



AFRICA INTERCONNECTION REPORT

ANALYSIS OF SUB-SAHARAN AFRICA'S CLOUD & DATA CENTRE ECOSYSTEM



balancing act
TELECOMS, INTERNET AND BROADCAST IN AFRICA
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CONTENTS



INTRODUCTION	2	OVERVIEW OF CLOUD SERVICES	19
METHODOLOGY	3	THE CURRENT CLOUD SERVICES LANDSCAPE IN SUB-SAHARAN AFRICA	20
EXECUTIVE SUMMARY	4	UNDERLYING CLOUD SERVICES DYNAMICS	21
SUB-SAHARAN AFRICA'S DATA CENTRE AND CLOUD LANDSCAPE	5	DATA CENTRE AND CLOUD SERVICES USERS	22
BROADER GLOBAL AND AFRICAN INDUSTRY TRENDS IMPACTING GROWTH	6	DIFFERENT WAVES OF GROWTH	23
FACTORS ENCOURAGING THE DATA CENTRES AND CLOUD SERVICES ECOSYSTEM	8	LOCAL EXAMPLES OF DIGITAL TRANSFORMATION	25
MAPPING SUB-SAHARAN AFRICA'S DATA CENTRES	10	INTERCONNECTION OPPORTUNITIES IN SUB-SAHARAN AFRICA	30
EXISTING AND PLANNED GROWTH OF CARRIER-NEUTRAL DATA CENTRES	11	THE GROWING NEED FOR LOCAL INTERCONNECTION	31
INTERNATIONAL PRESENCE IN IXPS AND CARRIER-NEUTRAL DATA CENTRES	14	CONSOLE CONNECT IN SUB-SAHARAN AFRICA	32
FUTURE DISTRIBUTION OF CARRIER-NEUTRAL DATA CENTRES IN THE REGION	16		

INTRODUCTION: CLOUDS GATHERING OVER SUB-SAHARAN AFRICA

2020 has been a significant year for Africa's cloud ecosystem. Considerable new investment is going into carrier-neutral data centres across Sub-Saharan Africa and slowly but surely the adoption of cloud services is gathering pace.

The impact of the Covid-19 pandemic has led many businesses to accelerate adoption of cloud services in order to help them operate during these difficult times. But they are also looking beyond the short-term and want a more strategic view of how cloud can drive efficiencies and reduce cost in the future.

To gain a deeper insight into these trends, Console Connect by PCCW Global recently commissioned consultancy firm Balancing Act to gather market research on the region's data centre and cloud ecosystem.

The research focuses on 10 of the region's largest economies, but to some lesser detail covers all countries across Sub-Saharan Africa. The countries of focus in the report are: Angola, Cote d'Ivoire, Djibouti, DRC, Ghana, Kenya, Nigeria, Mozambique, South Africa and Uganda.

This report is made up of five sections. The first looks in detail at the current state of Africa's data centre and cloud landscape, exploring some of the broader global and local trends

that are driving growth in data centres and cloud services.

The second section focuses more closely on the region's data centres, mapping the growth of carrier-neutral data centres and the emergence of regional hubs. From there, we look at the arrival of hyperscale cloud providers to the region and chart the impact this will have on both local businesses and infrastructure.

This is followed by a profile of data centre and cloud service users in Africa; looking at the likely growth sectors over the next 5 years and showcasing some current examples of digital transformation.

Finally, we look at new interconnection opportunities in Africa and consider the role network automation can play in enabling carriers and enterprises to harness the power of cloud.

We would like to thank all those people that spoke to Balancing Act during the course of this research - almost all of which was conducted on video conferencing tools like Google Hangout, Skype, Teams, WhatsApp and Zoom. A further illustration of the current importance of cloud-based communications services to businesses across the region.

About Balancing Act

Balancing Act focuses on Africa and carries out consultancy assignments for a variety of clients. The company helps national and global brands with their involvement in the African continent.

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METHODOLOGY

It is important to clarify that this study is primarily about the use of public cloud rather than private cloud services. It also uses the term hyperscalers as a shorthand for global public service providers.

Interviews were conducted with key players in the following countries: Angola, Benin, Cote d'Ivoire, Djibouti, DRC, Ghana, Kenya, Nigeria, Mozambique, Senegal, South Africa, Tanzania, Uganda, Morocco and Egypt.

Interviews were carried out in the following industry categories: data centres, cloud service providers, carriers and ISPs, enterprise users and other (investor, platform, vendor). We have used a generous definition of carrier-neutral data centres, which includes companies that operate their data centres independently of their other activities.

These interviews provide a good snapshot of a fast moving sector for the following reasons:

1. All country markets chosen have proven data centre and cloud services potential.
2. Our own broader data gathering and reports support the findings and insights offered.
3. All those interviewed were CEOs, Managing Directors or Heads responsible for data centres and/or cloud service activities.

There were many, many useful insights in these conversations but as ever, the opinions and findings expressed in this study are entirely from Balancing Act (except for Section 5 of the report).

GLOSSARY

Some common industry terms used throughout the report:

Data localisation: It is the act of storing data on any device physically present within the borders of a country. As of now, most of these data are stored, in a cloud, outside countries.

Data sovereignty: It is the idea that data is subject to the laws and governance structures within the nation within which they are collected.

Edge computing: It is about pushing the frontier of computing applications, data, and services away from centralised nodes to the logical extremes of a network. It enables analytics and data gathering to occur at the source of the data.

Hybrid cloud: It is a computing environment that combines a public cloud and a private cloud by allowing data and applications to be shared between them.

Private cloud: It is defined as computing services offered either over the internet or a private internal network and to selected users only.

Public cloud: It is a type of computing in which a service provider makes resources available to companies and the public via the internet. Some public cloud providers offer resources for free, while clients pay for other resources by subscription or a pay-per-usage model.

Tiers II, III and IV: The different service level provisions of a data centre provided by the Uptime Institute.



EXECUTIVE SUMMARY

Some high-level findings from the report:

- The report identifies countries with potential to develop carrier-neutral data centres and cloud services. The more operators there are in a country, the greater the need for interconnection, either through an IXP or a data centre, or in nearly all cases both. This point is most vividly illustrated by the position of South Africa and Nigeria but at a smaller level is also seen in Ghana and Tanzania.
- There are 10 Sub-Saharan African countries with carrier-neutral data centres (Angola, Cote d'Ivoire, Djibouti, Ghana, Kenya, Mauritius, Mozambique, Nigeria, South Africa and Zambia) and 6 more are coming on stream shortly (DRC, Ethiopia, Rwanda, Senegal, Uganda and Zimbabwe). Overall, significant investments are being made in new facilities.
- About a quarter of Sub-Saharan African countries have an existing or planned carrier-neutral data centre. Of the rack capacity in 5 key countries (South Africa, Nigeria, Kenya, Ghana and Angola), South Africa represents 89% of total capacity in those selected countries (see P11).
- The quality and operational expertise of carrier-neutral data centres in Sub-Saharan Africa has improved a great deal over last 5 years. Operators who were in the first wave of launches can now point to nearly a decade or more of continuous successful operation. Several of the planned next generation data centres are being built to Level IV standard.
- Several carriers – mainly mobile operators – have made significant investments in data centres. These include data centres of some scale in the following countries: Cameroon, Cote d'Ivoire, Kenya, Malawi, Mozambique, Nigeria and South Africa.
- There are 28 IXPs across Sub-Saharan Africa. In countries where they exist, international players also locate themselves. The greatest concentration of international companies and organisations is found in South Africa, followed by Kenya and Nigeria (see P14).
- There are five major hyperscalers with an active interest in Africa. These are: Microsoft Azure (which is probably currently the largest provider), AWS, Google Cloud (which has a significant presence in Kenya, Ghana and South Africa), Whale Cloud (part of Alibaba) and Huawei Cloud (see P20).
- African companies that are either using carrier-neutral data centres for data recovery or have replaced their in-house data centres with an external supplier are on a journey towards further cloud adoption.
- In more liberalised communications markets, there are local telcos and ISPs which need a meet point function: even with a relatively small number of players, it makes no sense in an IP world to have individual connections to all players.
- Among the first wave of carrier-neutral data centre users were banks, which are under increasing legal obligations to have their disaster recovery outside their own premises (see P23). The second wave of users were multinational companies looking for cost and operational efficiencies. Several examples of companies transitioning to the cloud are given on P25.
- The acceleration in digital transformation and the arrival of more data centres and cloud service providers in Africa will increase the overall need for local interconnection (see P21).

An aerial photograph of a river delta, showing a complex network of channels and floodplains. The water is a muddy brown color, and the surrounding land is a mix of light tan and dark brown. A bright cyan line runs diagonally from the top left towards the bottom right. A thick purple band runs horizontally across the middle of the image, with a wavy, organic shape on its left side. The text is overlaid on the cyan band.

1. SUB-SAHARAN AFRICA'S DATA CENTRE AND CLOUD LANDSCAPE

BROADER GLOBAL AND AFRICAN INDUSTRY TRENDS IMPACTING GROWTH

The findings of this study must be set in the context of the trends affecting the data centre and cloud sector, both in Africa and globally:

Impact of COVID-19

This study was completed during the COVID-19 pandemic and many of the responses given were based on a return to some version of normally functioning economies. At the time of writing, the full economic implications of the crisis were far from clear.

However, the impact of the various national lockdowns in Sub-Saharan African countries has reinforced the importance of the ability to have flexible working. This is a trend that requires the following: access through a range of devices; effective online communications platforms; access to all the necessary work documents; and sufficient security to ensure that no-one can abuse any part of what is required.

That said, major markets like South Africa and Nigeria have been experiencing what will almost certainly be a medium-term economic downturn.

Hybrid implementation

Although migration to cloud applications is accelerating in key markets in Sub-Saharan Africa, more cautious companies are relying on platform technologies before making everything cloud based. This means that enterprise customers may choose to take parts of their services to the cloud, such as Know Your Customer (KYC) implementations.

Hybrid implementation may also involve companies using local, in-country cloud solutions, which in the first wave of migration feel “closer to home” or seem to deal more effectively with bespoke requirements. It may also mean before going to global hyperscalers, transferring all or some operations to a local, private cloud.

These implementations may use things like VMWare cloud software that can be provided closer to home. Software of this kind also offers integration with all the main hyperscalers.

However, over time companies using these platforms will inevitably consider the often cheaper, large-scale cloud providers which have a much wider customer experience to draw upon. Initial experience will make them more confident about shifting more decisively later in the transition.

The more cautious approach to the cloud in Sub-Saharan African countries may reflect a combination of circumstances: fears about the adequacy and reliability of bandwidth; the speed with which their customers (both enterprise and retail) are migrating online; and fears about how good cloud security will be.

In several of the countries surveyed, there were latency issues and some data centre providers said only local hosting would work for cloud services. Those businesses that are consumer facing are looking to raise revenues through mobile apps and trying to work out whether





they can use Artificial Intelligence (AI) and Machine Learning (ML). Mobile apps also allow companies (particularly banks) to give their customers 24/7 service.

On security, companies may feel more confident that an external provider can handle all of the business of security, such as automatic back-up, intrusion detection, SSL encryption and vulnerability tests. The estimated number of security professionals on the continent (around 10,000) is about the same size as, for example, Oracle's security team.

Over the medium-term, the advantages of cost savings, more efficient processes, only paying for what you use as demand scales up and down and the ability to make service changes more quickly will begin to be more persuasive as the first cohort of major cloud users demonstrate that the technology works.

One of the key cost savings is shifting from time spent on manual processes (in say, payroll payments) to automating processes and being able to understand more easily the meaning of a company's own data.

Digital disruption

Whether globally or in Sub-Saharan Africa, there is an increasing level of digital disruption. According to Weetracker, US\$679 million was invested in African start-ups in the Fintech sector in 2019. Most of this investment was made in Kenya and Nigeria. There are now significant pan-continental operators in this space.

Alongside the newcomers, there has been a steady transformation in the digital offerings of African banks, particularly in Nigeria. For example, the country's largest retail bank, First Bank of Nigeria, has over one million downloads of its Android app. The same is also true for Kenya's largest retail bank KCB.

The combination of start-up and existing enterprise innovation is creating new transaction ecosystems. This migration can be seen most clearly in the financial sector

but will also take place across other domains in the economy, both for B2B and consumer transactions. Worsening economic conditions will add to the pressure to innovate.

An example taken from India illustrates how this might happen to the payments ecosystem for telecoms. Vodafone Idea, a player in India's hotly contested telecoms space, is moving to a cloud-native charging solution delivered using its own private cloud. The pilot is managing over 4 million live subscribers and serves up more than 1,000 transaction units per second (TPS) traffic for online data charging. The purpose of the pilot is a two-step process: firstly, to roll-out the private cloud option across India and secondly, as a step towards a public cloud platform.

Data sovereignty and localisation:

Data centres and cloud services raise particular challenges for regulators. For example, a Kenyan's individual data might be stored in any one of a number of data centres globally, some on the continent and some not.

Therefore how can national law protect the individual from abuse in non-national jurisdictions? What right does that Kenyan individual have to see the data that has been collected on him or her? Data sovereignty covers legislation that information which is stored in the cloud is subject to the laws of the country in which it is physically stored.

In 2016, the European Union passed the General Data Protection Regulation (GDPR), which had five key provisions:

- Requiring the consent of subjects for data processing
- Anonymising collected data to protect privacy
- Providing data breach notifications
- Safely handling the transfer of data across border
- Requiring certain companies to appoint a data protection officer to oversee GDPR compliance



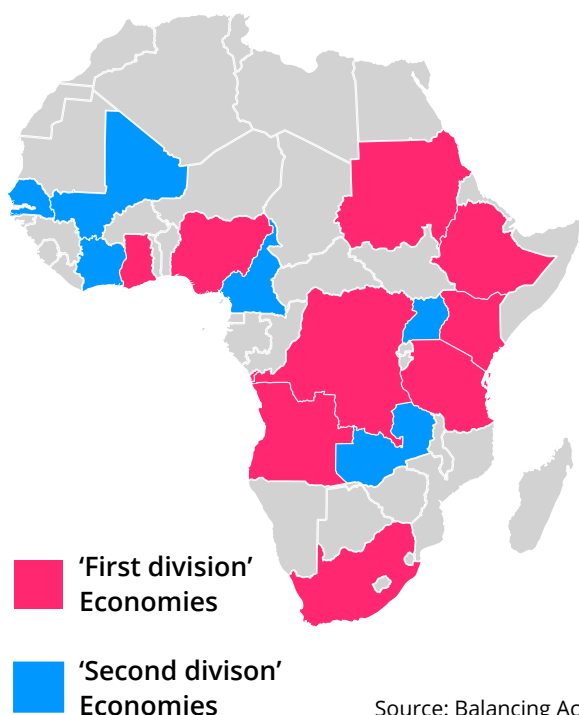
Because a large number of multinational companies are based or operate in Europe this has had the effect of 'exporting' many of these requirements to other countries.

According to a Lexology report in 2019, 16 African countries had passed data protection legislation with a further 8 due to do so. According to a 2017 Personal Data Protection report from Deloitte, 13 African countries require notifications of personal data breaches.

Data localisation means that there is legislation (or guidelines) that requires companies to store a copy of the data locally, requiring companies to process data locally, and mandating individual or government consent for data transfers.

The most obvious example in Africa is Nigeria. The 2014 Guidelines for Nigerian Content Development in Information and Communications Technology (ICT) mandated that all subscriber, government, and consumer data be stored locally.

Map indicating size of African economies



Likewise in Tanzania, circular number FA.56/293/01/54 (dated 23 August 2019) from the Bank of Tanzania specifies that banks locate their primary or secondary data centres in Tanzania.

Furthermore, in 2011, Nigeria's Central Bank introduced a measure that required all point-of-sale and ATM transactions to be processed locally.

Another example globally would be India where the Reserve Bank of India insisted on data localisation of financial transactions in 2018. Whether right or wrong, these kinds of legislation (or guidelines) will lead to growth in local data centre and cloud activity.

FACTORS ENCOURAGING THE DATA CENTRES AND CLOUD SERVICES ECOSYSTEMS

There are three key factors that encourage the development of a data centre and cloud services ecosystems in Sub-Saharan Africa:

Overall size of economy and population

Taking GDP (PPP) US\$ and GDP per capita (PPP), there is a clear 'first division' in Sub-Saharan African economies, comprising the 9 following countries (in descending scale): Nigeria, South Africa, Ethiopia, Angola, Sudan, Kenya, Tanzania, Ghana and DRC.

This is followed by smaller but nonetheless relatively larger economies that make up a 'second division', of the following six countries (in descending scale): Cote d'Ivoire, Cameroon, Uganda, Zambia, Senegal and Mali.

Although there is some political risk in a number of these countries – Ethiopia, Sudan, DRC and Mali – they are all in the main economies with growth potential. The June outlook from the IMF predicts that Sub-Saharan African growth will recover to 3.4% in 2021. Population size matters: the more people in



a country as its economy is expanding, the greater the level of economic activity. All the 'first division' countries have a 2020 estimated population of over 30 million except for Ghana, which has 29 million. All the 'second division' countries have populations of above 15 million and below 30 million.

On this basis, there are fifteen countries that have economies and population sizes that give them the potential to develop data centre and cloud services ecosystems. There are two exceptions: Cape Verde and Djibouti. The former has higher wealth levels based on tourism but in the short to medium term this may prove problematic in terms of the impact of COVID-19. Djibouti's key position as a data centre is defined by its geographic positioning as a crossroads for several important cables.

Number of operators

The more operators there are in a country, the greater the need for interconnection, either through an IXP or a data centre, or in nearly all cases both. This point is most vividly illustrated by the position of South Africa and Nigeria.

In South Africa there are four mobile operators, 11 MVNOs, 160 or more ISPs and many other companies involved in connectivity. As a result, there are two IXPs and the Teraco operated exchange point, NAPAfrica, which has 430 peering partners.

The numbers are not so large in Nigeria but still show the same point: four mobile operators, more than 30 ISPs and again many other companies involved in connectivity. IXPN, the

country's IXP has 65 members, including 19 drawn from Abuja, Kano and Port Harcourt.

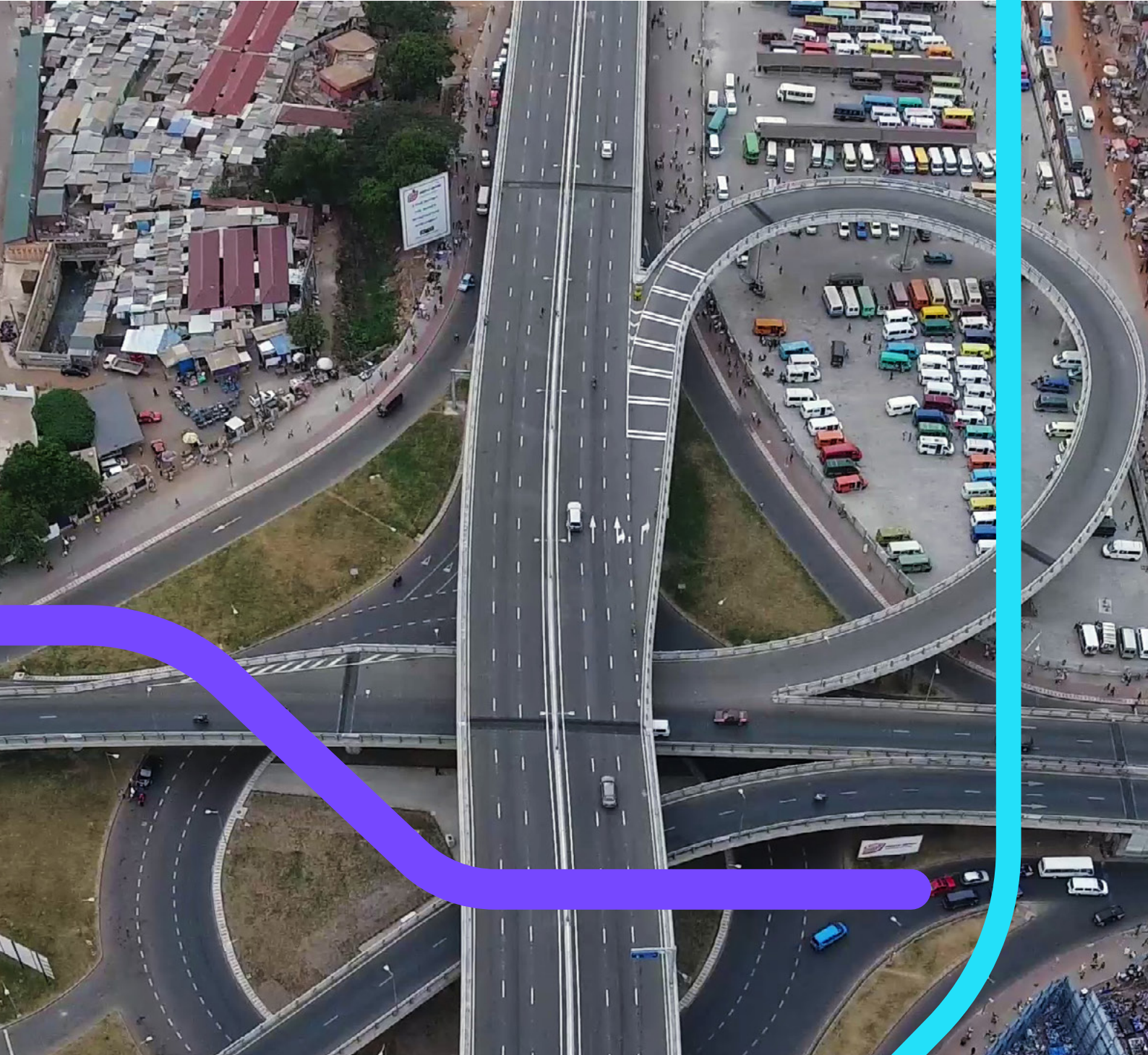
Two other countries make the same point at a smaller level. Tanzania has four mobile operators and 14 members of its ISP association TISPA. TIX, the country's IXP has 35 members and there are smaller IXPs in Arusha (AIX), Mwanza (MIXP) and Zanzibar (ZIXP). Ghana has three mobile operators and 18 members of the country's ISP association, GISPA. GIX, the country's IXP has 22 members.

Regulatory climate

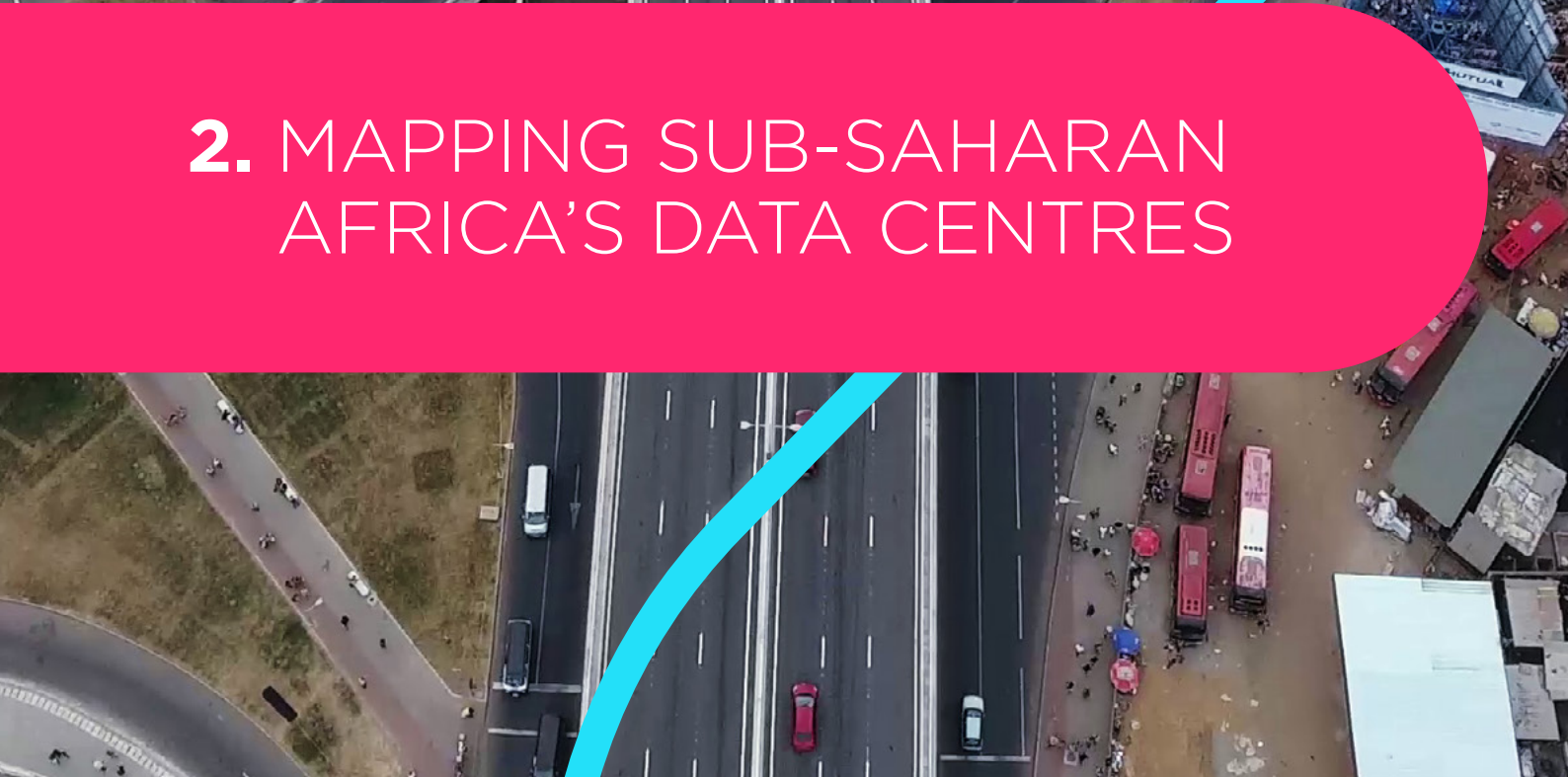
The development of a data centre and cloud services ecosystem requires an 'open market' attitude to regulation and an understanding of how the data ecosystem operates elsewhere in the world.

On this basis, Ethiopia is entering new territory, as it both liberalises its market and privatises its incumbent, Ethio Telecom. However, these are both developments that have taken time to work through in other countries.

Cameroon has a de-facto monopoly over significant parts of its infrastructure and a dominant player that fights hard to maintain its privileges. In Senegal, there is also a de-facto dominant player but in recent years the government and regulator have opened up the telecoms and internet service provider sector to new players. Nevertheless, Orange has invested in new data centres in both countries and will undoubtedly become a key player in the ecosystem.



2. MAPPING SUB-SAHARAN AFRICA'S DATA CENTRES



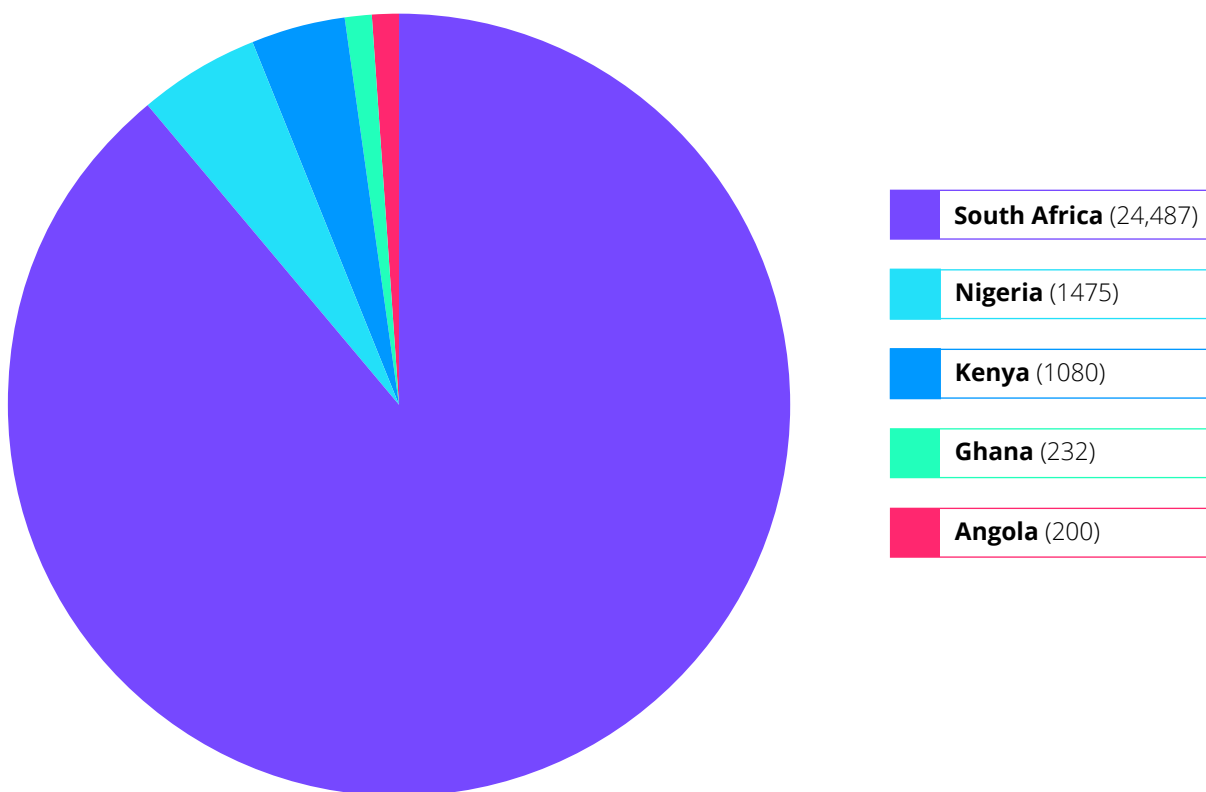


EXISTING AND PLANNED GROWTH OF CARRIER-NEUTRAL DATA CENTRES

There are 10 Sub-Saharan African countries with carrier-neutral data centres (Angola, Cote d'Ivoire, Djibouti, Ghana, Kenya, Mauritius, Mozambique, Nigeria, South Africa and Zambia) and 5 more are coming on stream shortly (DRC, Ethiopia, Rwanda, Uganda and Zimbabwe).

Overall, significant investments are being made in new facilities. On this basis, about a quarter of Sub-Saharan African countries have an existing or planned carrier neutral data centre. The chart below shows the rack capacity in 5 key countries. Of these, South Africa represents 89% of total capacity in the countries shown.

Chart 1: Number of racks in carrier-neutral data centres in 5 key countries in 2020

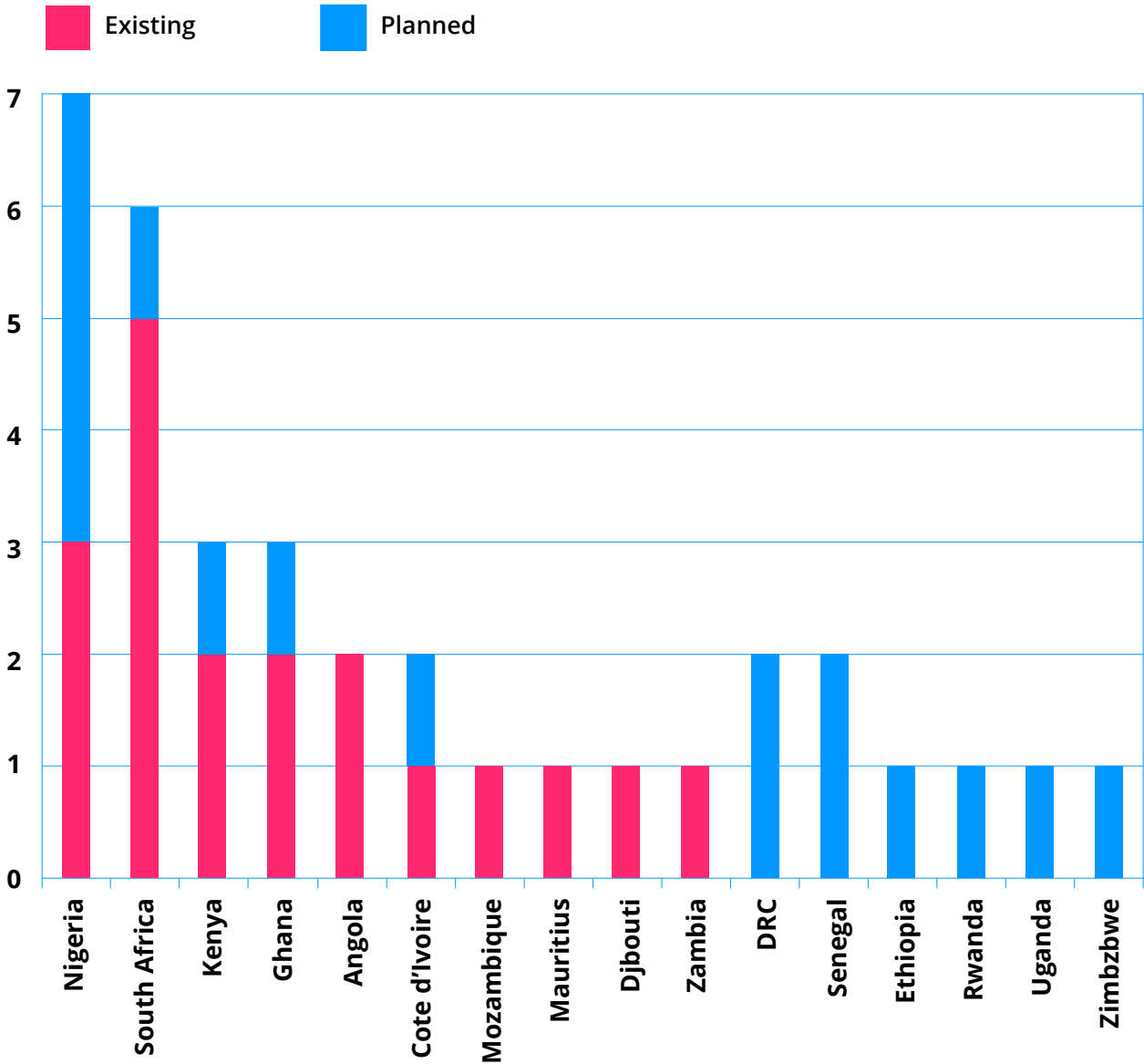


Source: Balancing Act



The chart below shows the geographic distribution of carrier-neutral data centres (20) and a full list of planned new facilities (15) - some of which are in countries that already have one or more carrier-neutral data centres. There are also a number of “under-the-radar” projects that have not yet come to fruition and are therefore not included in these figures.

Chart 2: Number of existing and planned carrier-neutral data centres in Sub-Saharan Africa by country



Source: Balancing Act

On the basis of the criteria outlined in section 1 (See P8), there are another six countries that may see the opening of a carrier-neutral data centre: Benin, Cameroon (if telecoms regulation changes), Cape Verde, Madagascar, Namibia and Zambia.

The quality and operational expertise of carrier-neutral data centres in Sub-Saharan Africa has improved a great deal over last 5 years. Operators who were in the first wave of launches can now point to nearly a decade or more of continuous successful operation. Several of the planned next generation data centres are being built to Level IV standard.

In a summary of the data centre landscape for the African Data Centres Association, Xalam Analytics said that there were 100 data centres of Tier III and above and that there were a further 20 planned facilities. These figures relate to all types of data centres, not just carrier-neutral data centres.

It estimates that South Africa is currently 70% of the market but that will change over the next 5-10 years as 85% of what it defines as broadband connections are outside South Africa.

In a sign of the times, in May 2020, Liquid Telecom-owned Africa Data Centres received approval from the South African Competition Tribunal to buy Standard Bank's data centre (and the land on which it sits) in Samrand, north of Johannesburg. According to Africa Data Centres, the Samrand facility was purpose-built as a Tier IV data centre to provide maximum levels of security and reliability for banking IT systems.

Several companies (for example, icolo, Main One, PAIX, Rack Centre and Raxio) have regional expansion plans and will either buy or build facilities in a range of countries. The countries involved might include: DRC, Mozambique and Namibia.

AFRICAN DATA CENTRES ASSOCIATION: A TRADE BODY TO DEVELOP GROWTH

At the 2017 Data Cloud Monaco event, there was an Africa Day that included a panel session with 5 African colocation companies from all over the continent.

During the discussion, it showed that they were not connected to each other, while sharing similar challenges.

Out of this discussion, the Africa Data Centre Association was launched in Marrakech on September, 2018.

The current board members represent a diversity of African countries - Senegal,

Tunisia, South Africa, Kenya, Ghana, Ivory Coast and Zimbabwe – and its members include both carrier-neutral and carrier data centres.

The Africa Data Centres Association (ADCA) is the trade organisation for data centres in Africa. It provides a platform for data centres actors in Africa to get together, with the aim of promoting and developing growth for the industry, as well as being a catalyst for Africa digital development.

Its mission is to create a thriving, world class African data centres and cloud

infrastructure ecosystem, that will be a catalyst for economic transformation of the continent.

The Chair of ADCA Fatoumata Sarr, who is also CEO of Orange Services Group, said: "The amount of data centre area in square metres on the African continent is similar to the Paris or Amsterdam Area, with an economy of 12 million people. That means there is a 1 for 100 ratio and shows the room for growth in Africa. To enable our members to benefit from this opportunity, the ADCA helps its members navigate the different challenges."



Several carriers – mainly mobile operators – have made significant investments in data centres. These include data centres of some scale in the following countries: Cameroon, Cote d'Ivoire, Kenya, Malawi, Mozambique, Nigeria and South Africa.

There is a clear difference between the level of investment planned by key carrier-neutral centres companies and the pattern of investment by carriers. In March 2020, Actis announced that it would invest US\$250 million to create an African data centre platform. In May 2020 Teraco announced that it would be investing US\$220 million in its next stage of growth. That said, not all neutral carrier data centres are investing at this level: for example, PAIX's investment in Ghana and Kenya was 2 million euros.

INTERNATIONAL PRESENCE IN IXPS AND CARRIER-NEUTRAL DATA CENTRES

The Executive Chairman of global data centre operator Equinix, Peter Van Camp, has compared data centres to "international airports where passengers from many different airlines make connections to get to their final destinations". In Sub-Saharan Africa, this 'airport' function was initially played by national Internet Exchange Points (IXPs) that were set up to ensure local traffic stayed local. Nearly all have been successful in attracting the majority of carriers and ISPs in their respective countries and in doing so, have created a "meet point" function.

The earliest international presence in Sub-Saharan Africa was to be found in IXPs and in many countries even now, the number of international players is greater in IXPs than carrier-neutral data centres where they exist. Not all IXPs and data centres declare all of their hosting parties so what follows is based on publicly available information.

There are 28 IXPs across Sub-Saharan Africa. In countries where they exist, international players also locate themselves. For example, in Ethiopia there is no IXP because at the moment there is only one incumbent carrier in the market, EthioTelecom. But with liberalisation coming and bringing more carriers into the market, the planned Raxio carrier-neutral data centre has the potential to become both a meet point and the place to host the country's IXP.

The greatest concentration of international companies and organisations is found in South Africa, followed by Kenya and Nigeria. For example, Kenya's KIXP hosts Amazon, Facebook, Google, Microsoft, VeriSign, Cloudflare, Multichoice, BICS, China Telecom, China Mobile, Hurricane Electric and Swisscom.

As streaming services develop, CDNs start hosting locally. For example, Netflix has a local presence in Nigeria, while Apple Music has a local presence in South Africa.

The table on P15 shows international companies and organisations hosted at NAP Africa (part of Teraco in South Africa), which has the largest number of peering connections on the continent. It shows how as markets develop – both in size and complexity – that increasing numbers of companies need to use its 'airport' function. It also demonstrates that the larger the number of peering connections at a data centre, the more incentive there is for nearby countries to use it as their regional hub.

There are 15 African countries represented there: the majority are sub-regional but two (Burkina Faso and Kenya) are some considerable distance away. One of the major limitations on this kind of regional peering is latency, an issue that will be touched on in section 4 of the report (see P23).



Table 1: Categories of international hosting partners at NAPAfrica

GLOBAL CARRIERS	REGIONAL CARRIERS	CDNS AND HOSTING	CLOUD PROVIDERS	OTHER
Airtel India	Alban Communications (BW)	Amazon	Africa Cloud Exchange	Broadcom
BICS	Angola Cables	Akami	Alibaba Cloud	Cisco
BT	Aptus (TZ)	Cachefly	AWS	SITA
China Telecom	Avoxi	Cloudflare	G-Core Labs	Rogers Capital Technology Services (DC in MU)
CM Telecom	BTC (BW)	Facebook	Google Cloud	Route Views
CMC Networks	Canal+ Telecom	Fastly	Microsoft Azure	The Packet House
Dialpad	Congo Telecom	FFG Connection		Tiggee
G8	Liquid Telecom	GVA Canalbox		Ubuntunet
Hurricane Electric	Mahanagar Telecom (MU)	I3D.net		Epsilon
IPTP Networks	Mauritius Telecom	Misaka Network		
Layer3 Telecom	OPQNet (BW)	NSOne		
Netnod	Orange Tunisie	Psychz Networks		
Netovate	Paratus Africa	Reunicable		
Orange Business Services	Safaricom	Showmax		
Packet Clearing House	SEACOM	Tysflo		
PCCW Global	Skyband (MW)	Valve		
Saudi Telecom	Swaziland PTC	VeriSign		
SG.GS	Telecom Namibia			
Siliconsky	TNM (MW)			
Swisscom	Telone (ZW)			
	Togo Telecom			
	Utande (ZW)			
	Virtual Technologies and Solutions (BF)			
	Webmasters (MZ)			
	WIOCC			

Source: Balancing Act



FUTURE DISTRIBUTION OF CARRIER-NEUTRAL DATA CENTRES

The major carrier-neutral data centres in Europe are clustered in a number of different countries. For example, Telehouse London sits on the crossroads of several major international fibre routes and as a result is host to 530 carriers. Likewise Altice Portugal's data centre is relatively close to the Sessimbra landing stations crossroads, albeit for a much smaller number of cables. The presence of a large, regional or global financial centre also seems to play a role in scale and diversity of companies hosted.

So the key question in the longer-term is where will Sub-Saharan Africa's regional carrier neutral data centres be located? The data centre and cloud services ecosystems in some countries acts as a sub-regional hub, for more than one country.

This regional hub effect is a combination of three things:

- Good fibre links to neighboring countries, particularly those inland.
- Good onward fibre links across several countries.
- An advantageous position on the crossroads of several international cables.

With a favorable combination of all three, a country can act as a regional data centre and cloud services ecosystem.

So for example access to one of the planned international cables emphasises this connection. Access to the 2Africa cable will either be through carrier-neutral data centres or through an Open Access landing station.

The table on P17 identifies countries with either actual or potential regional hub status through looking at their international and regional fibre links.

Map indicating potential regional hubs

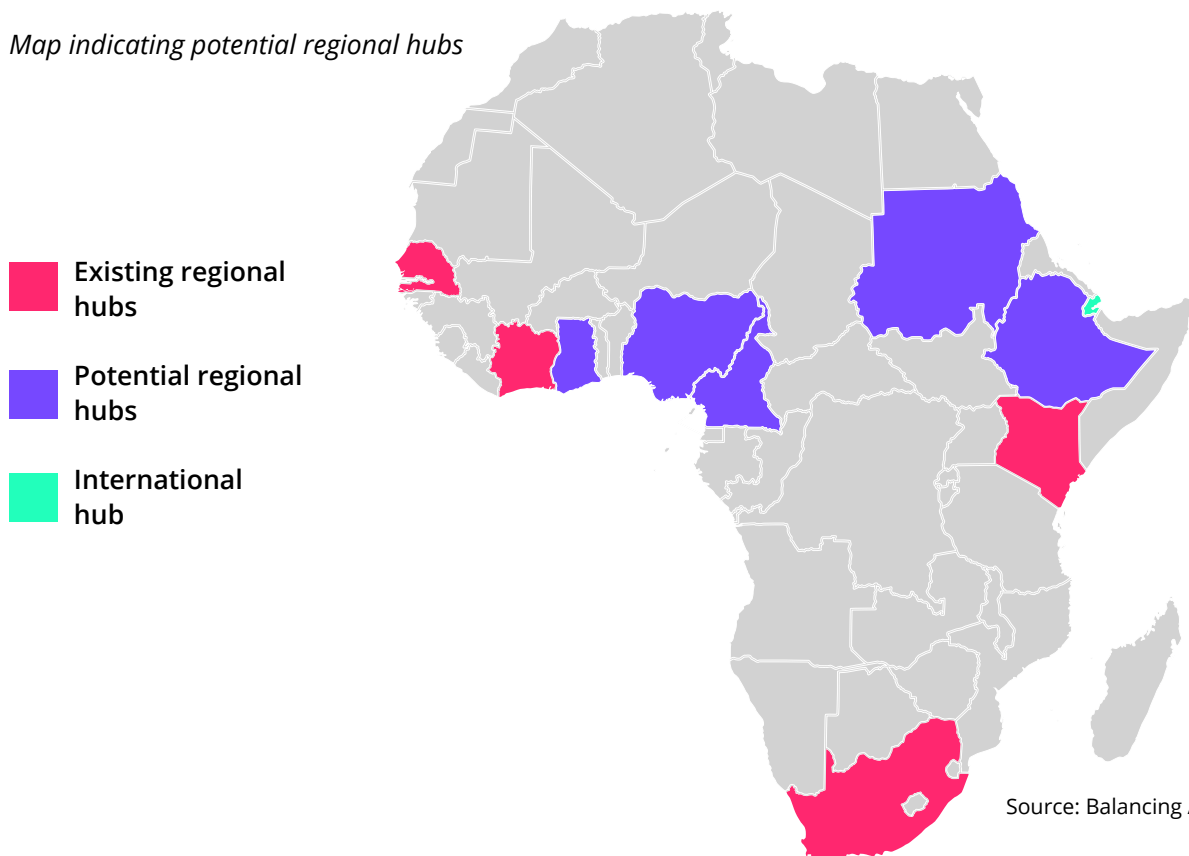





Table 2: Potential regional hubs (based on international and cross-border fibre links)

Source: Balancing Act

EXISTING REGIONAL HUBS	INTERNATIONAL SUBSEA CABLES	CROSS-BORDER FIBRE LINKS	ADDITIONAL COMMENTS
South Africa	Existing: EaSSy, SAT3/WASC/SAFE, SEACOM, WACS Under construction: A2Africa, Equiano, PEACE	Lesotho, Mozambique, Namibia, Swaziland, Zimbabwe (and good links further north)	<ul style="list-style-type: none"> Also an international hub JSE is a large regional stock exchange
Kenya	Existing: EASSy, LION 2, SEACOM, TEAMS Under construction: A2Africa, PEACE	Ethiopia, South Sudan (via Uganda) Tanzania, Uganda and on-connections to Burundi, Rwanda, DRC (Gombe)	<ul style="list-style-type: none"> Strong East African trading links Nairobi is a regional business centre Nairobi Stock Exchange is the fourth largest on the continent
Cote d'Ivoire	Existing: ACE, Main One, SAT3, Maroc Telecom international cable Under construction: A2Africa	Burkina Faso, Ghana, Liberia, Mali	<ul style="list-style-type: none"> Abidjan is a regional business centre and has significant percentage of its export trade within West Africa Home to West Africa's BRVM; the region's sixth largest stock exchange
Senegal	Existing: ACE, Main One, SAT3 Under construction: A2Africa	Gambia, Mauritania, Mali (and on to Guinea-Bissau and Guinea)	
POTENTIAL REGIONAL HUBS			
Cameroon	Existing ACE, NCSCS, SAIL, SAT3, WACS	CAR, Chad, Republic of Congo, Equatorial Guinea (and on to Gabon)	
Ethiopia	Existing: SEACOM (via Djibouti)	Eritrea (planned), Kenya, Somalia, South Sudan, Sudan	
Ghana	Existing: ACE, GLO 1, Main One, SAT3, WACS Under construction: A2Africa	Benin, Burkina Faso, Cote d'Ivoire, Togo	<ul style="list-style-type: none"> Ghana Stock Exchange is the fifth largest on the continent
Nigeria	Existing: ACE, GLO 1, Main One, SAT3, WACS Under construction: A2Africa, Equiano	Benin, Burkina Faso, Cameroon, Ghana, Niger, Togo	<ul style="list-style-type: none"> NSE is the region's third largest stock exchange exchange, the NSE.
Sudan	Existing: SAS-1 Under construction: A2Africa	Chad (planned), Ethiopia, Kenya (planned 2021), South Sudan, Uganda	
INTERNATIONAL HUB			
Djibouti	Existing: SEA-ME-WE 3 & 4, I-ME-WE, EIG Under construction: A2Africa, PEACE		<ul style="list-style-type: none"> Djibouti could be become the Horn of Africa hub



On a rational basis, the most likely regional carrier-neutral data centre locations would be South Africa, Nigeria and Kenya.

South Africa is well connected to its Southern African sub-region and has good links to countries further up the continent. Furthermore, Teraco has the largest group of data centres in a single Sub-Saharan African country. Its IXP NAPAfrica is the 7th largest in the world and it hosts 250 carriers.

As a regional data centre hub, Nigeria is still very much a work in progress. There is no single company that looks like a leading player yet; the corporate market is still transitioning into external data centres; and connections to Francophone Africa are weak (both in terms of trade and fibre links). That said, Rack Centre has 35 carrier connections making it and MDX-i with 26 carrier connections the strongest current contenders.

Kenya is already a regional hub for connectivity but it has not yet become the place to host regionally. Carrier-neutral data centres have been relatively slow to develop and there is no clear leader yet, although East Africa Data Centre is currently the largest.

However, there are a number of factors that may affect the rational simplicity of the view expressed above. As already identified in section 1 (see P7), data sovereignty and localisation laws and regulations may lead to some countries insisting that their citizens' data is held on national soil. Although many countries in Sub-Saharan Africa have passed data protection laws – some to bring themselves in line with Europe's GDPR – the situation is still far from clear.

Furthermore, the differences between Anglophone and Francophone business areas may lead to two very different regional entry points. Likewise, there is a complicated set of regional policy considerations in the Horn of Africa that could lead to several countries bidding to be a regional hub there.

An aerial photograph of a volcanic crater, showing a dark, rocky rim at the top and a reddish-brown interior. The crater floor is covered in intricate, wavy patterns of ash and sand. A blue graphic element, consisting of a rounded rectangle with a curved bottom edge, is positioned in the upper left quadrant. A pink graphic element, a thick curved line, starts from the right edge of the blue shape and curves downwards and to the left, ending near the center of the image. The text '3. OVERVIEW OF CLOUD SERVICES' is written in white, uppercase letters within the blue shape.

3. OVERVIEW OF CLOUD SERVICES

THE CURRENT CLOUD SERVICES LANDSCAPE

There are five major hyperscalers with an active interest in Africa:

- Microsoft (*which is probably currently the largest provider*)
- AWS
- Google Cloud (*which has a significant presence in Kenya, Ghana and South Africa*)
- Whale Cloud (*part of Alibaba*)
- Huawei Cloud

The table below summarises the local cloud presence of the five major players. Both AWS and Microsoft have expanded beyond South Africa and Alibaba plans to expand from there into other Sub-Saharan African countries over the next 12-18 months. It is also scaling up overall, recruiting 5,000 people globally

in the next year. Microsoft says it has seen 110% growth over the last year and has quite advanced plans for a number of new services including SAP on Azure and Machine Learning.

At the AWS Online Summit Europe, Middle East and Africa in June 2020, the company said it had tens of thousands of customers, including Old Mutual, Standard Bank, South Africa's National Department of Health and Apex Innovation.


According to the company, customers choose it for four reasons: flexibility, global reach, security and product innovation.

Although Huawei Cloud launched last year in South Africa, it does not yet appear to have made much market impact outside of Government contracts in South Africa and with its core customer base, telcos.

Table 3: Hyperscaler and local presence by country

Source: Balancing Act (estimates)

COUNTRY	PRESENCE	LOCAL CLOUD PROVIDERS
Nigeria	<ul style="list-style-type: none"> • Microsoft • VMWare Cloud Provider • Google Cloud 	3-5
South Africa	<ul style="list-style-type: none"> • AWS (Cape Town and Johannesburg) • Google Cloud • Huawei Cloud • Microsoft Azure • VMWare Cloud Provider • Whale Cloud Services • Teraco's neutral cloud platform 	40-50
Kenya	<ul style="list-style-type: none"> • AWS • Microsoft Azure • Google Cloud 	2-4
Angola	<ul style="list-style-type: none"> • Microsoft Azure 	1
Ethiopia		2
Uganda		3
Cote d'Ivoire		1
Mozambique		2
Multi-location	SEACOM (offers hybrid cloud)	



In addition to the local presences noted in Table 3, Microsoft has over 10 PoPs in countries along the coastline of Africa and can offer cloud capability in countries in which there is not a Microsoft local presence. In revenue terms, Microsoft's cloud business revenues come 75% from South Africa and 25% from the rest of Sub-Saharan Africa.

According to IDC, annual cloud computing subscriptions in South Africa will grow from US\$370 million in 2019 to US\$1.7 billion in 2024. There is little or no data on the turnover of cloud services outside of South Africa. Analysys Mason estimates that revenue from public cloud services delivered to businesses in South Africa will reach US\$170 million by 2023, accounting for more than half of all such revenue across Sub-Saharan Africa as a whole.

UNDERLYING CLOUD SERVICES DYNAMICS

There is no doubt that COVID-19 has accelerated the uptake of cloud services in Sub-Saharan Africa. Companies that might not have considered these services before have gone through lockdown periods where they needed to provide hassle-free home working and communications.

For some, especially outside South Africa, this requirement had already been on their roadmap in the form of things like future Bring-Your-Own-Device strategies for multi-location companies and COVID-19 has simply accelerated their implementation.


As one oil and gas company in Nigeria told us: "The (COVID-19) lockdown has increased the need for data to be accessed from here. Office 365 can't supply everything. The future is fully cloud."

For others, like African TV broadcasters, they have had suddenly to patch together cloud working for production and news-gathering from a standing start with publicly available tools to survive. Going forward, they will undoubtedly be creating more considered approaches to cloud working.

For some, like banks, the COVID-19 crisis has been a moment to focus tactically on providing cloud based digital services to offer convenience to their home-bound customers. For example, many of the big lenders in Kenya, like Equity Bank, were offering free bank to mobile wallet transfers to their customers.

Research company IDC has predicted as a result of the pandemic, cloud spending will rise across Middle East, Turkey and Africa to US\$2.8 billion a year. It sees online collaboration tools, cloud-based platforms, and secure remote access as all being central to this process, as will also improvements in infrastructure resiliency and disaster recovery. The sectors it highlights are: education, media and communications, government, healthcare and retail.

Beyond these COVID-19 changes, there were already several dynamics producing a migration to the cloud. When a carrier-neutral data centre opens in a country there is an accompanying growth in local cloud suppliers. Over time, many of them become consultants who bridge the gaps between legacy systems and hyperscaler offers. This is particularly true in South Africa where there are large numbers of companies supplying cloud software expertise rather than products and services.



4. CARRIER-NEUTRAL DATA CENTRE AND CLOUD SERVICES USERS





DIFFERENT WAVES OF GROWTH

Naturally there is a significant overlap between data centre and cloud service users. African companies that are either using carrier-neutral data centres for data recovery or have replaced their in-house data centres with an external supplier are on a journey towards further cloud adoption.

This journey actually starts with quite a narrow initial group of users. In more liberalised communications markets, there are local telcos and ISPs who need a meet point function: even with a relatively small number of players, it makes no sense in an IP world to have individual connections to all players. Later with smartphones, telcos needed the capacity to service a growing number of handset apps.

The other group of African companies in the first wave of carrier-neutral data centre users were banks, who were increasing under legal obligations to have their disaster recovery outside their own premises.

The second wave of users were multinational or multi-location companies looking for cost and operational efficiencies. This category includes a long list of potential business categories including:

- Oil and natural gas
- FMCG
- Automotive
- Power distribution
- Retail
- Mining
- Fertilizers
- Betting companies
- International NGOs
- Insurance
- Conglomerates

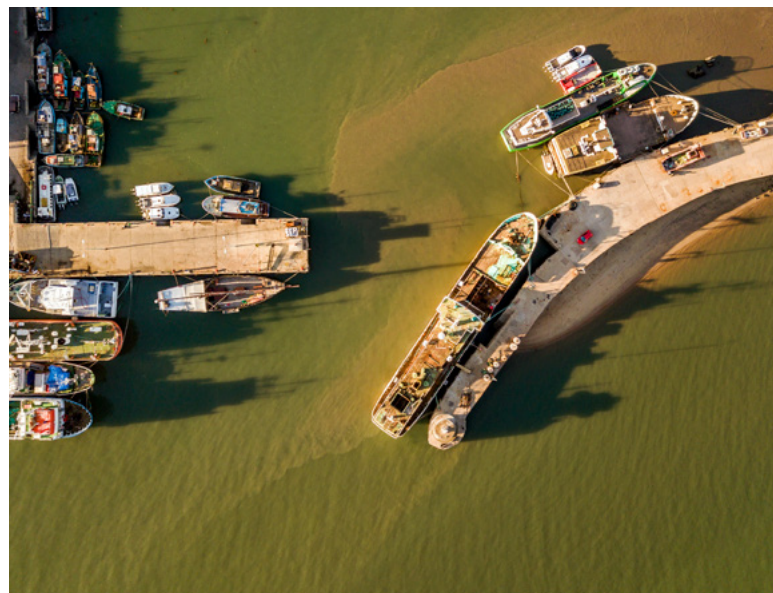
This second wave of growth in individual countries is by no means complete and relies on improvements in bandwidth and power supply and regulatory changes to create a trusted environment.

The third wave, which has begun to happen in larger markets includes: international telcos, Content Delivery Networks (CDNs), large local or regional companies, payment processors, manufacturing companies, online start-ups and larger private hospital companies. In due course, it may begin (as is already the case in South Africa) to include the public sector.

The number of potential customers and rack use strongly correlates with the size of the economy. In the bigger economies, like South Africa, Nigeria and Kenya, there is a larger number of racks per customer but in smaller countries, like Cote d'Ivoire and Ghana, there is usually only one rack per customer (or less).

In some countries, the number of likely data centre or cloud services users is relatively small and most are already in data centres, if not using cloud services. As one data centre operator said: "The economy here is not so stratified. There are some industrial companies but there's not enough quality of IP in their space."

Some Francophone countries like Cote d'Ivoire seem ready for cloud services ("All realise the importance of the cloud with the current crisis," said one local ISP) but smaller countries like Benin may be much slower to transition ("Local companies don't make many changes. It will be three years before it happens," said a local ISP).





For some categories, like international NGOs, the speed of moving towards cloud on their roadmap is much slower. They may have cloud services in Europe, the US and some parts of Asia but for Africa, one executive told us that: “The IT people are still very concerned about losing control. In normal times in Nairobi the bandwidth would be fine to deliver these services.”

The kind of migration experienced can best be illustrated by a Kenyan company spoken to for this study, which was an early cloud adopter in 2012. Initially it used a local MNO for putting its customer data on a cloud service. It experienced issues around storage and scalability before moving it to Microsoft Azure. There were no issues of latency on its database function. However, it tried to move its call centre (taking 10,000 calls a day) to the cloud but at that time experienced latency issues as it was being served from South Africa. A second attempt (using a hybrid cloud) has been made to move it to the cloud but again the service was not of good enough quality and it has remained locally hosted.

The latency issue was identified as key by one of the hyperscalers: “It’s not just about the public cloud. It’s going to be hybrid cloud for quite some time because of the distances from data centres”. At its worst, latency from regional locations can be between 120-150 milliseconds and the upper end of this range causes problems for the customer.

However, in one West African country, latency was 300 milliseconds to neighboring countries and 50 milliseconds in the country itself. Sometimes the latency experienced by a customer can be laid at the door of network optimisation. One cloud service provider told us of a customer in Botswana who was experiencing a 125 millisecond delay. With network optimisation, it was able to halve this level of latency. MyBroadband’s 2019 Cloud Survey of gathered responses from 386 South African companies of different scales, of which 77% used cloud services and 23% did not. 31% of those surveyed use telecoms cloud services.

The main uses of cloud services in South Africa are summarised in the table below.

Table 5: Type of cloud services used by percentage in South Africa

TYPE OF SERVICE	% OF COMPANIES USING SERVICE IN SOUTH AFRICA
Backup-as-a-Service	53.24%
Software-as-a-Service	42.16%
Infrastructure-as-a-Service	26.76%
Platform-as-a-Service	26.22%
Recovery-as-a-Service	20.54%
Other	0.81%

Source: MyBroadband, 2019

EXAMPLES OF DIGITAL TRANSFORMATION USING DATA CENTRE AND CLOUD SERVICES

Example 1: A regional conglomerate

Mukwano Industries is an East African conglomerate with interests that include manufacturing, agriculture and property development. Its products, ranging from petroleum jelly and detergents to cooking oil and soap; from drinking water to household and commercial plastics; can be found in many homes across Uganda.

Although it had implemented the SAP ECC 6.0 platform in 2008, it still depended a great deal on paper-based systems and Excel spreadsheets. Furthermore, the system had been customised many times and digital management did not go down to operations and plant management.

It was in the words of its CEO Tony Gadhoke in a situation where it “had data everywhere, but information nowhere. This meant we had low cost insights and a growing need for operational efficiencies. Something had to give.”

It decided to move straight from its legacy systems and to move its core business processes to the Cloud using the SAP S/4HANA Public Cloud platform. Gadhoke said: “In doing so, we aimed to leverage Cloud capabilities to improve technical and operational agility, enhance real-time visibility across the business, harmonise data, improve reporting, and enable future growth and innovation.”

In order to keep costs down, it made the changeover in five and a half months. In a first for Uganda, the business put its core business systems into the cloud by the agreed deadline, with minimal disruption to the business. The company has already seen significant gains in productivity and faster time to market. It has greater visibility into its operations than ever before, through an intuitive, unified

platform from which it can oversee its business operations from end-to-end. It has also seen a “huge” reduction in capex on its server infrastructure and IT resources.


Example 2: A regional bank

Standard Bank has launched digital-only banks in Botswana, Cote d'Ivoire, Ghana, Kenya, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe. As African banks increasingly come under pressure from other services like mobile money, it has created a unified digital strategy across diverse markets that allows the advantages of scale and cost-cutting as accounts are self-servicing. Having services on a digital platform (rather than on legacy systems) also allows them to take new products and services to market more quickly than their competitors.

In June 2020, the bank, which uses both AWS and Microsoft Azure, signed an agreement with Salesforce to power the Standard Bank Group Digital Platform and service its ecosystem of clients and partners.

The group has more than 53,000 employees, approximately 1,200 branches and over 9,000 ATMs on the African continent, which enable it to deliver a complete range of services across personal and business banking, corporate and investment banking and wealth management.

In March 2019, it migrated its production workloads, including its customer facing platforms and strategic core banking applications to the cloud. It named AWS as its preferred cloud provider to enable it to use data analytics and machine learning, to



automate financial operations and enhance customer facing web and mobile applications. Subject to approvals from local regulators it will take place across all business units.

Sim Tshabalala, Group CEO of Standard Bank said: "For Standard Bank Group to remain a leader in African financial services, we recognise we need to adopt a cloud-first approach to our business. AWS Cloud technology will create a springboard for Standard Bank Group, helping us to rapidly roll out our digitisation and data strategy to better cater to customers whose needs are constantly evolving. The combination of AWS's rapid agility and high levels of security, combined with Standard Bank's customer obsession and desire to constantly raise the bar, will allow us to build Africa's financial services organization of the future and to be positioned as more than a bank."

Example 3: A regional retailer

Pick 'n Pay is a continental retailer with shops in South Africa (its largest operation), Nigeria, Zimbabwe, Namibia, Zambia, Botswana, Swaziland and Lesotho. In South Africa it is the largest supermarket group, with nearly 1,700 stores across the country employing approximately 85,000 people.

The company has complex, multi-supplier relationships and its finance team analyses all bills relating to its IT environment to ensure that the correct expenses are allocated to the right business units and to identify any billing inaccuracies. In the past, this team would manually enter every line item from each vendor invoice into its ERP software - a task that was time consuming, inefficient and error prone.

In 2018 it went over to using a Microsoft Azure-based solution called OneView to automate the process and generate reports. The impact has been significant: during the March 2018–February 2019 financial year, OneView has helped Pick 'n Pay recover just over ZAR 3 million in costs.

In addition, OneView has helped the supermarket chain monitor and control mobile device usage and costs. And because it's built on a secure cloud, OneView delivers the speed, safety, and security required by Pick 'n Pay as it begins the journey to becoming an increasingly technology-driven business.

Example 4: Content Distribution Network

iBAKA TV was one of the first video streaming platforms to launch in Nigeria in 2012. Although it started as a YouTube Premium Channel it has become a VoD platform, serving Nigerians at home and in the diaspora. It was iBAKA TV that organised the first global online premier for a Nollywood film in June 2012 for Obi Emelonye's Last Flight to Abuja.

Like many Nollywood VoD platforms, it gets 90% of its revenues from the African diaspora and currently has 70-100,000 people who have signed up and 40-50,000 active subscribers, which means that there are probably around 5,000 subscribers

Between 2015 and 2017, the company began to experience a range of problems on the VoD platform it was using: "We were partnering with an international company based in the UK. There were major challenges with three issues: piracy, speed and quality. We asked them to see how they might encrypt our content and they could not fully implement the technology. Our subscribers in Europe were having problems that affected access."

"(In 2020) we decided to approach a different company. We had used AWS before for hosting our website. It was able to guide us through the product and how to implement it in terms of low pricing. It's a far better deal financially as we got a 40% discount. It has a storage service and elastic load balancing and really is a cloud first service." The Amazon Cloudfront service claims to deliver: "On average, up to a 50% reduction in first-byte latency when wishing to access watchable content."

So what has been the impact of the COVID-19 lockdown on the company's platform? "It has created more engagement on our platform with longer watch times. People are now looking at 5-10 movies a month and we've had increased subscription levels. But we haven't had any drop in terms of speeds or downtime." It has future plans to expand its service into Ghana and Liberia.

Example 5: FMCG multinational in China:

This final example is included to show what a multinational with a strong presence in Africa is doing in another emerging market. One of the biggest multinational consumer goods companies, Unilever has started an initiative in China to carry out digital marketing campaigns using the Cloud. It believes that it will enable it to predict more precisely and respond more quickly to changing customer buying habits across multiple platforms.

In July 2020, it went into partnership with Alibaba Cloud, to use its Artificial Intelligence (AI) and cloud-based technologies to optimise its omni-channel, online and offline demand generation activities. These technologies can help to unlock detailed insights into its customers buying patterns and behavior. The data-driven business intelligence could help it accelerate the creation of new and precisely targeted digital marketing campaigns. The software can follow consumers' purchasing journey through Unilever's online stores in Taobao and Tmall.



5. NEW INTERCONNECTION OPPORTUNITIES IN AFRICA



THE GROWING NEED FOR LOCAL INTERCONNECTION

The acceleration in digital transformation and the arrival of more data centres and cloud service providers in Africa will increase the need for local interconnection.

Local interconnection between networks, data centres, clouds and applications will help provide robust digital foundations for enterprises and carriers operating in Africa, while also addressing immediate connectivity needs.

Enterprises that are pressing ahead with digital transformation initiatives and that are already migrating workloads to the cloud already require greater network flexibility.

There are many more options available to modern enterprises as they build their cloud environments. Hybrid cloud and multi cloud models present bigger challenges for networks and increase the need for direct connections to data centres and local cloud instances.

As they move further along their digital transformation journey, businesses across Africa will become interdependent on a much larger pool of cloud, SaaS and other business services. As well as needing quick and instant access to data centres, enterprises will require seamless interconnection between their SaaS, cloud and other business critical services.

As enterprises become more interdependent on these applications and services, networks in Africa will be responsible for carrying much larger volumes of business critical data and will handle many more types of connections.

Enterprises will look to network providers in the region to simplify the management of these connections, and will require APIs to automatically call upon these products and services. They will also expect quicker turn-



around times from network operators and will no longer be willing to wait 4-6 weeks for a new network service to go live.

Finally, networks in the region need to address security and privacy concerns that will become of increasing importance to enterprises as they embrace new digital models. The public internet may no longer be considered secure enough for accessing some critical business applications, suggesting a move towards private, dedicated connections to local cloud instances and data centres.

CONSOLE CONNECT IN AFRICA

Network automation can help support the development of Africa's cloud and data centre ecosystem. Console Connect's Software Defined Interconnection platform provides African enterprises and carriers with new levels of network speed, agility and security as they connect to more clouds and data centres inside and outside of the region.

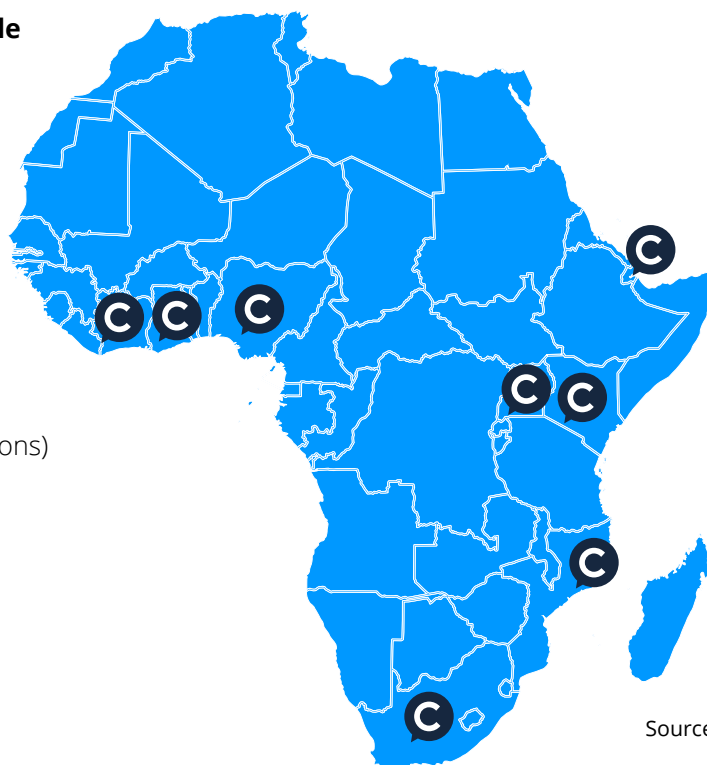
Using Console Connect's self-provisioning automated platform, users can instantly spin-up international services in real-time from over 350 data centres globally to key locations in Africa.

The platform also enables users to spin-up direct and secure layer 2 services to global cloud, SaaS, and IX peering partners on the platform.

Users of the platform can interconnect between key data centres, which are currently located in South Africa, Kenya, Nigeria, Mozambique, Uganda, Ghana, Ivory Coast and Djibouti (see map below).

List of cities with Console Connect-enabled data centres:

- Djibouti City
- Accra
- Abidjan
- Nairobi
- Maquto
- Lagos
- Dakar
- Cape Town
- Johannesburg (2 locations)
- Dar es Salaam
- Kampala



Source: Console Connect

Earlier in 2020, Console Connect partnered with Teraco to make Console Connect available on its Africa Cloud Exchange (ACX). Through this partnership, enterprise and service provider customers can directly connect to the platform via any one of Teraco's five South African data centres – giving them instant access to our growing ecosystem of cloud, SaaS, IX and IoT providers.

This partnership has since been extended to Africa's largest IX provider, NAPAfrica. By accessing NAPAfrica through Console Connect, users can peer locally in South Africa with enterprises, network operators, CDNs and cloud services providers. NAPAfrica's internet exchange points (IXPs) offer direct access to over 430 unique networks (ASNs) servicing over 20 countries in the southern African region.

Console Connect is continuing to expand its ecosystem of data centres, cloud, SaaS and XaaS partners across Africa and worldwide.

Please visit consoleconnect.com for further information.



About Balancing Act

Balancing Act focuses on Africa and carries out consultancy assignments for a variety of clients. The company helps national and global brands with their involvement in the African continent.



Russell Southwood is the CEO of Balancing Act, a consultancy and research organization specializing in telecoms, Internet and media in Africa. Its clients include operators, broadcasters, investors and agencies doing policy and regulatory work. He is the author of several of the industry market reports the company produces. He spends a lot of time travelling and working on the field across the African continent. Russell Southwood also founded Smart Monkey TV - a web news portal and webTV, 'Creators and innovators in Africa at the crossroads of technology and culture'. He holds a BA from SOAS University of London (SOAS-The School of Oriental and African Studies).



TAKE CONTROL | CUT COMPLEXITY | MAKE INTERCONNECTIONS EFFORTLESS

Console Connect is PCCW Global's Software Defined Interconnection® platform which spans over 40 countries, capitalising on our low latency, fully-redundant, uncontended global MPLS Network. The Console Connect digital platform allows users to instantly self-provision connectivity between carriers, enterprises, cloud, SaaS, IX, IoT, UCaaS, Security-as-a-service and other network-as-a-service partners in seconds.

Easy as a click! Try it for free [HERE](#)
Have other questions we didn't cover?
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