\$2bn in 2020**



It is expected to reach **\$5bn by 2026**



expanding at a CAGR of **15% in 2021-26**

Case Study



With headquarters in the US, Starline provides customised power distribution and monitoring systems for commercial, mission critical and light industrial use in both developed and developing countries. While the group was acquired by major energy supplier Legrand in 2019, it has maintained a high level of autonomy.

Legrand offers reliable, competitively priced data centre services and solutions across the continent from its base in South Africa. The company's operations feature a representative business model whereby local specialists find and manage opportunities, as well as develop contacts, in the markets in which they operate. The Covid-19 pandemic highlighted the importance of using this model, as it proved to be a critical tool at a time when international travel was largely suspended due to movement restrictions in many countries.

Although Southern Europe was seen as having the most potential for the management and deployment of data centre services in the early 2000s, today Africa is poised for expansion. The continent's data centre industry has grown considerably in recent years, especially with the arrival of hyperscale clients. Africa is set for an acceleration in terms of scaling. The company works to meet demand for reliable power distribution, which is critically needed in such an environment.



Viewpoint

Stéphane Levillain, Sales Director for South Europe and North and West Africa, Starline

The decision by Google, Amazon, Facebook and Apple to deploy hyperscale data centres in Africa is a welcome addition to the development of the burgeoning local industry. Their arrival was promptly followed by interest from their Asian counterparts: Baidu, Alibaba, Tencent and Xiaomi. Although these Chinese companies do not currently have data centres in Africa, their interest highlights the rising demand for data and cloud services.

In Europe data and cloud services tend to be outsourced to hyperscale providers. This is because it is more cost effective, secure and operationally advantageous to outsource to a hyperscale provider. African countries are perhaps a decade behind their European peers, given the rate at which advanced data infrastructure is being deployed. Both small and large African companies may be able to leapfrog the in-house data operations that Europe laboured with, and instead connect directly to hyperscale services.

The connection of submarine cables to points across Africa will ameliorate connectivity and support digital development. It is clear that some countries will embrace data and lead the way. Ireland and Estonia, for example, have made significant advancements, and digitally inclined countries in Africa could follow their example.

Part 2: Recent Developments

AfCFTA Impact

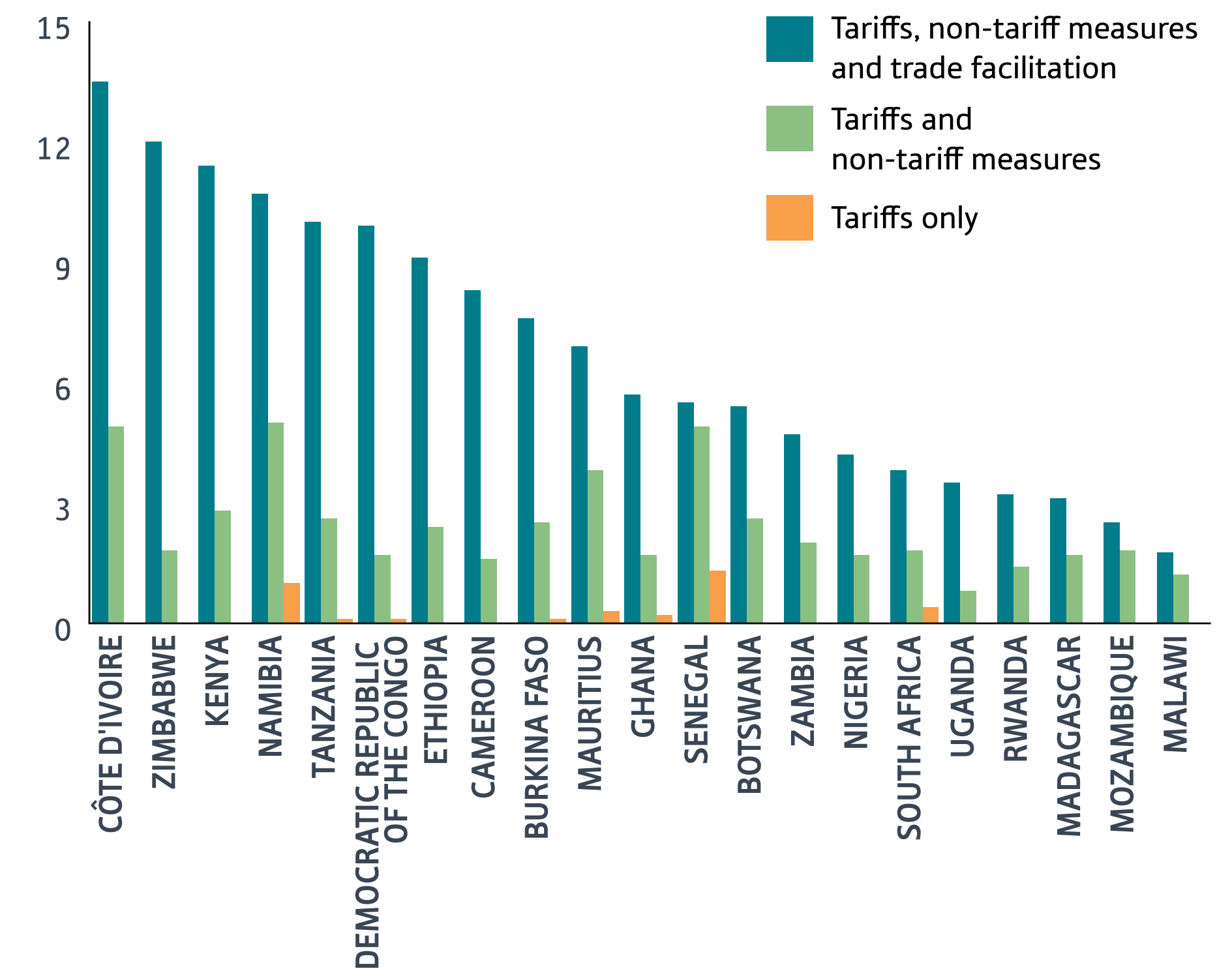
The African Continental Free Trade Area (AfCFTA) has the strong potential to galvanise DC investment across Africa. As it stands, cross-border investments are subject to several impediments, including capital transfer tax and separate taxes on various items of equipment, and it can be risky to move money between countries due to fluctuating currency values. Such structural hurdles have impaired industry growth as it limits the ability to take profits and invest them in new ventures in different geographies. For this reason, development has been concentrated in existing hubs such as South Africa.

AfCFTA seeks to establish a trade system with similar provisions to those enjoyed in the EU, including free movement of labour and zero tax on capital and equipment transfers within the continent. The treaty has provisions for the creation of a continent-wide Customs union, and aims to create an online mechanism for monitoring, reporting and eliminating non-tariff barriers, as well as a pan-African payment and settlement system to make it possible for African companies to clear and settle intra-African trade transactions in their local currencies. As of July 2021, 54 of 55 African countries had signed on to AfCFTA, with 37 of those ratifying the

agreement. Under ratification, least developed countries (LDCs) consent to liberalise 90% of tariff lines within a decade of signing and their more developed counterparts must do so within five years. Sensitive products, which account for up to 7% of tariff lines, will be fully liberalised over 13 years for LDCs and 10 years for non-LDCs, with the final 3% of tariff lines excluded from liberalisation. If successfully implemented, the agreement will create a single African market of over 1bn consumers and a combined GDP of more than \$3trn.

The single market should sharply lift intra-African trade and provide a platform for DC players to accelerate the rollout of new capacity. The share of intra-African exports as a percentage of total African exports was just 17% in 2017, extremely low compared to Europe (69%), Asia (59%) and North America (31%). Removing tariffs on goods under AfCFTA is projected to increase the value of intra-African trade by between 15% (\$50bn) and 25% (\$70bn), depending on the degree of liberalisation, by 2040. Lowering the cost of importing and accessing communication and network security equipment will encourage businesses to set up or ramp up operations in Africa, with corresponding benefits for DC demand.

Income gains due to AfCFTA in 2035 (% change from baseline)



Part 2: Recent Developments

Supporting Regulations

Currently, France's second-largest city Marseille serves as the primary gateway for the transfer of African data, as up to 80% is domiciled offshore, limiting the ability of operators in Africa to offer premium data transfer speeds to their customers. However, the continent is experiencing a change in attitude towards data sovereignty, or the idea that data is subject to the laws and governance structures of the nation in which it is collected. With the EU's General Data Protection Regulation (GDPR) serving as a benchmark and following campaigns by India and China to ensure data is stored onshore, African countries are legislating to remedy the situation, which has profound implications for DC growth.

As of 2019, 16 African countries had passed data protection legislation, which usually includes a provision to host data onshore,



with a further eight due to do so. These rules either follow independent national objectives or regional models such as the African Union Convention on Cybersecurity and Personal Data Protection. While this trend is largely positive for DC capacity requirements, industry stakeholders have also raised a note of caution: there is a possibility that regulations may be too stringent and therefore extremely difficult to adhere to.

In 2019 Uhuru Kenyatta, the president of Kenya, approved data protection legislation that complies with the GDPR and facilitates the lawful use of personal data, thus strengthening individuals' rights. The law also stipulates that personal data cannot be transferred outside of Kenya unless there is proof of adequate data protection safeguards or consent from the data subject. South Africa has implemented the Protection of Personal Information Act (POPIA), which puts in place personal data protection controls of as rigorous a standard as those in the GDPR. In Nigeria all subscriber, government and consumer data has been mandated to be stored locally since the Guidelines for Nigerian Content Development in ICT were passed in 2014. More recently, Nigeria's central bank required all point-of-sale and ATM transactions to be processed at home. Tanzanian banks, meanwhile, are obligated to build DCs to store customer data within national borders. Consent is required in Zambia before data can be transferred outside of the country.

Case Study



Headquartered in Cameroon and with offices in Côte d'Ivoire, Congo, Togo, Gabon and Benin, ST Digital helps organisations meet digital transformation targets with cloud technology and professional integration, training and consulting services delivered through its Tier-3 data centre and partnerships with cloud providers such as Microsoft and Oracle. Despite unreliable energy sources, high electricity costs, data sovereignty issues and a lack of local regulation, ST Digital installed the first carrier-neutral, Tier-3 data centre in Cameroon in 2020.

Costs associated with operating a data centre in Africa are higher than those in Europe, and expanding innovative solutions in the mass market comes with greater risk. "The regulatory framework for data centres is not yet mature in Africa," Anthony Same, CEO of ST Digital, told OBG. "As a result, the adoption of technologies has been sluggish, which has delayed the disruption of traditional business models in Africa. This is coming at a time when internet access is seen as a basic right, a factor that brings into question the sovereignty of internet users' personal data." While there are around 80 data centres across Africa, France – with a population some 15 times smaller than that of Africa – operates 200 data centres. To stymie the growing digital divide, Same notes that a collaborative ecosystem of equity funds, national IT agencies, strong regulators, telecoms operators and global big tech players is needed.

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Part 3: Overcoming Barriers

Investment and Finance

The Covid-19 pandemic squeezed the budgets of many potential investors, presenting another obstacle to regional data centre (DC) growth. In 2020 foreign direct investment (FDI) to Africa declined by 16% to \$40bn. This lower investor appetite affected not just DC venture funds, but financiers of supporting ICT infrastructure as well.

That said, international finance deals in Africa's renewable energy sector increased by 28% to \$11bn in 2020, brightening the outlook for a DC market in need of broader access to sustainable energy sources. Nevertheless, amid vaccine rollouts beset by delays and supply constraints, and the emergence of new virus strains, significant downside risks persist for investment in Africa.

Greenfield projects seeking capital present a particular challenge for investors since there is often no corporate financial or operational history on which to base their project evaluation, making risk assessment arduous. However, announced greenfield FDI in the Middle East and North Africa region rose strongly in the third quarter of 2020

to \$10.7bn, rebounding from just \$1.5bn in the previous quarter. IT services were a relative bright spot, with third-quarter greenfield FDI rising by 66% year-on-year (y-o-y). In the six sub-Saharan African countries for which the World Bank compiled data, announced greenfield FDI declined consistently following the outbreak of Covid-19, totalling \$3.2bn in the third quarter of 2020, down 78% y-o-y. Logistics investments declined by 68% y-o-y, with utilities down 73%, reflecting deep uncertainty about future global trade and energy demand.

Announced greenfield FDI in MENA rose to **\$10.7bn** in the third quarter of 2020



International finance deals in Africa's renewable energy sector increased by **28%** to **\$11bn** in 2020

Case Study



Founded in 2018 Raxio Group focuses exclusively on the African continent, where its platform of carrier-neutral, co-location Tier-3 data centres (DCs) offer digital infrastructure solutions in Uganda, Ethiopia, the Democratic Republic of the Congo and Mozambique. Raxio is creating a network of interconnected DCs across the continent and expects to be operating 10 facilities by 2023. Since the company's foundation, the market dynamics in Africa have shifted. While the DC industry used to be inadequately supplied from a financing perspective, there is now an increasing number of international firms eager to invest in African digital infrastructure. Meanwhile, media outlets are keen to report on DC-related developments and the underserved needs of the continent.

However, operating in Africa is not without challenges. Some of the most important factors to consider when analysing potential new markets in the DC space are connectivity

and power, according to Robert Mullins, CEO of Raxio. "Many markets in Africa are known for having power challenges and this needs to be accounted for in our operational and business models," Mullins told OBG. "We need to factor in off-grid time, and we are continuously exploring innovative and green solutions to supplement our power needs."

While being a first-mover in digital infrastructure projects is an attractive proposition for investors, it is ultimately their long-term prospects to serve the continent's infrastructure needs that play a crucial role in convincing investors of their returns. "The most interesting phase comes towards the end of development," Mullins said. "When a DC nears completion there is a real buzz around the project, with commercial interest coming from sectors not previously considered. This has helped to convince those interested in the industry about the longer-term potential."

Part 3: Overcoming Barriers

However, there are reasons for optimism for future development: telecoms provider MTN Group, based in South Africa, announced in 2020 that it would invest \$1.6bn to strengthen its 4G network in Nigeria. The anticipated adoption of the African Continental Free Trade Area's Sustainable Investment Protocol could also bolster foreign investment flows to and within Africa in the long term, particularly to special economic zones.

North Africa, for its part, is expected to benefit from the agreement reached in mid-2021 to activate a \$16bn Saudi-Egyptian investment fund that lists tourism, health, pharmaceuticals, infrastructure, digital technologies, financial services education and food as priority sectors.

The anticipated adoption of the African Continental Free Trade Area's Sustainable Investment Protocol could bolster foreign investment flows to and within Africa



Case Study



N+One, founded in 2008, is the first carrier-neutral data centre (DC) provider in Morocco. While it was initially challenging to convince customers about the economic advantages and efficiency gains associated with externalising data operations, the development of the local ICT sector and a focus on cybersecurity underscored the importance of DCs. Headquartered in Casablanca, N+One offers Tier-3 facilities featuring high-speed, fibre-optic connectivity; cooling infrastructure; uninterrupted power systems; and on-site back-up power generation. In addition to rolling out more solutions to drive the kingdom's digital transformation, the company launched operations in Senegal as a starting point for its development into sub-Saharan Africa.

The importance of carrier-neutral DCs became more widely understood as Morocco's digital infrastructure developed. This not only helped foster better digital services, but also helped shape the country's digital transformation. All of this put the kingdom in a good position to respond to some of the challenges of the Covid-19 pandemic, which stimulated new digital behaviours that are likely to become longer-term habits. Indeed, the country was well placed to swiftly ramp up its DC capabilities: the industry is expanding and players have the capacity to host more data. At the same time, hyperscale providers are entering the market.



Viewpoint




Amine Kandil, Founder & CEO,
N+One Data Centres

Africa has become the frontier of digital development, as the continent has all the characteristics of an exciting and fast-growing digital economy. Its youthful demographics, as well as widespread access to smartphones and internet services, have helped create this dynamic. The Covid-19 pandemic highlighted the fact that this younger population consumes large amounts of data – far higher volumes than ageing populations in Europe and North America.

Data hosting is the backbone of African digitalisation, and is complemented by the region's submarine cable connectivity, fibre internet and entrepreneurship in the digital space. Strong connectivity infrastructure, transparent and liberal regulations, and carrier neutrality will be key for growth. Most notably, DC companies must understand that carrier neutrality is critical and far more than a marketing tool. In Morocco we have seen first-hand the positive impact that creating carrier-neutral DCs has not only on the IT industry, but on the entire ecosystem – including for telecoms operators. As governments continue to welcome investment in digital infrastructure and re-engineer their regulations to become more open – and as more businesses understand the importance of data sovereignty, latency and cloud services – the path for real carrier-neutral DC development will become clear.

Access to Land and Power

African DC requirements

| Peer country | Benchmark type | Power requirement (MW) | Land requirement (m sq metres) | Number of DCs needed* |
|--|----------------|------------------------|--------------------------------|-----------------------|
| India  | Low | 120 | 1.4 | ~80 |
| South Africa  | Medium | 1000 | 3.5 | ~700 |
| Netherlands  | High | 6000 | 52.5 | ~7000 |

*assuming a size of 3 MW

DCs are difficult to construct as they require a combination of hard-to-obtain inputs. The first is real estate spanning several thousand square metres and preferably not too far from a city's business district, as latency increases with distance. Such land can be expensive to acquire in the absence of supportive government policies. According to a February 2021 report by Xalam Analytics and the Africa Data Centres Association, Africa needs to find 1.4m to 3.5m sq metres of well-located and adequately provisioned land to facilitate the buildout of the DC infrastructure necessary to address a growing capacity deficit, around half of which is in Nigeria, Egypt, Algeria and Ethiopia.

DCs also require a tremendous amount of energy. In 2013 DCs in the US were already consuming an estimated 91bn KWh of electricity, equivalent to the annual output of 34 coal-fired power plants with a capacity of 500 MW each. Xalam found that the rest

of the continent requires about 1000 MW of combined additional DC capacity to achieve capacity equivalent to that in South Africa. Africa's deficit is broadly distributed, with 15 countries requiring 5-10 MW of capacity and another 20 needing in excess of 10 MW. While South Africa raised the maximum capacity for private power generation plants to 100 MW in June 2021, delivery remains the preserve of state-owned players in many other African countries. This can result in high prices for large industrial users or delivery failures that lead to blackouts.

Other challenges include limited access to fibre-optic connections, although this is improving in coastal regions. DCs also consume significant volumes of water for electricity generation if sites are independently powered, as well as for cooling servers. DC design must therefore integrate access to water, which is becoming increasingly scarce due to climate change.

Part 3: Overcoming Barriers

Market Reform

One reason for South Africa's leadership in the continent's DC market is the relatively early stage at which it liberalised its telecoms sector. By adopting an open market and inviting multiple carriers to contest for market share, the country created a competitive market for telecoms and related services, helping drive down prices and encouraging uptake of data-heavy services. Nigeria is similarly vibrant, with four major carriers and an abundance of independent service providers. DCs need liberalised environments so they can support economies that require high levels of data storage, while carriers are among the largest sources of demand for interconnection services.

Regulatory reform has proceeded at an uneven pace across Africa. In Cameroon and Senegal, for example, governments have a de-facto monopoly over telecoms infrastructure and there is one dominant provider. Nevertheless, Orange has established new DCs in both countries after segments of the markets were

opened to limited competition. Ethiopia, for its part, began liberalising the telecoms sector and privatising its incumbent state operator Ethio Telecom. Although the reform is ongoing, DC operator Raxio intends to establish a carrier-neutral Tier-3 DC on the outskirts of Addis Ababa beginning in late 2021 to help facilitate the country's first internet exchange point.

Carriers are among the largest sources of demand for interconnection services



Governments have a leading role to play in fostering a supportive regulatory environment, both for the DC market and entities that use their services, particularly start-ups. This requires regulators to work in tandem with industry to ensure legislation does not become overly onerous. Regulators must also create viable regimes that punish violations of data protection laws – a grey area in much of Africa that presents unquantifiable risk to investors.



Viewpoint

Stéphane Duproz, CEO, Africa Data Centres

Africa
DataCentres

Now and again, a new ICT solution sees a combination of factors unite to create a perfect storm of demand – one that is exacerbated by the various vendors' inability to keep pace with growing consumer needs.

One industry with a lot of promise is the multi-tenant co-location data centre (DC) market in Africa, which is poised to expand significantly due to several factors, including rising demand for cloud services, pressure from regulators to bring local content back to Africa, a surge in media content markets and improved broadband services across the continent.

DCs are at the heart of economic growth in Africa, and developing rich and self-sufficient ICT ecosystems cannot happen without them. These facilities are the lifeblood of every business and the foundation of the internet itself – the place where thousands of networks and connections converge. Sustained investment in

connectivity and broadband services will enable digital transformation in Africa. For example, 2018 saw mobile penetration reach 44% in sub-Saharan Africa, which in turn witnessed record demand for data for both personal and business use. Additionally, the availability of affordable smartphone devices and more reasonable data plans demonstrates the continent's growing demand for digital services.

To meet Africa's needs and support its digital transformation agenda, the continent must build more DC facilities. It is for this reason that we have announced a wide-reaching \$500m expansion plan in 10 countries.

Keep in mind that a slew of new technologies – including analytics, the internet of things, artificial intelligence and cloud solutions – are fuelling demand for rapid and reliable services, as is digital infrastructure that is locally based rather than situated in Europe or the US.

Part 3: Overcoming Barriers



Viewpoint

Jan Hnizdo, CEO, Teraco



South Africa's ICT sector is well served by many established telecoms operators and data centres (DCs). The country has widespread terrestrial fibre networks, as well as access to multiple subsea cable systems. Investments in fibre networks, 5G infrastructure, hyperscale DCs, and new subsea cables such as the Africa Coast to Europe, 2Africa and Equiano will facilitate further growth.

South Africa's strategic location at the tip of the continent, as well as its liberal telecoms and technology policies, access to high-quality DC infrastructure, and connectivity to cable systems that service both the east and west coasts, have enabled the country to become the DC powerhouse for public cloud infrastructure providers looking to service markets throughout sub-Saharan Africa. The country also operates as the digital interconnection centre for much of the region, with over 250 telecoms companies and 50 content providers housing their key nodes in South Africa. It is also home to NAPAfrica, the continent's largest internet exchange point and the seventh largest in the world in terms of membership. The facility offers access to over 300 unique networks that service more than 20 countries.

Meanwhile, the DC segment in the rest of sub-Saharan Africa is beginning to grow. Countries like Nigeria, Ghana and Kenya have numerous initiatives under way. Moreover, investments in edge DCs are being made in Angola, Botswana, Ethiopia, Namibia, Tanzania, Mozambique and Zambia. Two of the new subsea cable systems, 2Africa and Equiano, are being built in collaboration with content providers aiming to access the large and growing population of sub-Saharan Africa – estimated at 1.1bn. These will drive investment opportunities and lead to the creation of new edge DC markets.

The development of public cloud infrastructure will be driven by enterprise and government demand, and the need for lower latency. The African public cloud market is currently serviced by large-scale deployments in Europe, the Middle East and South Africa.

The primary reason for the flourishing telecoms market in South Africa is deregulation, which saw the industry grow from three dominant telecoms operators to over 200 in operation today. These include internet service providers, fibre-optic and network providers,

and mobile operators. The business case for constructing large-scale data centre facilities increases when the telecoms regulatory environment allows for a thriving and competitive market.

Deregulation has been the critical enabler for digital transformation across the continent, allowing universal access to the internet and digital services. In markets that are not liberalised, growth is inhibited, and pricing of telecoms infrastructure becomes prohibitive. Public cloud infrastructure providers and global social media platforms are more attracted to investments in fully liberalised telecoms markets. Similarly, an open telecoms sector in Africa is expected to bolster investment in DCs across the continent.

Looking at the future development of the DC industry, Africa is likely to face issues related to data sovereignty if they are not addressed by a continental, unified response. It makes sense for Africa to agree on a single data privacy standard along the lines of the EU's General Data Protection Regulation, known as GDPR. This will further facilitate universal access to digital services and enable digital transformation.

“ The primary reason for the flourishing telecoms market in South Africa is deregulation ”

Improving the ICT Talent Pool

Data on digital skills in Africa remains limited, while the methodology that is used to break down levels of digital skills attainment into basic (e.g., sending emails with attached files), standard (software configuration, connecting new devices and spreadsheet use) and advanced (computer programming) is widely considered to be outdated. That being said, a lack of ICT skills is clearly an impediment to wider uptake of internet services on the continent, and as such acts as a brake on demand for DC capacity. According to a 2019 survey of internet users living in low- and middle-income countries by mobile network industry association GSMA, one-third of respondents cited a lack of digital know-how as the top reason for not using mobile internet. Furthermore, nearly half of the world's uncovered population lives in sub-Saharan Africa. The use of digital technologies among local companies is low, with 7% of informal businesses in sub-Saharan Africa using the internet for business purposes prior to the pandemic.

There is also a dearth of professionals with the cybersecurity skills necessary to protect Africa's growing digital infrastructure.

A variety of actors have stepped in to fill this skills gap. For example, in 2019 Chinese firm KaiOS Technologies partnered with mobile operators in sub-Saharan Africa to release smart feature phones offering free apps that help users acquire digital skills. Meanwhile, the South African government initiated South Africa in the Digital Age, a digital skills programme focused on improving engineering and computer science faculties at universities, while Uganda and Rwanda are increasing investment in university-level science, technology, engineering and mathematics education, including more funding for scholarships.

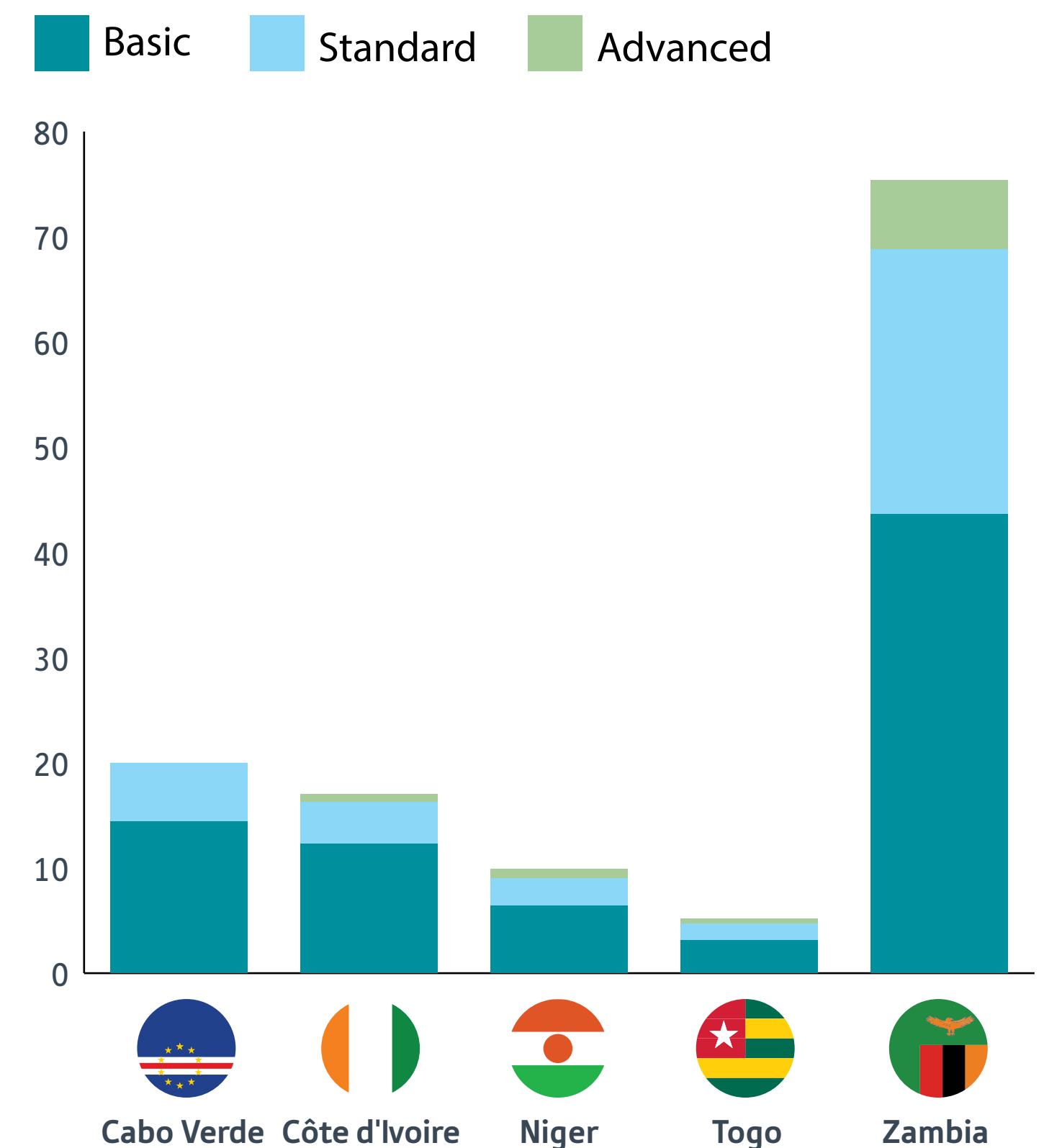
While this is a good start, more needs to be done to integrate digital literacy into school curricula and life-long learning initiatives. To this end, the International

Telecommunication Union launched four digital transformation centres in Africa that aim to develop citizens' digital skills to intermediate level. The first phase will run from January 2020 to September 2021. One of the centres, the Smart Zambia Institute, cooperated with Cisco to equip 72 master trainers with the knowledge to pass on basic digital literacy to local citizens, school teachers and public servants. While their influence is hard to quantify, Africa's growing network of start-ups acts as a locus of digital skills training and information. In 2019 there were 643 tech centres in Africa – 90 of which were active accelerators – supporting and training technology-orientated businesses.



Digital skills levels vary widely across Africa

ICT skills in selected African countries, most recent year 2017, 2018 or 2019 (% of population)



Part 3: Overcoming Barriers

Closing the Digital Divide

Africa's mobile network coverage gap is the largest in the world, with 44.3% of the population within reach of a 4G signal as of 2020, compared to 77.4% who can receive 3G and 88.4% who have a mobile signal of any kind.

Achieving universal access to broadband in Africa by 2030 requires some \$100bn in funding, roughly 250,000 new 4G base stations and at least 250,000 km of fibre links. Innovation will be key to reducing the high costs associated with broadband deployment in rural areas. Solar-powered equipment is tipped to help solve power availability problems, for example, while Huawei's Ruralstar mobile broadband programme helps to reduce capital and operating costs, and has been deployed in Ghana and Kenya. New satellite technologies and deployments, such as Elon Musk's Starlink service and Amazon's plans to launch 3000 satellites that allow for high-speed broadband, will work in tandem with microwave backhaul networks to connect remote areas of sub-Saharan Africa.

Africa's mobile broadband usage gap is considerable, with GSMA indicating that about 45% of people in sub-Saharan Africa live in an area covered by mobile broadband but are not using mobile internet. In addition to a lack of digital skills,

affordability is another factor impeding access. Africa has some of the least affordable prices for ICT and telecoms services, but this is beginning to change as mobile operators focus on reducing handset prices to increase uptake of 4G services. Notably, prices for entry-level, internet-enabled devices in less developed economies accounted for 34% of average monthly income in 2019, down from 44% in 2018, driven partly by increased availability of lower-cost devices.

Maintaining an open data environment is vital to closing the digital divide and driving demand for DC capacity. Africa is second only to Europe in subscribing to the IMF's data standards initiatives, and most African countries maintain a functioning data portal. However, enforcement is typically weak. Only nine countries have issued cybersecurity standards, while 18 have an organisation in charge of setting such standards. This suggests that more can be done to create an environment where customers feel comfortable online.

An estimated **\$100bn** in funding is needed to achieve universal access to broadband connectivity in Africa by 2030



Case Study



Founded in 2006, Workonline Communications provides wholesale connectivity services across sub-Saharan Africa. The company has operations in East, Southern and West Africa, and is set to expand into Central Africa, actively helping to close the digital divide. It is one of the largest IP transit networks on the continent, while also providing ethernet transport, co-location and remote peering services to major internet exchanges.

IP transit is a fundamental component of the region's digital ecosystem. Internet service providers (ISPs) rely on their upstream provider to route traffic to its destination as efficiently as possible. The upstream provider is also responsible for providing content-heavy networks with access to the users in a market as efficiently as possible. An IP transit network operating at an optimal level results in a significantly better experience for all internet users in that market.

"Our expansion in Africa is founded on a thorough understanding of the macroeconomics of a chosen market, including becoming familiar with the local regulatory framework and requirements, and ensuring the availability of a carrier-neutral data centre, internet exchange points and an active ISP community," Benjamin Deveaux, head of business development at Workonline Communications, told OBG.

Part 3: Overcoming Barriers

Regional Integration

The number of people in sub-Saharan Africa living within a 25-km range of an operational fibre-optic network more than doubled between 2009 and 2020 to about 620m, or 56% of the population. By another measure, the World Bank estimates that around 45% of Africa’s population is further than 10 km from fibre network infrastructure, a higher percentage than on any other continent. When the fibre network currently under construction enters service, the region’s fibre reach will increase to 59.6% of the population – or 631m people – rising to 64.1% – 679m people – once planned networks enter service, according to Hamilton Research.

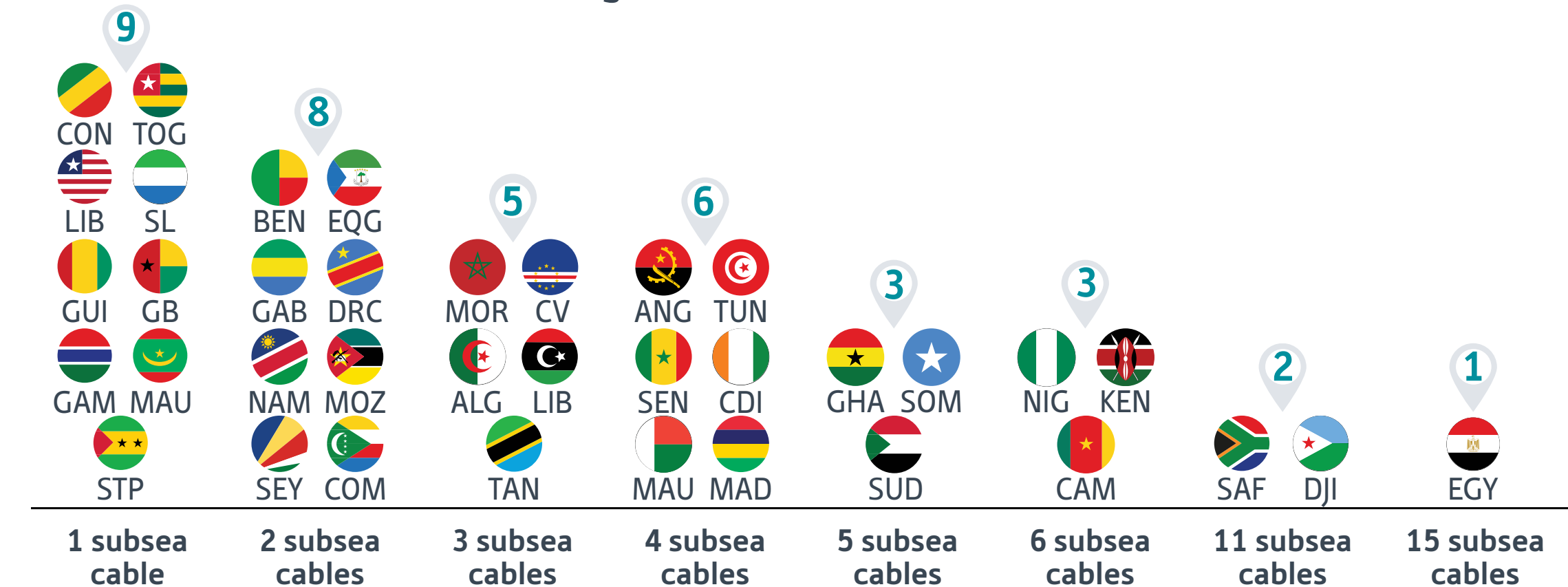
The vast majority of Africa’s fibre-optic network is in the form of subsea cables. All but one of the continent’s 38 countries with a connection to the sea has at least one subsea cable landing – the exception being Eritrea. Egypt has the most with 15; while South Africa and Djibouti have 11 each; and Cameroon, Kenya and Nigeria have six apiece. These links make each country a viable regional DC host, where international subsea cables connect to fast cross-border fibre-optic networks.

Two major subsea cable initiatives are set to markedly improve Africa’s connectivity and resiliency. The first is the 2Africa cable, an initiative of Facebook and other major tech and telecoms firms including China Mobile, Vodafone and MTN Group. The \$1bn project aims to circumnavigate the continent by 2024, connecting 23 countries along a 37,000-km cable and adding 180 Tbps to design capacity. Meanwhile, Google’s Equiano cable will run from Lisbon to Cape Town via Lagos, and provide up to 20 times more network capacity than the last cable laid to serve the region.

At the same time, terrestrial cross-border fibre connections remain limited on the continent. Of the total bandwidth of 8.814 Tbps available in sub-Saharan Africa as of December 2019, 8.126 Tbps, or 92.2% of the total, was delivered directly by submarine cable, while just 678 Gbps, or 7.8% of the total, was supplied by cross-border networks connected to submarine cables.

Various initiatives are under way to address this imbalance, comprising rollouts of national

Number of subsea cable landings in African countries, 2019



backbone fibre and cross-border networks. Liquid Intelligent Technologies (LIT), for instance, announced in June 2021 that it had completed a 100,000-km fibre-optic network across 14 African countries, linking Egypt with South Africa over land. LIT is also partnering with Facebook to build a 2000-km network between the Democratic Republic of Congo and Rwanda that is expected to considerably improve connectivity in Central Africa.

Orange, meanwhile, has linked up its national fibre-optic deployments in West Africa under the name Djoliba, billed as the first pan-African backbone, which loops 10,000 km of terrestrial fibre with an equivalent length of subsea cable, serving eight countries. As uptake of broadband services accelerates across the continent, terrestrial fibre rollouts will have to keep pace to facilitate higher demand for interconnection services.

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Developing the ICT Ecosystem

Digital technology is expected to serve as a key enabler of Africa’s sustainable development targets, and it is essential to addressing challenges facing the continent, including food security, education, health, energy and competitiveness. The IMF emphasised in a March 2021 report that the pandemic presented an opportunity for African governments to redouble efforts to adequately fund investment in ICT skills, infrastructure and technologies. Moreover, the health crisis has the potential to allow policymakers to re-imagine economies’ structures, service delivery systems and social contracts.

The pandemic accelerated digitalisation, market consolidation and regional cooperation, the last of which is set to receive a significant boost after the implementation of the African Continental Free Trade Area. In line with digitalisation efforts, the rising use of mobile technologies and digital payments has the potential to help Africa leapfrog traditional phases of industrial development, as access to smartphones enhances consumer information, networking opportunities, job creation and financial inclusion.

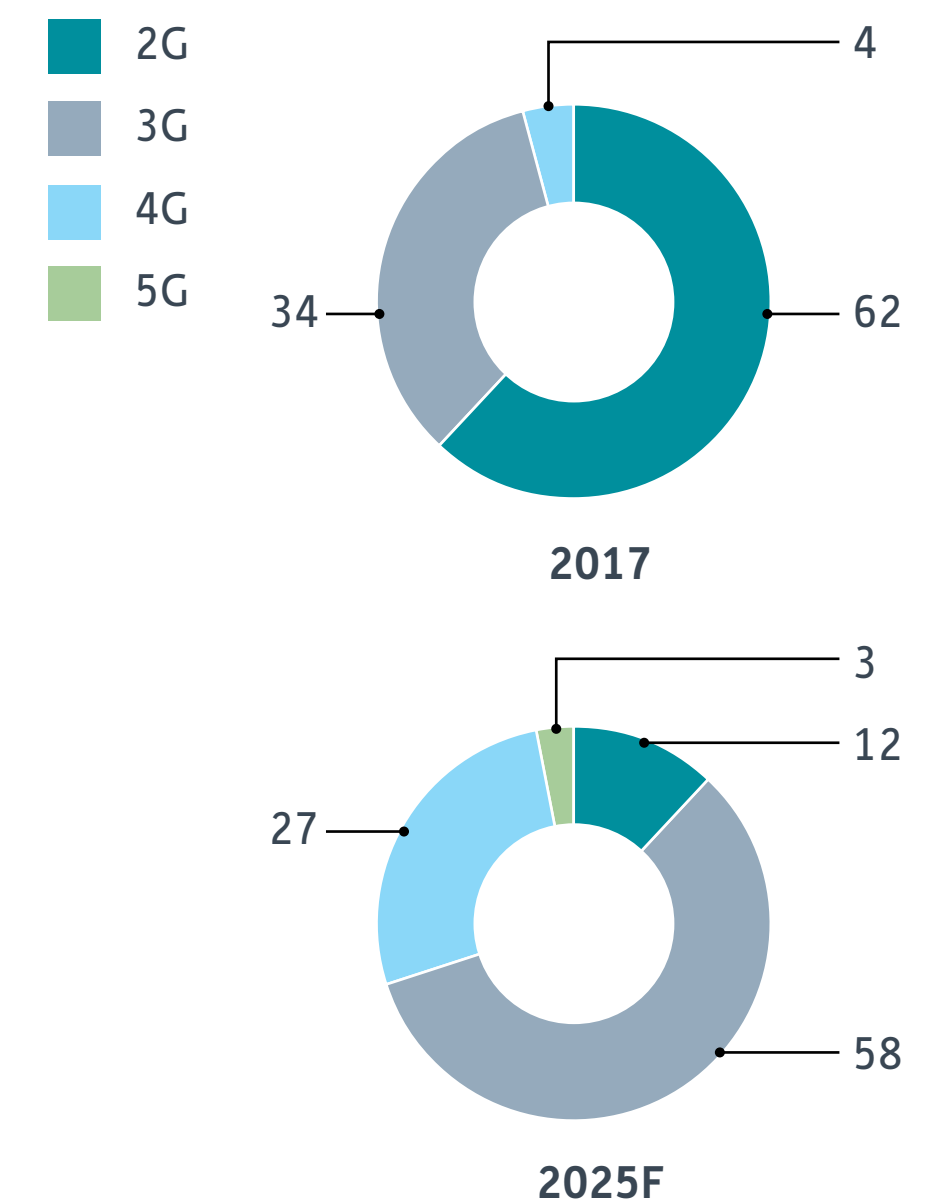
According to a December 2019 study by Harvard Business Review, South Africa leads the continent in terms of the ease of creating digital jobs, with its ecosystem supported by strong consumer demand, a supportive policy environment, the deployment of emerging technologies such as biometric data and payment cards for social security, and the lowest rate of power outages on the continent. Meanwhile, Kenya, where over 70% of the population has a mobile money account – largely due to the success of local tech firm M-Pesa, a global pioneer – is another digital leader. The country’s policymakers are keen to capitalise on the shift to mobile payments, and have engaged with industry leaders to establish data governance laws that encourage digital payments. In May 2019 the country launched the Digital Economy Blueprint to bolster its digital ecosystem. The plan identifies five pillars of the digital economy: digital government, digital business, infrastructure, innovation-driven entrepreneurship, and data skills and values.

Elsewhere, Rwanda is an emerging digital economy that is leveraging improved 4G coverage to expand

the penetration of mobile money. Nigeria leveraged its ICT infrastructure, affordability, and locally relevant content and services to attract more than \$307m in venture capital in 2020, the highest value on the continent. This has supported ICT ventures in education, financial technology, agriculture, health care, logistics and travel. In Ethiopia the government committed to training 70% of its students in science, technology, engineer and mathematics. Digital technology in Egypt is also fast growing, underpinned by a vibrant e-commerce market that bolsters widespread entrepreneurial activity.

The future growth of Africa’s ICT ecosystem will require sustained improvements in the continent’s fragmented network of data and ICT standards, and greater regional cooperation between both governments and industry leaders will be key towards meeting this goal. The entrance of new data centre (DC) operators and cloud service providers should heighten the need for interconnection services, enabling large markets to leverage their fibre connectivity to support the wider ICT ecosystem.

Mobile technology mix in sub-Saharan Africa, 2017-25F (% of total connections)



Africa as a Tech Lab for the Future

Several governments have committed to digital-first agendas to boost the economy and create jobs as more technology centres emerge and existing ones – such as Silicon Savannah in Nairobi, Kenya or Yabacon Valley in Lagos, Nigeria – expand. As of 2019 Africa was the fastest-growing continent for developers in the world. That year Microsoft announced it would invest \$100m in new development centres – initially in Nairobi and Lagos – that would serve as a base for up to 500 developers by 2023. Indeed, investors are giving Africa’s digital economy an injection of the capital required for rapid, region-wide expansion. The number of African start-ups securing venture funding expanded at six times the global average between 2015 and 2020, growing at an average of 46% each year to reach 359 start-ups in 2020, according to a 2021 report from the Boston Consulting Group. However, the majority do not survive beyond the Series-B stage, with only 3% doing so in 2019. This is a consequence of a range of factors, including political and economic instability, weak consumer purchasing power, inadequate data communications infrastructure and the unavailability

of digital talent. The focus on the digital economy is part of an effort to overcome these challenges.

Encouragingly, African start-ups stepped in to fill gaps in health provision during the pandemic. In Kenya, Morocco and Rwanda local start-ups created track-and-trace apps to monitor the spread of infections. Rwanda also tapped telemedicine to reduce in-person visits to clinics, and created chatbots to provide people with Covid-19 updates. Meanwhile, in Ethiopia several homegrown ride-hailing apps and e-commerce markets have emerged, as well as an agri-tech incubator and a seed fund.



Case Study



Rack Centre was established in 2012 and was the first carrier-neutral commercial data centre (DC) to obtain a Tier-3 Certification of Constructed Facility in Africa. Its clients include telecoms carriers, internet service providers (ISPs), and foreign and local firms. The DC has direct links to all five subsea cables that serve the Atlantic coast of the continent, and is supported by a diverse ecosystem of carriers, eyeball networks and ISPs. The company is expanding its DC capacity from 1.5 MW to 14.5 MW through the addition of hyperscale, large-footprint and retail data halls. Rack Centre is the largest carrier-neutral DC in West Africa, and the expansion will consolidate this position.

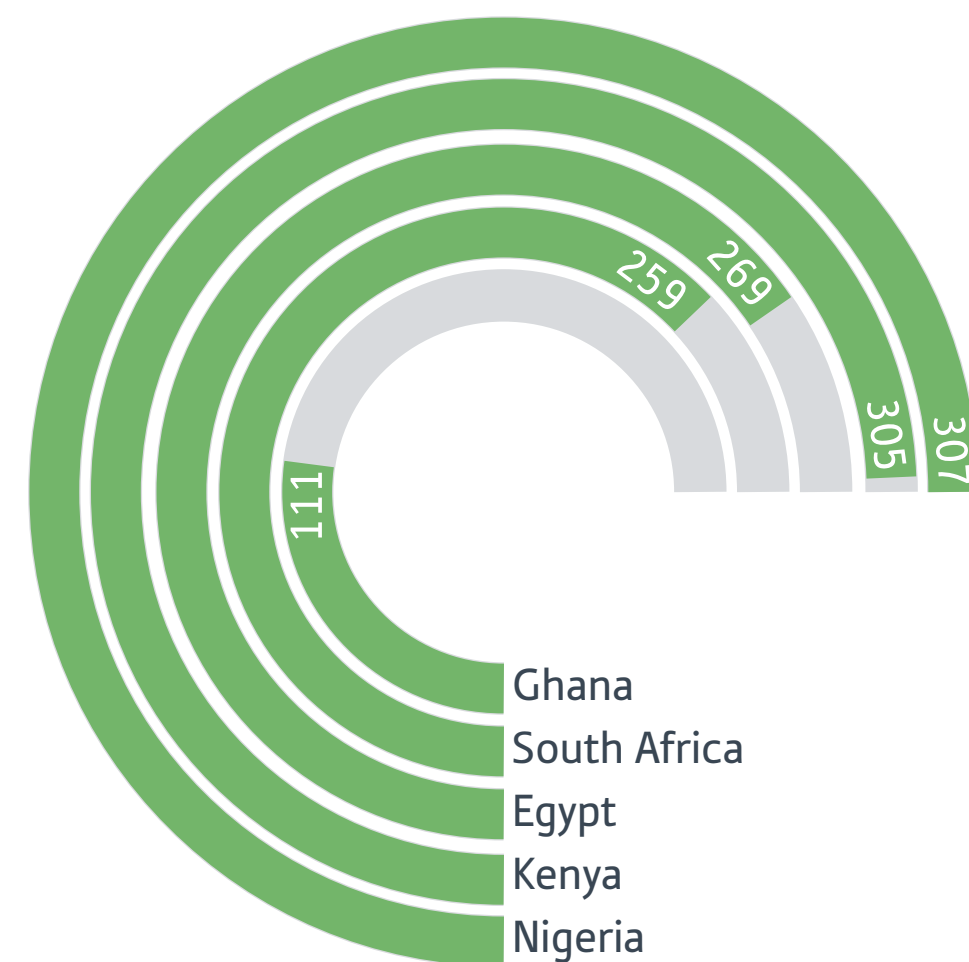
Africa hosts just 1% of global DC capacity, yet accounts for 17% of the global population and 4% of global GDP. Data consumption is projected to grow significantly due to the continent’s young, digital-literate population.

The expansion of DCs such as Rack Centre will be key to meeting data capacity demand. “Nigeria has over 40m micro-, small and medium-sized enterprises, over 150m internet users, and growing broadband penetration. These are strong fundamentals that will fuel the growth of DCs and digital infrastructure,” Ayotunde Coker, CEO of Rack Centre, told OBG. However, sufficient and sustainable power, and efficient power utilisation are crucial. “The cost of power is key, and addressing this issue in Africa is a challenge,” Coker added. “Investing in DCs is capital intensive but access to funds is difficult to come by locally. Diversified power sources are crucial for operational and risk management.” The company has its own power infrastructure, using gas as a primary source and diesel as a backup, and leverages economies of scale to lower unit costs. Indeed, Rack Centre is prioritising innovation to promote energy efficiency and environmental sustainability.

Part 4: Outlook

The number of African start-ups securing venture funding expanded at **six times** the global average between 2015 and 2020, growing at an average of **46% each year** to reach 359 start-ups in 2020

Top-five African countries by venture capital secured, 2020 (\$ m)



Case Study



Galaxy Backbone, incorporated in 2006, is a public enterprise of the federal government of Nigeria. Headquartered in the capital city of Abuja, the company provides digital infrastructure and shared provider services to federal ministries, departments and agencies. Despite being tied to the public sector, Galaxy operates as a limited company. It specialises in hosting, connectivity, cloud computing data centres (DCs) and consulting services. Galaxy Backbone has DCs in Abuja, Enugu and Lagos, and is building another Tier-4 facility in the north of the country. Its DCs operate as an ecosystem for co-location and cloud services. In addition, Galaxy Backbone has laid fibre-optic networks in 13 states of the country, with fibre optics currently being laid in 21 additional states.

The company has taken advantage of increasing digitalisation rates since the start of the Covid-19 pandemic to develop and extend their services to new customers. This growth has translated into improved digital services for Nigerian citizens, notably with the national e-identity project that links an individual's identification card to his or her SIM card. As the market with the largest population in Africa, it will be important for Nigeria to adhere to international standards to attract foreign investment and exposure. Until the market matures, these certifications will be key to facilitating further DC development.



Viewpoint

Muhammad Bello Abubakar, Managing Director and CEO, Galaxy Backbone

I am confident that Nigeria will have a positive impact on the development of Africa's digital economy. The country will be the locus of the data centre (DC) industry by 2025 given its significant untapped potential, favourable demographics and the rapid deployment of new IT projects largely driven by demand-side growth.

Nigerian data must remain localised, and as such, it is unlikely that the government will outsource data management to international businesses in foreign countries. Indeed, in 2021 a directive was issued requiring public sector organisations to host their data activities in government-approved DCs. Moreover, e-government services are likely to be rolled out in earnest throughout 2022. Challenges remain in meeting these goals, however. DCs play an important role in the last-mile solution but require more reliable sources of power and improved maintenance.

Another challenge is human resources: there is a lack of local experts in the industry. The government is increasingly recognising the importance of developing digital skills and infrastructure, thus there is a growing emphasis on employing more Nigerians in the tech sector. Ultimately the future is bright for Nigeria's digital landscape, especially as the number of technology users grows.

Unifying Standards

The development of global standards that will give investors and customers alike the confidence to engage in the DC industry is paramount, and bodies such as the Africa Data Centres Association (ADCA) are working with regional officials to establish such protocols. The current combination of national and international standards confuses the landscapes and impairs growth. As such, a more unified and globally recognised set of standards will be required to enable African DC operators to deliver reliable services, and expand to meet demand.

Recent developments offer an opportunity to establish a pan-African DC standards framework. The International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) are cooperating to produce globally applicable best practice guidelines for DCs. African countries are eligible to participate in the process and contribute to the creation of a set of key performance indicators (KPIs) that will help guide the industry towards sustainable growth.

For example, the first set of full standards focusing on DC resource efficiency will be published in 2021. This has the potential to harmonise the industry’s understanding of energy efficiency under the power usage effectiveness (PUE) standard. A complementary set of KPIs will address the physical facility, such as power distribution, cable infrastructure and security systems. Enhanced engagement between international organisations such as the ISO and the IEC, and regional bodies such as ADCA, will help to unify DC standards and ensure that the industry adopts internationally recognised best practices.

International key performance indicators for DC infrastructure

KPIs for DC facilities and infrastructure

| | | |
|--|-----------------------|---|
| General concepts | Power distribution | Telecommunications cabling infrastructure |
| Building construction | Environmental control | Security systems |
| Management and operational information | | |

Case Study



Uptime Institute is a global digital infrastructure advisory firm focused on improving the performance, efficiency and reliability of critical digital infrastructure via innovation, collaboration, education and independent certifications. Its primary aims include improving the reliability of African data centres (DCs) and bolstering their resilience against power outages and other disruptions.

While digital infrastructure is varied across Africa, all DCs must develop resilience in terms of power, cooling and connectivity to ensure reliability and continuity of service for their clients. This requires expertise, and Uptime Institute provides training through educational programmes to close the skills gap on the continent. Indeed, a new culture of corporate-sponsored education is emerging across Africa to bridge the distance between the supply and demand of qualified experts throughout the digital infrastructure ecosystem.

Overcoming availability issues, including access to uninterrupted power, typically requires solutions that begin with the design and construction of DCs. Uptime Institute provides solutions to these and other issues through a variety of assessments that encompass design, construction and operation of both new and existing DCs. Global standards certification, and tier and other third party assessments are important when facilities are built by local contractors who may not be familiar with the intricacies of constructing DCs.

“If a DC has a tier certification, it shows that it has reached a higher level of performance,” Mustapha Louni, senior vice president for the Middle East, Africa and Greater India at Uptime Institute, told OBG. “The facility has been verified as capable of meeting real-world challenges and the requirements of the organisation. Tier certification highlights that infrastructure has been built to minimise risk.”

Sustainability

Incorporating sustainability into data centre (DC) design is especially important in Africa because higher temperatures necessitate additional cooling power – which is often in limited supply. Access to renewable energy sources is therefore essential, particularly for multinational, hyperscale providers such as Google and Microsoft that are committed to global sustainability targets.

Solar power has particular potential for operators on the continent. Nine African countries are building up their solar capacities, and Egypt and South Africa are already members of the solar “gigawatt club” of countries with installed capacity of at least 1 GW of solar power, according to a 2021 report from the Africa Solar Industry Association. Morocco is working towards the 1-GW target, with its 1200-ha, 580-MW Noor Ouarzazate Solar Complex – the world’s largest concentrated solar power facility. Meanwhile, in West Africa solar capture and storage

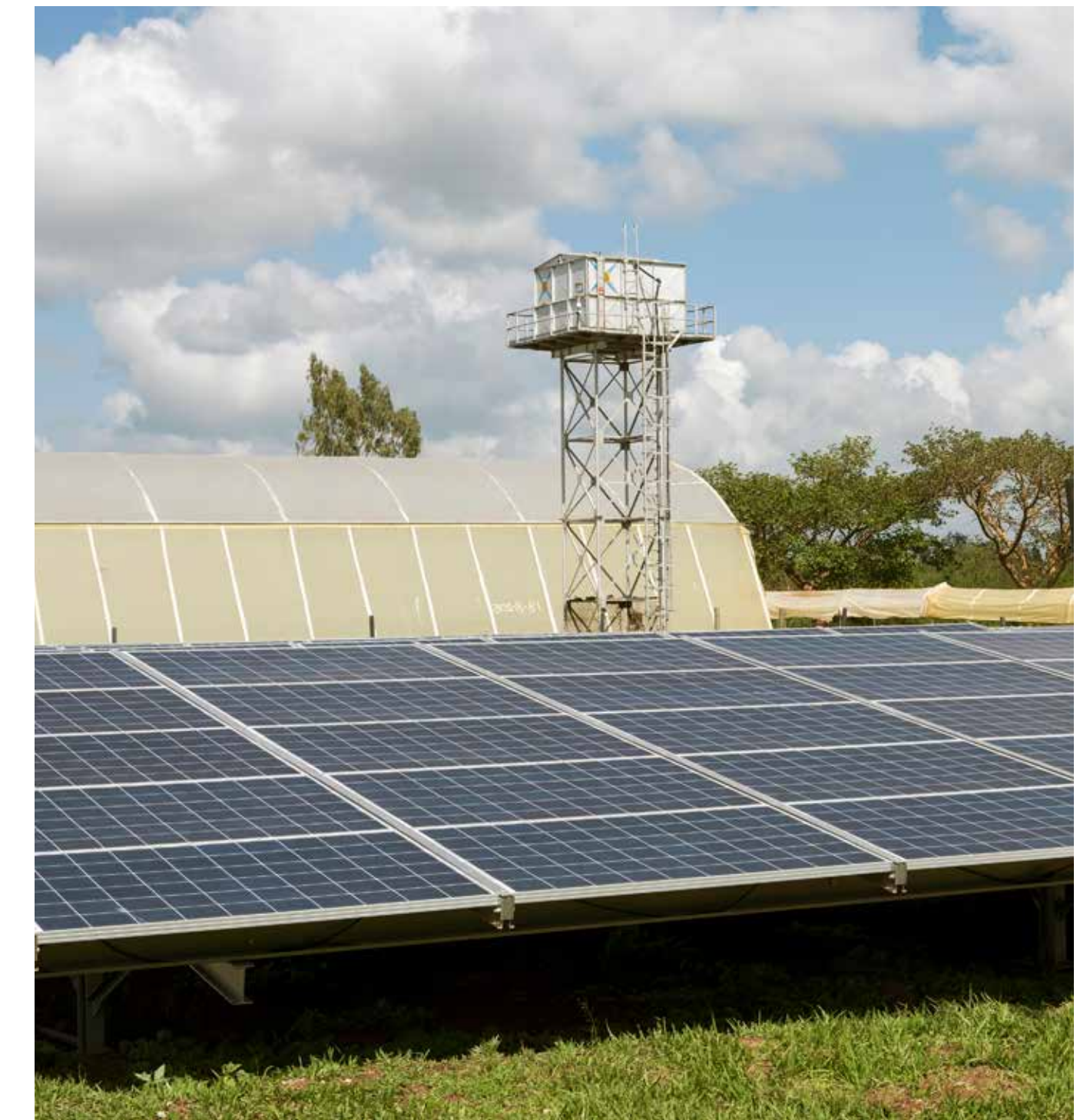
projects are making progress in resolving the limited storage capacity of the region’s grids.

Africa is also an emerging leader in microgrid capacity – grid-connected, on-site energy generation or storage plants that can help DCs lower power bills by saving on peak demand costs. Co-location and enterprise operators are adopting renewable energy sources to power DCs. For example, Zimbabwean telecoms firm Econet’s Distributed Power Africa unit is overseeing the integration of alternative energy solutions into Econet’s DC assets in Burundi, Kenya and South Africa.

ADCA and other organisations are working to establish an energy-efficiency code of conduct. They are drawing inspiration from the European Commission’s best-practice guidelines for DC energy efficiency, which outlines roles and responsibilities for various stakeholders in the construction, retrofitting and maintenance of a DC. The guidelines

recommend a modular rather than monolithic DC design to limit excess provisioning of space, power and cooling. They also include guidance on energy-efficient equipment and airflow management to reduce the need for cooling – often a DC’s largest source of energy loss. Looking to the future, advanced building information modelling will allow for taller building designs and direct-liquid cooling systems that focus air movement on servers alone rather than entire buildings.

Water consumption is another area of concern. Cooling systems in older facilities account for up to 30% of total DC energy demand, but until today the industry has largely focused on reducing power consumption, in part as a consequence of the use of PUE ratios as an indicator of DC sustainability. Operators in Africa have an opportunity to spearhead a global drive to include water source and use metrics in their reporting, and promote the wider use of water recycling in data facilities.



Case Study



CBRE's data centre (DC) solutions division was established in 2015 as a standalone service catering to growing demand. Today it is the largest DC outsource service provider, active in more than 45 countries through some 3000 technical roles. CBRE manages over 400 DCs with 99.99968% uptime – a key metric for the industry – and has a turnover of \$1bn. The company's base in Africa was launched in the 1990s, with DC activity supporting the likes of IBM. In 2018 CBRE announced a partnership with Excellerate – a services firm based in South Africa – to expand its footprint across the Middle East and Africa, offering the required DC capability to support digital needs.

There are similar trends between the DC boom currently under way in Africa and the evolution of the DC industry in the UK at the turn of the century, with one example being the tough competition for talent. In the UK in the 2000s newcomers to the market were able to easily move DC resources by offering attractive packages. CBRE

regards talent as one of the fundamental drivers of wider economic growth in Africa, and sees the skills piece as the most significant aspect of building a successful DC industry on the continent. Bridging the skills gap globally is important, but as the DC boom takes place in Africa, there will likely be challenges related to overcoming local skills shortages: mirroring how the situation played out in developed markets some 20 years ago.

In the future the company hopes to promote more apprenticeships and training programmes to respond to the needs of this rapidly growing industry. The required amount of experienced staff will likely be unavailable to operate and maintain a DC in five years, as demand for DC construction is forecast to outstrip the supply of talent to manage them, so there must be a focus on meeting the skills requirements of the future, today. CBRE believes there are more effective ways to train apprentices in the current system and manage them in a way that nurtures their strengths.



Viewpoint

Lee Perrin, Data Centre Business Lead - Middle East and Africa, CBRE Global Workplace Solutions

Global data centre (DC) operators are becoming increasingly interested in Africa, particularly given the attractive prospect of connecting the last large population to the internet and the fact that the continent is well positioned to leapfrog older technologies. Investors can construct DCs in African markets confident in the knowledge that sufficient current demand exists, and that it will grow in line with the needs of Africa's young, tech-savvy demographic.

The ability to scale businesses on the continent is another competitive advantage that Africa has: there is a lot of space in Africa, and the asset class for DCs is increasingly robust. The DC industry is a massive opportunity for African markets to change the way they do business. This shift will strengthen the region's ability to be on the digital front and be a serious player in the global DC arena. DC facilities continue to attract healthy investment levels and contribute to developing the continent's wider digital

ecosystem, creating more growth opportunities for local firms and entrepreneurs.

Certifications, partnerships with mobile network operators and high uptimes are critical metrics that are valuable for reputation in the industry. The issue for Africa – which is something we have seen for decades – is that it is viewed as a risky, unknown frontier. As a result, there has been a massive rise in certifications, adherence to global standards and engineers promoting their qualifications. In the US or Europe there might not be a need for these moves, but in a new market such as sub-Saharan Africa, accreditations speak to a level of quality and serve a real purpose for attracting investment.

Another benchmarking metric for the industry is sustainable operations. The greatest benefits come with scale and standardisation when creating processes to manage energy, greenhouse gas emissions, water and waste.

Artificial Intelligence

As demand for DC resources rises, artificial intelligence (AI) is emerging as a key element of development. AI is integral to improving energy efficiency, as machine learning can build a picture of likely spikes in IT loads and energy consumption, and help cooling systems adapt to lower PUE. In some systems cooling sensors communicate in real time with cooling management systems to achieve greater efficiency. For example, Huawei's iCooling solution in a DC in Ningxia, China helped reduce the facility's energy consumption by 3.2%, lowering costs and carbon emissions. The Chinese firm has similar solutions for power and operations management, with the latter including cloud-based tools for operators overseeing multiple sites. Elsewhere, Google's DeepMind has been deployed in one of the tech giant's DCs to reduce energy used for cooling by 40%. Siemens offers a dual approach that controls chilled water delivery in tandem with a platform that monitors air

supply and temperature data, and adjusts airflow accordingly. Siemens has deployed the technology in one Tier-4 DC to bring PUE down to 1.2 (a PUE of 1 denotes zero energy loss). While Google's technology is proprietary, Siemens' is provided by private vendor Vigilant, demonstrating how far-sighted DC operators can purchase AI solutions to suit their needs.

Turning to predictive maintenance, AI allows DC operators to foresee and remedy system faults and component failures. Sensors can listen for unwanted vibrations or sounds in IT equipment, flagging potential failures before they occur. At the same time, algorithms can also help balance server workload, which in turn reduces system stress and the risk of data outages. Machine learning can also assist in tightening cybersecurity, as well as analysing regular inflows and outflows of data, detecting aberrations that suggest the presence of malware or attempts at hacking.

Impact of AI on DC operations



Improves security

AI-based cybersecurity can screen and analyse incoming and outgoing data, detect malware and implement behavioural analytics to protect data



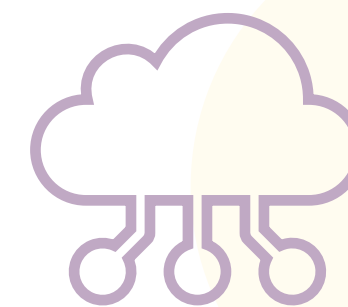
Optimises servers

AI-powered analysis can help distribute workload across various servers



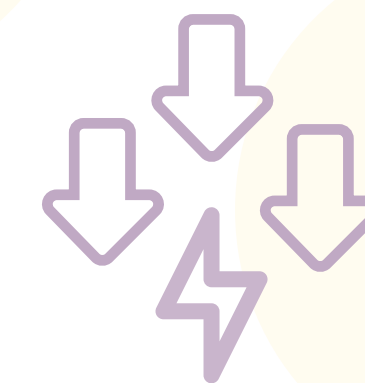
Monitors equipment

AI uses pattern-based learning to identify equipment defects



Reduces downtime

AI can monitor server performance, network congestion and disk utilisation to detect and predict data outages



Conserves energy

AI can learn and analyse operations to identify and remedy sources of energy inefficiency, reducing overall consumption

Key Takeaways

1 Carrier-neutral capacity

Africa is underserved in terms of DC capacity, accounting for 1% of the global total. Up to 700 new facilities are required to meet rising demand for DC services and put capacity density on a par with South Africa, the continental leader. Efforts to bridge this capacity gap will drive the continent's market expansion at a compound annual growth rate of 12% between 2019 and 2025, reaching a value of \$3bn. This should make the operation and provision of DCs a highly profitable enterprise.

2 Long-term demand

Over half of global population growth through to 2050 is expected to occur in Africa, boosting demand for mobile data services from an increasingly youthful, internet-connected consumer base. Broadband connectivity is improving and costs are falling, even before the completion of several large-scale fibre-optic cable projects. Governments are keen to enact data sovereignty laws that will mandate onshore data storage. Meanwhile, multinational cloud providers such as Amazon, Microsoft and Huawei are galvanising demand for DC services in the continent's regional powerhouses.

3 Supply-side challenges

As the global economy recovers from the Covid-19 pandemic, financing is likely to remain constrained for mid- to high-risk initiatives, including DC operations in Africa. Securing real estate and reliable sources of power – in addition to navigating complex policy and security environments – will likely raise costs and necessitate support from operatives on the ground in each jurisdiction. While long-term plans to improve the supply of talent remain important, DC operators will continue to face immediate staffing challenges.

4 Unified standards

Africa can emulate economies such as China by deploying leapfrog technologies and avoiding problems related to legacy systems and interests. With the combination of regional cooperation and corporate leadership, and engagement with international standard-setting bodies, Africa can establish continent-wide standards that nurture an energy-efficient, sustainable DC industry.

5 Emerging markets

DC operators are building new facilities in hot spots such as South Africa, Kenya, Nigeria, Egypt and Ethiopia. This is an urgent task, as the Africa Continental Free Trade Area is expected to cut red tape and allow successful enterprises to reinvest profits in new geographies at reduced cost. This will raise barriers to entry for new players, and particularly those without the financial resources to invest in AI. A series of large-scale investments have already been announced across the continent, with more likely to follow once the viability of business cases is proven.

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