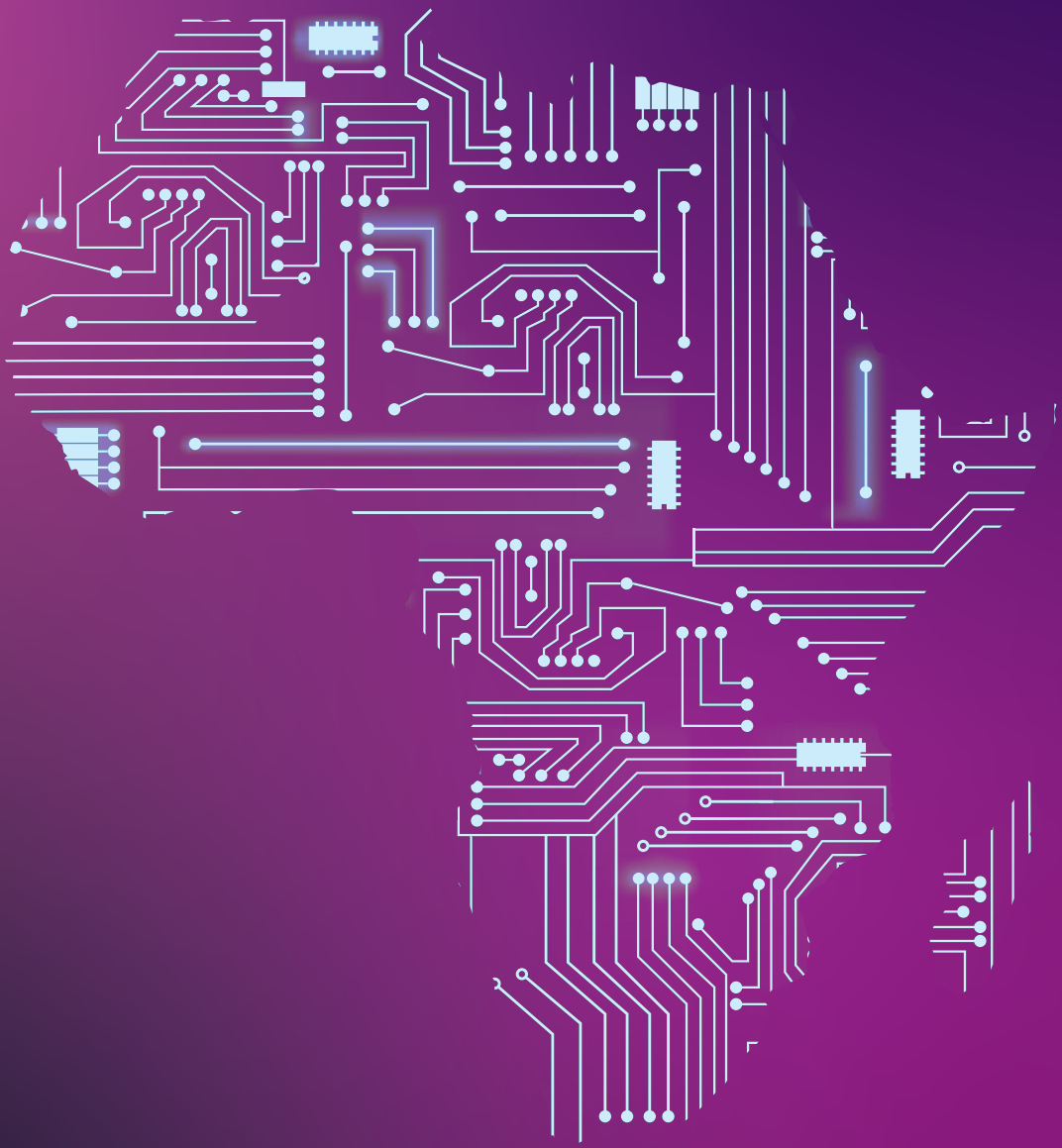
DIGITAL INFRASTRUCTURE IN AFRICA



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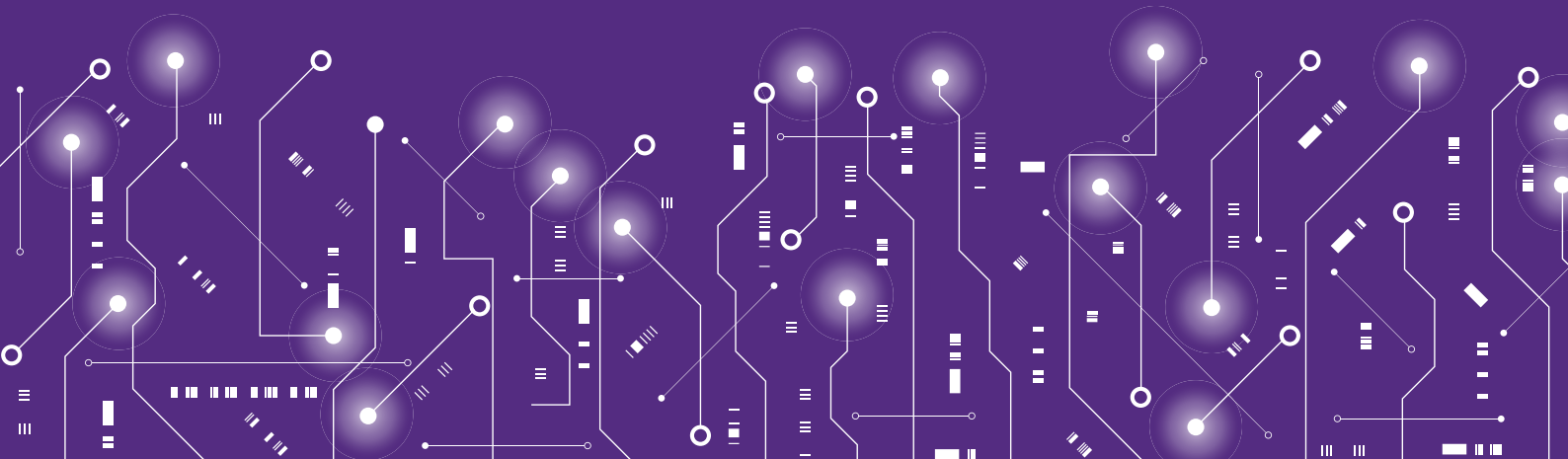

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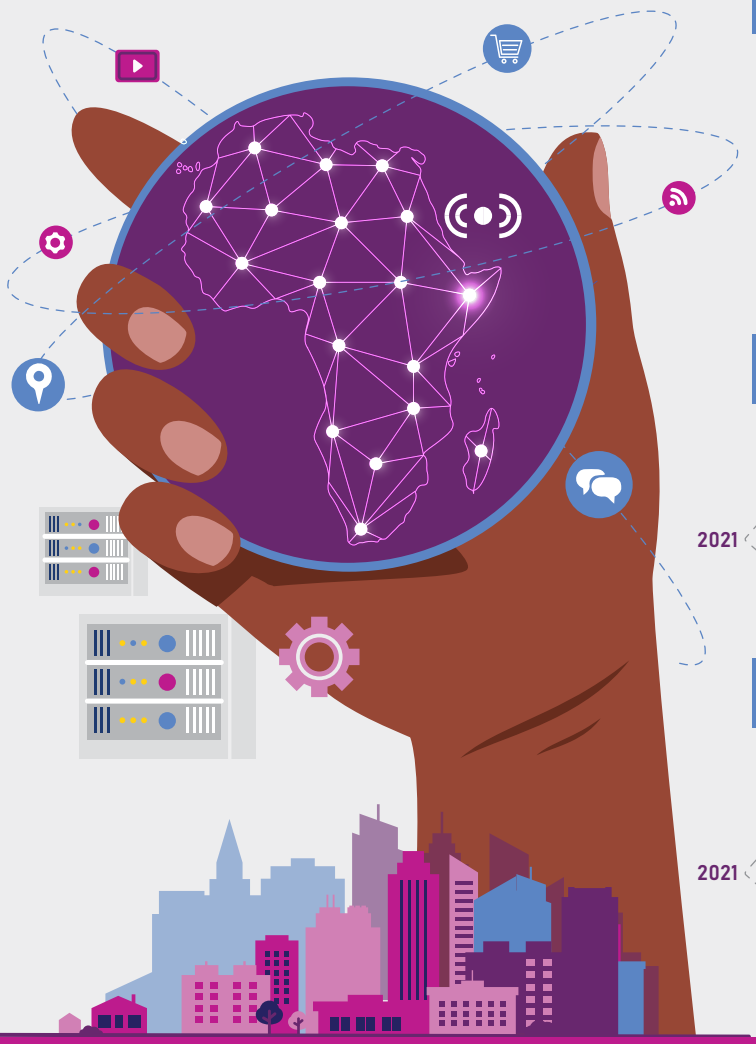
The study's lead author was Laura Naliaka from ECA, with contributions from Emmanuelle Bugeau (formerly ECA) and Talkmore Chidede from the AfCFTA Secretariat. Valuable feedback to the study was provided by Melaku Desta, Simon Mevel and Jason McCormack from ECA, as well as delegates attending the third meeting of the committee on digital trade. Meron Kinfemichael from the African Centre for Statistics Division of ECA developed the maps, and Yaphet Lejalem Fuja designed the infographics. Phoenix Aid Design Company designed the Executive Summary, and Communications Development Incorporated edited the study. The layout of the report was done by Dilucidar. Senait Bekele coordinated the editing and designing of the study.

Abbreviations

2G	second generation
3G	third generation
4G	fourth generation
5G	fifth generation
ACE	Africa Coast to Europe
AfCFTA	African Continental Free Trade Area
ARAPKE	African Regional Action Plan on Knowledge Economy
ATEX	African Trade Exchange
EAC	East African Community
ECOWAS	Economic Community of West African States
COMESA	Common Market for Eastern and Southern Africa
Digital STRI	Digital Service Trade Restrictiveness Index
GDP	gross domestic product
ICT	information and communication technology
IPS	instant payment system
ISP	internet service provider
IXP	internet exchange point
PAPSS	Pan-African Payment and Settlement System
PIDA	Programme for Infrastructure Development in Africa
RDTII	Regional Digital Trade Integration Index
SADC	Southern African Development Community
SAT3/SAFE	South Atlantic 3/South Africa Far East
WTO	World Trade Organization

EXECUTIVE SUMMARY

THE SPREAD OF INTERNET VARIES AMONG AFRICAN COUNTRIES



Internet penetration in Africa has been driven largely by the rapid growth of mobile broadband networks, which has greatly outpaced the penetration of the fixed broadband networks

Fixed broadband penetration: <1% (2013) → <1% (2022)

Mobile broadband penetration: 11% (2013) → 42% (2022)

These figures mask the heterogeneity at the country level

2021 Fixed broadband penetration: is <1% in 32 countries

in 39% Seychelles & 25% Mauritius > 16.8% World average

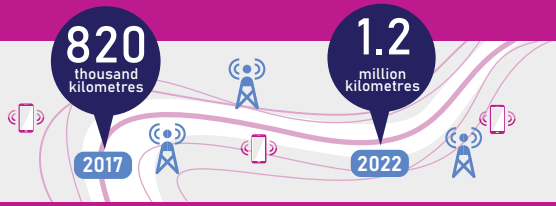
Country-level disparities are less extreme for mobile broadband penetration than for fixed broadband penetration

2021 Mobile broadband penetration: is >50% in 24 countries

is <10% in Burundi, Central African Republic, Chad, Equitorial Guinea, Liberia, Niger, Somalia and South Sudan

TERRESTIAL FIBRE NETWORKS ARE THE DOMINANT BACKBONE INFRASTRUCTURE IN AFRICA

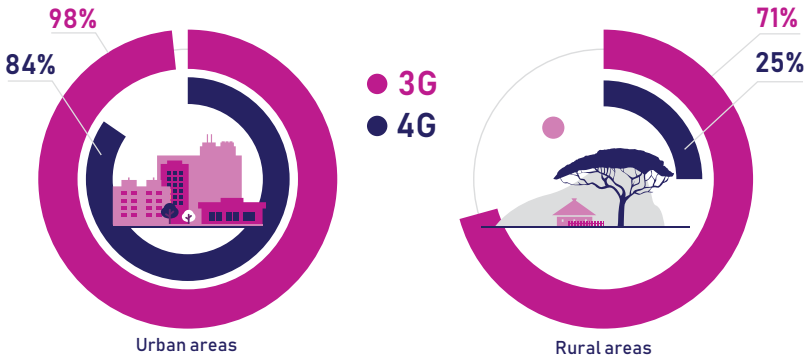
Terrestrial fibre network



Terrestial fibre networks predominate in major urban areas and high traffic routes

THERE IS DISPARITY IN THE SPREAD OF 3G AND 4G NETWORKS BETWEEN URBAN AND RURAL AREAS

Technological advances have improved the network capacity and speed of mobile broadband networks, which are prevalent in Africa. Several African operators have upgraded their 2G networks to 3G and 4G networks. However, there is a disparity between urban and rural areas.



LACK OF INTERNET INFRASTRUCTURE IS NOT THE ONLY BARRIER TO INTERNET ACCESS IN AFRICA

2021

50% of the African population live in areas covered by broadband networks, but don't use it

usage gap

18% of the African population does not have access to a mobile or fixed broadband network

coverage gap

FACTORS CONTRIBUTING TO THE USAGE GAP

- Limited digital literacy
- Lack of awareness
- Lack of power supply
- Affordability
- Concerns on online safety and security
- Absence of proof of identification

WOMEN TEND TO EXPERIENCE THESE BARRIERS DISPROPORTIONATELY CONTRIBUTING TO THE PERSISTENT DIGITAL GENDER DIVIDE

In Africa, more men than women use the internet

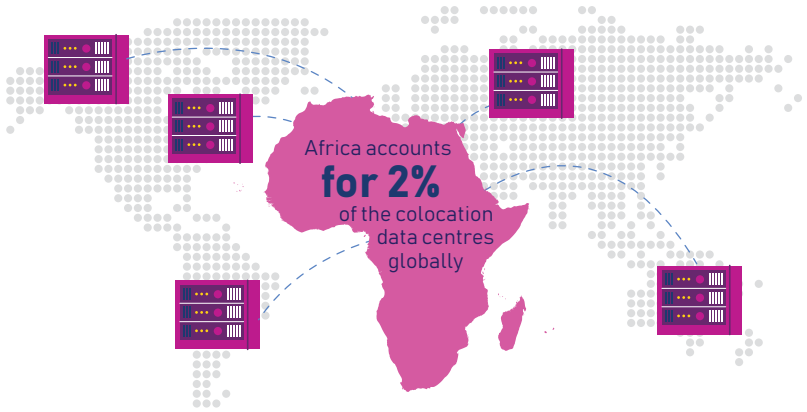
2022 — **34%** **46%**

MOST AFRICAN COUNTRIES ARE YET TO MEET THE MOBILE AND FIXED BROADBAND AFFORDABILITY TARGET (OF LESS THAN 2% OF MONTHLY GROSS NATIONAL INCOME PER CAPITA) SET BY THE BROADBAND COMMISSION

5 countries have met the Mobile broadband target

0 countries have met the Fixed broadband target

DATA FROM AFRICA ARE LARGELY STORED AND PROCESSED OUTSIDE AFRICA



As a result, Africa's data is largely stored outside Africa. This affects digital and data sovereignty and raises data transfer costs.

The number of data centres in Africa is expected to grow exponentially, driven by rapid digitalization due to:

- increased internet connectivity
- burgeoning dynamic and tech-savvy youth population

To meet the growth potential of the digital economy, Africa needs to increase its data centre capacity to

1200 MW by 2030

LIMITED INTEROPERABILITY OF PAYMENT SYSTEMS COULD HINDER THE GROWTH OF INTRA-AFRICA DIGITAL TRADE

In 2022, Africa had about **781 million** registered mobile money accounts and accounted for **69%** of global mobile money transactions by volume.

Moreover, there is proliferation of fintech startups providing innovative payment solutions in Africa.

These are positive developments for intra-Africa digital trade because they provide the sellers and buyers with alternative cross-border payment solutions.

The lack of interoperability of payment systems may prevent sellers - especially the small and medium enterprises- from venturing into markets beyond their national borders due to increased complexity, time and costs associated with making payments. This could hinder the growth of intra-Africa digital trade.

MOST OF THE LEADING ONLINE MARKETPLACES IN AFRICA OPERATE AT THE NATIONAL LEVEL

Digital trade platforms, particularly online marketplaces, are instrumental in facilitating digital trade. However, most of the existing online marketplaces operate only at the national level.

Share of visitors to most online national marketplaces from other African countries

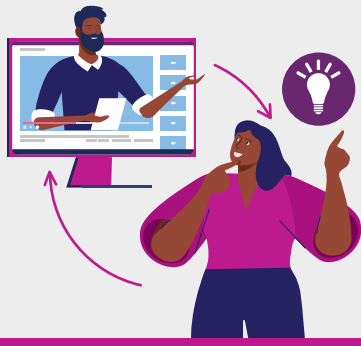
is **<10%**

Promoting intra-Africa trade in the AfCFTA requires ensuring that:

National online marketplaces

intraregional or continental level and are open to sellers and buyers from other African countries.

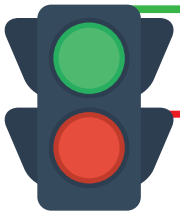
Capacity building is also needed to make sellers, buyers and other stakeholders aware of the benefits of cross-border digital trade



POOR LOGISTICS INFRASTRUCTURE REMAINS A CHALLENGE FOR ENTERPRISES ENGAGING IN CROSS-BORDER DIGITAL TRADE ACROSS AFRICA

In 2018, only three African countries (Côte d'Ivoire, Rwanda and South Africa) had an overall score on the World Bank's Logistics Performance Index that was above the world average.

A CURSORY LOOK AT THE INDICATORS CONTRIBUTING TO THE OVERALL SCORE REVEALS THAT:



Most African countries perform highly in terms of timeliness

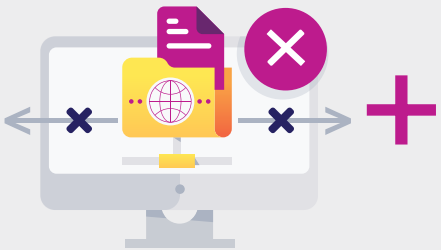
Customs and infrastructure are the main bottlenecks affecting the African logistics ecosystem.

INFRASTRUCTURE AND CONNECTIVITY ARE THE DOMINANT CHALLENGES TO DIGITAL SERVICES TRADE IN AFRICA, ACCOUNTING FOR SLIGHTLY MORE THAN A HALF OF ALL RESTRICTIONS

Main drivers of the infrastructure and connectivity restrictions in Africa

=

Restrictions on cross-border data flows ranging from the prohibition of transferring data abroad to lacking frameworks to protect transferred data



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Restrictive conditions for communication services

RECOMMENDATIONS

Countries should double down on efforts to implement proposed action outlined in existing regional and continental strategies such as the African Union Digital Transformation Strategy (2020-2030) and the Programme for Infrastructure Development in Africa and to adopt instruments such as the Pan-African Payment and Settlement System.

Existing best practices (in terms of regulatory frameworks and initiatives) already adopted at the national and regional levels that promote digital infrastructure development can be scaled up to the continental level, since the regional economic communities are expected to be the building blocks of the AfCFTA.

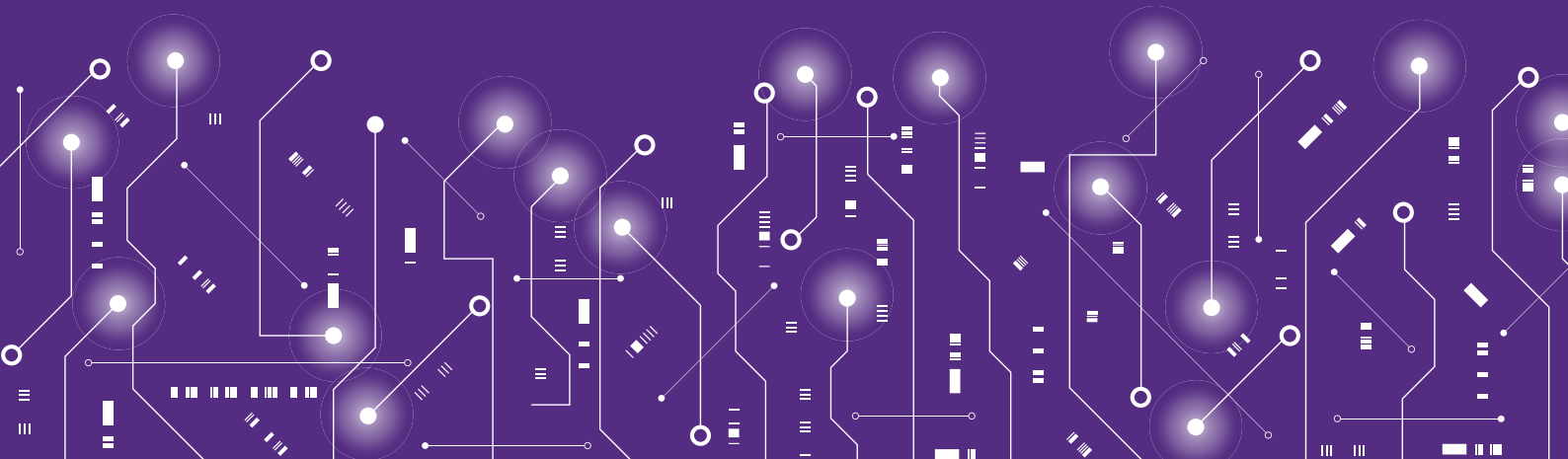
Concerted efforts should be directed to promoting the affordability of broadband services and devices. Countries that are yet to submit their category C list under the African Continental Free Trade Area (AfCFTA) tariff schedules should ensure that products related to internet infrastructure are not part of the excluded list of tariff offers.

Investment is needed at all levels of the education system, including primary and secondary schools, vocational training centres and universities, to boost digital literacy (especially among girls and women), as well as to build the pool of experts in Africa with the knowledge to develop, operate and maintain digital infrastructure.

Multistakeholder approach should be leveraged in developing digital infrastructure (for example, establishing data centres requires hefty resources) in Africa.

AfCFTA State Parties and non-State Parties should create a conducive environment to attract private investment in digital infrastructure in their countries.

1. INTRODUCTION



Digitalization has revolutionized how international trade in goods and services is carried out, leading to steady growth of digital trade worldwide. Digital trade —digitally enabled transactions of trade in goods and services that can be digitally or physically delivered and that involve consumers and firms— can drive socioeconomic transformation. Cognizant of the trends in and substantial benefits of digital trade, the African Union Assembly of Heads of State and Government decided in February 2020 to include a Protocol on E-Commerce in the African Continental Free Trade Area (AfCFTA) Agreement.[1] The assembly urged member states to review the e-commerce issues proposed in bilateral trade agreements by third parties to ensure that:

> …Africa is able to negotiate and implement an AfCFTA Protocol on e-Commerce where Africa has full authority on all aspects of e-commerce such as data and products being traded under e-commerce, and to promote the emergence of African owned e-Commerce platforms at national, regional and continental levels as part of our preparations for the negotiation of an AfCFTA Protocol on e-Commerce.

Digital trade is inextricably linked to digital infrastructure. Regions or jurisdictions with booming digital trade tend to have robust digital infrastructure. There is no widely accepted definition of digital infrastructure, but the Digital Transformation Strategy for Africa (2020–2030) definition includes fixed and wireless networks telecommunications, including broadband and high speed networks, terrestrial fibre optic networks, fibre over power lines, submarine cables, satellite communication, mobile communication, internet exchange points (IXPs), postal infrastructure, terrestrial digital broadcasting, data centres, telecentres, and digital and smart devices (AU, 2020).[2] Digital platforms and affordable devices have also been bundled with the components of this definition.

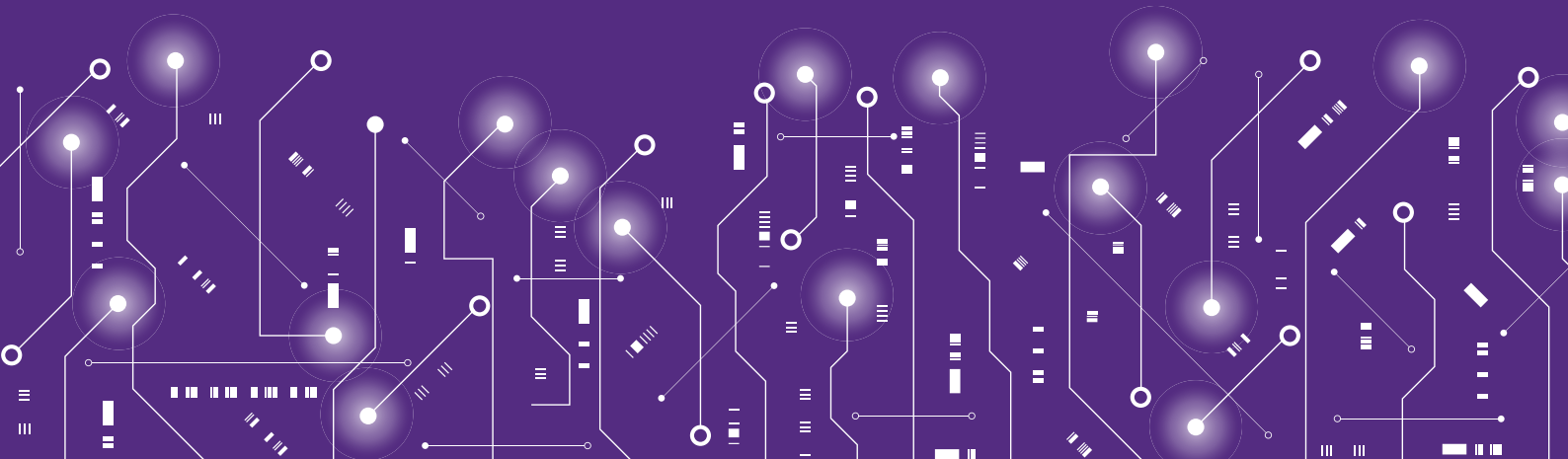
This study provides an overview of digital infrastructure in Africa and compares it with digital infrastructure in the rest of the world. The scope is limited to the components of digital infrastructure related to digital trade. In particular, the focus is internet infrastructure (notably, broadband infrastructure), data-related infrastructure (encompassing IXPs, data centres and cloud computing) and delivery-related or logistics infrastructure (such as the postal network). This study also covers elements that are likely to affect digital trade, such as digital payment systems and digital platforms.

The study is divided into four parts. Part 2 provides a snapshot of Africa's digital infrastructure landscape and how it compares with that of the rest of the world. Part 3 outlines the factors affecting the development of the region's digital trade landscape from a regulatory perspective. Part 4 draws out the conclusions and provides some recommendations.

1. Decision Assembly/AU/4(XXXIII). The scope of this protocol was later expanded to digital trade by the Council of Ministers on Trade.

2. This echoes the commonly used definition from the Broadband Commission, which broadly looks at digital infrastructure as including connectivity (for example, high-speed broadband networks and IXPs), the internet of things (for example, mobile devices, computers, sensors, voice-activated devices, geospatial instruments, machine-to-machine communications and vehicle-to-vehicle communications) and data repositories (for example, data centres and clouds).

2. SNAPSHOT OF AFRICA'S DIGITAL INFRASTRUCTURE ECOSYSTEM

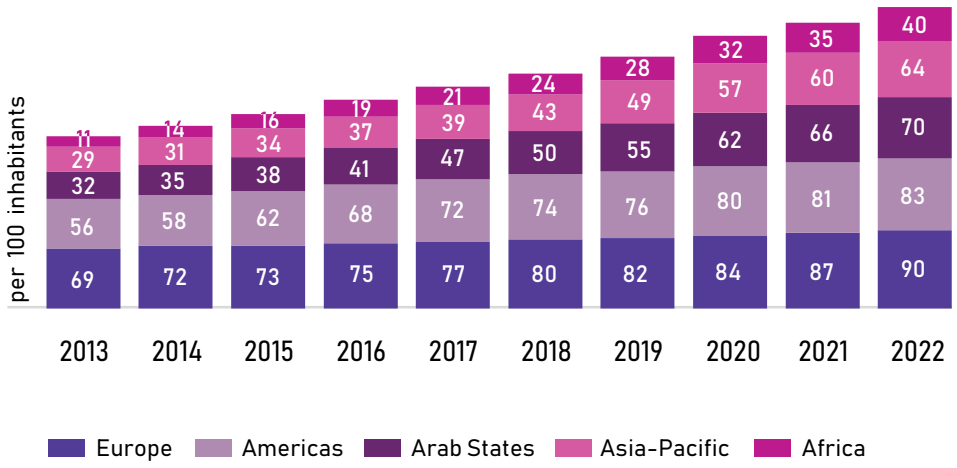


This part provides an overview of Africa's digital infrastructure, focusing on key enablers of digital trade. The first section assesses internet infrastructure, examining the penetration, quality and affordability of internet services in Africa. The second section discusses data-related infrastructure, which facilitates transmission, storage and processing of data and has become an important component of the digital infrastructure ecosystem. The final three sections assess digital payment systems, digital platforms (such as marketplaces and open government platforms) and delivery-related infrastructure (logistics used in the physical delivery of digitally ordered products).

2.1. Internet infrastructure

Internet connectivity is crucial in enabling digital trade by facilitating the exchange of goods and services online across countries and regions. Africa lags in internet use compared with other regions because internet access has had to grow from a very low base compared with other regions due to limited internet infrastructure and the high cost of internet service. Box 1 highlights additional factors that impact internet use. Nonetheless, the region is slowly catching up. It now has the fastest growing number of internet users: The proportion of Africans using the internet rose almost fourfold from 2013 to 2022 (figure 1).

Figure 1. Individuals using the internet, by world region, 2013–2022



Source: Based on data from ITU (2023).

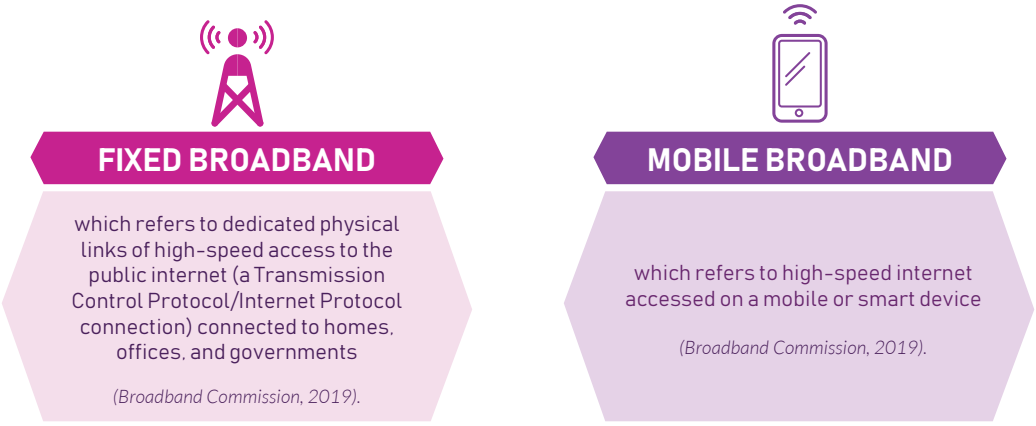
Regional data mask the heterogeneity in internet use at the country level, as well as disparities by gender and living areas. The proportion of the population using the internet ranges from less than 10% in Burundi, Congo, Somalia and South Sudan to more than 80% in Morocco and Seychelles (ITU, 2023). Regionwide, in 2022, more men (46%) than women (34%) used the internet. Moreover, the share of internet users is almost three times higher in urban areas than in rural areas (ITU, 2023).

The rest of this section focus on three dimensions of internet infrastructure: penetration, quality and speed, and affordability.

2.1.1. Penetration

2.1.1.1. Broadband networks

Broadband technology allows for high-speed transmission of voice, video and data over networks and through information and communication technology (ICT) applications (ITU, 2022).[3] This study focuses on two types of broadband networks:



The penetration rate for fixed broadband is proxied by fixed broadband subscriptions (which refers to actual subscribers with access to the public internet at downstream speeds of at least 256 kilobits per second and includes cable modems, digital subscriber lines, fibre to home or building, other fixed [wired] broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband) per 100 inhabitants. The penetration rate for mobile broadband is proxied by mobile broadband subscriptions (which refers to wireless broadband internet subscriptions using terrestrial mobile telecommunications) per 100 inhabitants. They cover actual subscribers and not potential subscribers, even though the latter may have broadband-enabled handsets.

Internet penetration in Africa has been driven largely by the rapid growth of mobile broadband networks, which has greatly outpaced the penetration of fixed broadband networks. Fixed broadband penetration in Africa was consistently below 1% between 2013 and 2022, while mobile broadband penetration rose from 11% to 42% in the same period (figures 2 and 3). The dominance of mobile broadband can be attributed to the low cost of upgrading existing mobile cellular networks to offer broadband compared with the cost of extending fixed networks. Moreover, fixed networks tend to have many attributes of a natural monopoly, whereas mobile services can be offered competitively in most countries (ITU, 2022).

Africa's fixed and mobile broadband penetration is the lowest among world regions (see figures 2 and 3). This could be a result of high subscription charges relative to income compared with

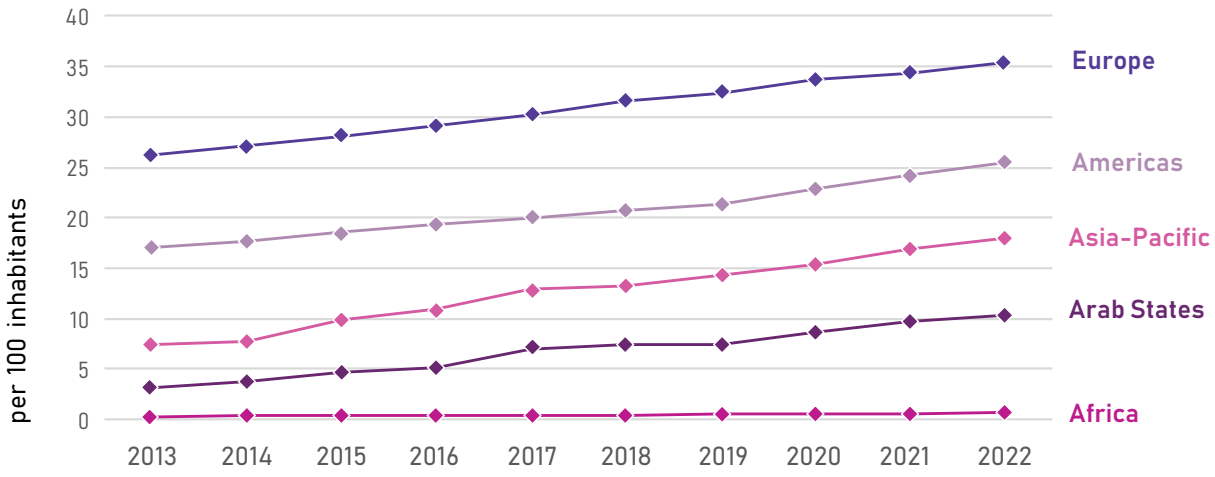
3. There are multiple working definitions of broadband. Traditionally, broadband has referred to high-speed communication networks that connect end-users at a data transfer speed of more than 256 kilobits per second. Still, there are limits on defining broadband in terms of speed. First, broadband speed definitions vary widely across countries and international organizations and may not keep pace with technology advances or with the speeds services and applications need to function properly. Second, such definitions may not reflect the speed realized by end-users, especially when the speed that commercial broadband providers advertise is much higher than the speed set by the government as broadband, or vice versa. To this end, several qualitative indicators, such as class of service and quality of service are now associated with broadband definitions and ecosystem (ECA, 2017; World Bank 2019).

other regions (see section 2.1.3 on affordability). Nonetheless, breaking down Africa's broadband penetration rates by country reveals a deeply unequal landscape (tables 1 and 2).

In 2021, the fixed broadband penetration rate for more than half of African countries was below 1%, though Seychelles and Mauritius had rates higher than the world average of 16.8% (table 1). Developing robust internet infrastructure has been a key priority for the governments of Seychelles and Mauritius, which have put in place robust legal and regulatory frameworks to do so. These governments also heavily invest in the requisite infrastructure.

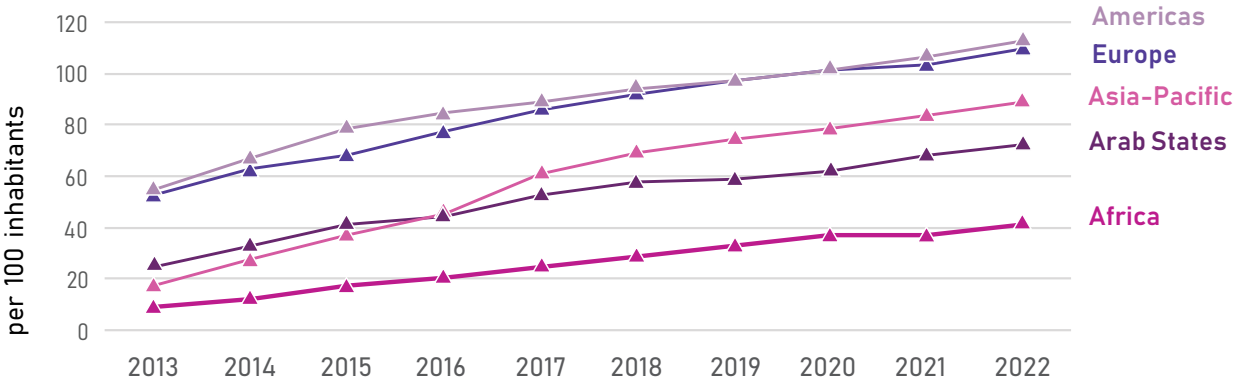
Fixed broadband penetration also seems to be positively correlated with country income. Most of the African countries with the highest fixed broadband penetration rates also have the highest gross domestic product (GDP) per capita in the region (table 1)

Figure 2. Fixed broadband subscriptions, by world region, 2013–2022



Source: Based on data from ITU (2023).

Figure 3. Active mobile broadband subscriptions, by world region, 2013–2022



Source: Based on data from ITU (2023).

Table 1. Fixed broadband subscriptions and gross domestic product (GDP) per capita in Africa, by country, 2021

Country	Fixed broadband subscription (per 100 inhabitants)	GDP per capita ($)	Country	Fixed broadband subscription (per 100 inhabitants)	GDP per capita ($)	Country	Fixed broadband subscription (per 100 inhabitants)	GDP per capita ($)
Seychelles	38.77	14,653	Zimbabwe	1.28	1,774	Benin	0.16	1,319
Mauritius	25.32	9,106	Senegal	1.23	1,637	Comoros	0.15	1,577
Tunisia	12.21	3,807	Côte d'Ivoire	1.22	2,549	Eritrea	0.14	644
Egypt	9.92	3,699	Angola	0.79	1,954	Madagascar	0.11	501
Algeria	9.46	3,691	Togo	0.77	973	Uganda	0.08	884
Botswana	7.84	6,805	Somalia	0.70	447	Burkina Faso	0.07	893
Morocco	6.08	3,795	Mali	0.66	874	Malawi	0.07	635
Cabo Verde	5.19	3,293	Ethiopia	0.42	925	Sudan	0.07	752
Libya	4.93	6,357	Mauritania	0.42	2,166	Equatorial Guinea	0.06	7,507
Namibia	3.53	4,866	Zambia	0.41	1,137	Niger	0.05	591
South Africa	2.85	7,055	Lesotho	0.35	1,094	Democractic Republic of Congo	0.03	577
Gabon	2.69	8,635	Ghana	0.35	2,363	Burundi	0.03	221
Eswatini	2.58	3,978	Congo	0.26	2,290	Nigeria	0.03	2,066
Cameroon	2.13	1,667	Liberia	0.25	676	Central African Republic	0.01	461
United Republic of Tanzania	1.95	1,099	Rwanda	0.24	822	Guinea	0.01	1,189
Sao Tome and Principe	1.53	2,361	Mozambique	0.20	492	Sierra Leone	0.002	480
Kenya	1.49	2,082	Gambia	0.19	772	South Sudan	0.002	–
Djibouti	1.32	3,150	Guinea-Bissau	0.16	795	Chad	–	–

Source: ITU (2023); World Bank (2023).
Note: – means data are not available.

As expected, country-level disparities are less extreme for mobile broadband penetration than for fixed broadband penetration (tables 1 and 2). Mobile broadband penetration was at least 50% in 24 African countries in 2021, but there is still cause for alarm in Burundi, Chad, Liberia, South Sudan, Niger, Central African Republic, Somalia and Equatorial Guinea, where the mobile broadband penetration rate is below 10%.

Table 2. Active mobile broadband subscriptions and gross domestic product (GDP) per capita in Africa, by country, 2021

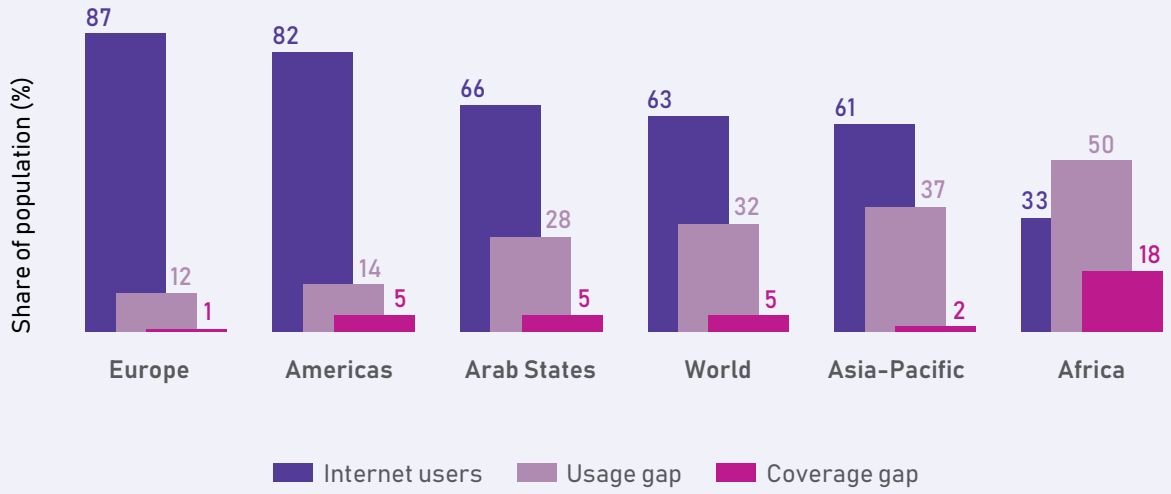
Country	Active mobile broadband subscriptions (per 100 inhabitants)	GDP per capita ($)	Country	Active mobile broadband subscriptions (per 100 inhabitants)	GDP per capita ($)	Country	Active mobile broadband subscriptions (per 100 inhabitants)	GDP per capita ($)
South Africa	116	7,055	Zimbabwe	58	1,774	Guinea	23	1,189
Eswatini	115	3,978	Kenya	54	2,082	Ethiopia	22	925
Mauritius	109	9,106	Zambia	53	1,137	Angola	21	1,954
Algeria	97	3,691	Guinea-Bissau	53	795	Sierra Leone	21	480
Gabon	96	8,635	Uganda	52	884	Mozambique	19	492
Senegal	94	1,637	Gambia	50	772	United Republic of Tanzania	18	1,099
Botswana	94	6,805	Rwanda	47	822	Madagascar	18	501
Seychelles	89	14,653	Sudan	42	752	Libya	17	6,537
Morocco	82	3,795	Comoros	42	1,577	Congo	16	2,290
Tunisia	81	3,807	Mali	40	874	Burundi	8	221
Côte d'Ivoire	79	2,549	Sao Tome and Principe	40	2,363	Chad	7	686
Cabo Verde	76	3,293	Malawi	39	635	Liberia	7	676
Namibia	76	4,866	Cameroon	38	1,667	South Sudan	6	1,072
Ghana	71	2,363	Nigeria	37	2,066	Niger	5	591
Mauritania	71	216	Djibouti	36	3,150	Central African Republic	5	461
Lesotho	64	1,094	Togo	34	973	Somalia	3	447
Egypt	61	3,699	Benin	33	1,319	Equatorial Guinea	0.5	7,507
Burkina Faso	61	893	Democratic Republic of the Congo	24	577	Eritrea	–	–

Source: ITU (2023); World Bank (2023).
Note: – means data are not available.

Box 1. Comparison between broadband coverage gap and usage gap

It is important to distinguish between individuals who are not using the internet due to lack of infrastructure and those not using the internet for other reasons. The coverage gap is the percentage of the population without access to a fixed or mobile broadband network, whereas the usage gap is the percentage of the population who live in areas covered by a broadband network but do not use it or remain unconnected (GSMA, 2022a; ITU, 2022). Africa's usage gap is higher than that of other regions—and much wider than its coverage gap. In 2021, Africa's usage gap stood at 50% compared with the coverage gap of 18% (see figure below). This shows that additional barriers, apart from lack of internet infrastructure, affect connectivity in the region.

Internet users, usage gap and coverage gap, by world region, 2021



Source: Based on data from ITU (2022).

Factors contributing to the usage gap include limited digital literacy and skills, lack of awareness about the benefits of the internet, lack of power supply, affordability of both devices and internet services, and dearth of relevant and localized digital content and services. Concerns regarding online safety and security and inadequate proof of identification hindering acquisition of Subscriber Identity Module (SIM) cards also contribute to the usage gap (GSMA, 2022a; ITU, 2022). Women in particular experience these barriers disproportionately, contributing to the persistent digital gender divide.

Addressing the usage gap requires comprehensive digital inclusion initiatives. Collaboration among governments, industry players, civil society organizations and international partners is essential to tackle the broadband coverage and usage gaps in Africa. Public-private partnerships can drive investment, knowledge sharing and capacity building. For instance, GSMA's Mobile Internet Skills Training Toolkit is an open-source resource providing basic lessons on mobile internet use that are delivered through local agents in written, audio and video format (GSMA, 2022a). The programme has shown success, with individuals in Benin and Cameroon who underwent the training up to four times as likely to use the mobile internet compared to those who did not receive the training. Countries should also develop regulatory frameworks to encourage broadband competition, innovation and affordability.

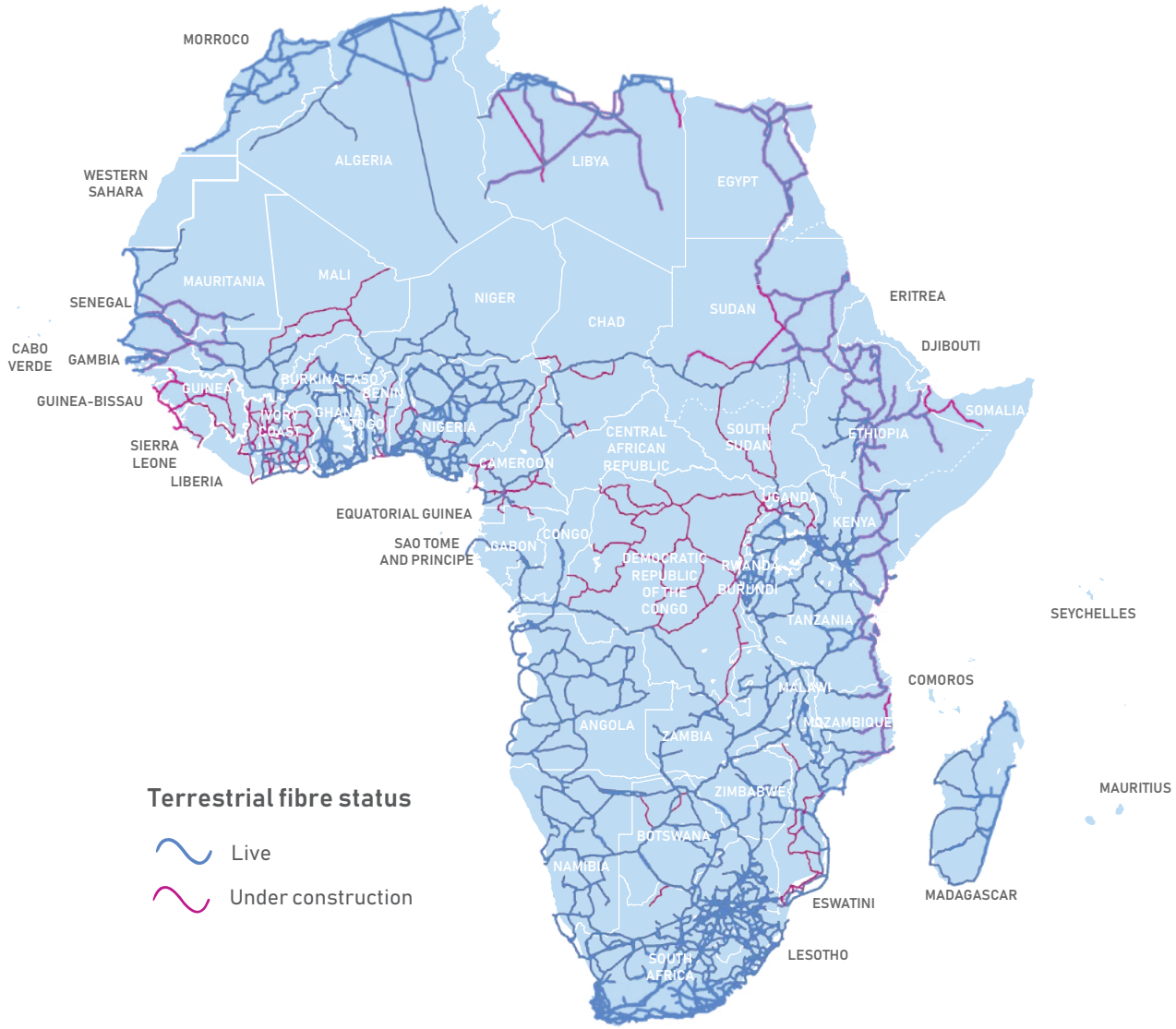
2.1.1.2. Backbone networks

Domestic backbone networks (including backhaul networks) are a critical component of broadband infrastructure. They carry internet traffic from a submarine cable landing point or the nearest border point to various parts of a country and to neighbouring landlocked countries, in addition to delivering internet traffic to national aggregation points such as IXPs (Broadband Commission, 2019; ITU, 2018).

Terrestrial fibre networks are the dominant backbone infrastructure in Africa. Unlike satellite technology, which relies on wireless networks and typically carries low volumes of internet traffic, terrestrial fibre networks allow for faster and higher volume internet traffic transmission by

sending pulses of light through a long fibre (usually made of plastic or glass). Wireless backbone networks, which are based on microwave and satellite signals, accounted for almost 90% of Africa's backbone network infrastructure about 15 years ago but are being deployed less and less (ECA, 2017; World Bank, 2008). In contrast, the operational terrestrial fibre network reached 1.184 million kilometres in June 2022, up from about 820,000 kilometres in 2017 (Hamilton Research, 2023). Still, the terrestrial fibre network is concentrated in certain countries and regions (figure 4) —especially those bordering oceans and seas due to close proximity to the submarine fibre optic cables. Fibre networks also predominate in major urban areas and high traffic routes, reflecting the demand for and cost of providing broadband services in these areas. Extending fibre networks to rural and other underserved areas remains important, especially for digital trade.

Figure 4. Spread of terrestrial fibre optic cables in Africa, 2021



Source: Based on data from AfTerFibre (2023).
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

Several regional initiatives have been adopted to engender the spread of backbone networks:

EAC

The East African Community (EAC) has **2 initiatives** for interconnecting national networks in the region:

- the **EAC Broadband ICT Infrastructure Network**, a public sector initiative.
- the **East Africa Backhaul System**, a private sector initiative.

ECOWAS

The **Intelcom II Programme** in the Economic Community of West African States (ECOWAS) identified :

32 interstate telecommunication links to form the backbone of regional broadband infrastructure.

The links will be connected to the global network, with support from a management system database.

SADC

The Southern African Development Community (SADC) **Regional Information Infrastructure Project** is a programme for developing **regional optic fibre links, terrestrial backhauls, backbone access networks, migration to all Internet Protocol networks** and **connection to the international internet backbone through submarine cable networks.**

All member states have set up cross-border transmission links using optical fibre technology, as envisaged under this project.

The private sector's role in developing national and regional backbone networks in Africa cannot be overemphasized. Mobile network operators such as Airtel, Orange, Safaricom and Vodacom have been rolling out backbone networks to support mobile communications and broadband internet services. Interest is growing among private firms in closing the digital divide by providing satellite networks in remote areas. Case in point is the Starlink satellite service provided by SpaceX, which is already being piloted in some African countries.[4] The satellite network currently deployed by most firms operates on new technology whereby the satellites are in low earth orbit and thus receive and transmit information with much lower latency than traditional communication satellites (Payton, 2022). Another emerging technology is free space optical communication, a wireless technology used to transmit data at high speed. This is being deployed in Google's Project Taara initiative, which transmits information at super high speed through the air as a very narrow, invisible beam of light (X-The Moonshot Factory, 2023).

2.1.2. Quality and speed

The quality of broadband services is as important as accessibility. Slow speed can adversely affect digital trade, particularly data-intensive applications, and services. The framework for universal and meaningful connectivity has a target speed of at least 10 megabits per second for all fixed broadband subscriptions by 2030, but only 41% of such subscriptions in Africa have reached it (ITU, 2022).

Data on mobile internet speed are patchy, but available country data suggest that the mobile internet download speed in Africa's top ranked country, South Africa (68.9 megabits per second) is below the global average (77.7) (WEF, 2022a). Two key aspects of broadband internet infrastructure that affect network quality and speed - international internet bandwidth and the type of technology - are discussed below.

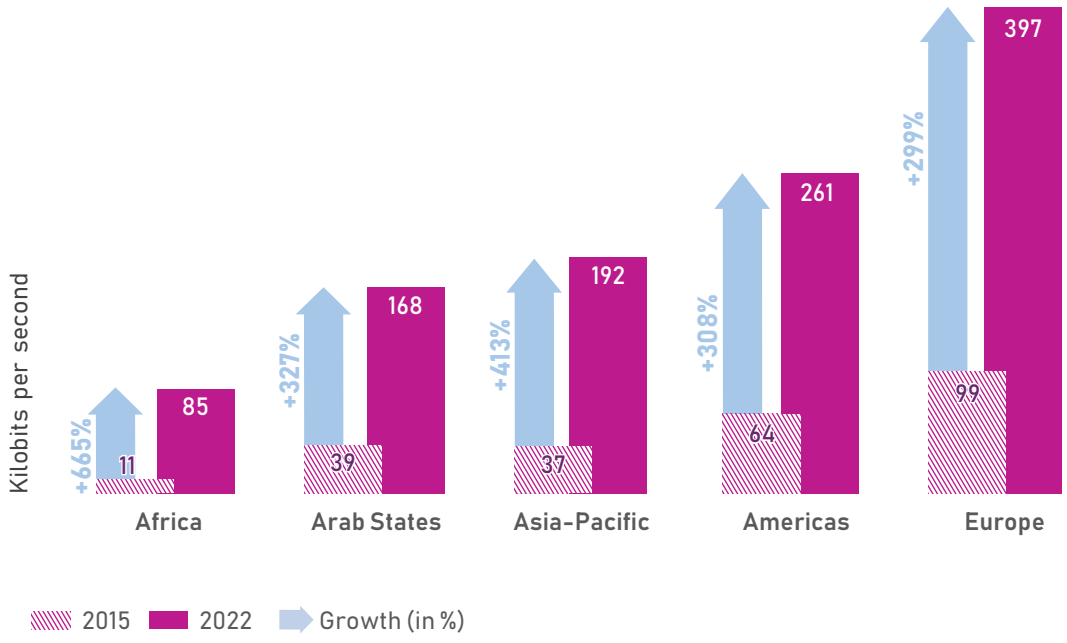
4. This includes Kenya, Mozambique, Mauritius, Nigeria and Rwanda.

2.1.2.1. International internet bandwidth

While national optical fibre transmission networks constitute essential infrastructure for access to high-speed networks, information on bandwidth helps in gauging the quality and speed available. Insufficient bandwidth is often characterized by slow load time of webpages (ECA, 2017; ITU, 2021). In fact, international internet bandwidth is a key building block for delivering data-intensive applications and services through high-speed networks (ITU, 2018).

Despite being ranked lowest among world regions, Africa's international internet bandwidth use has increased considerably, from 11 kilobits per second in 2015 to 85 in 2022 (figure 5). This is due to more submarine fibre optic cables being installed, particularly along the east and west coasts (box 2). However, international internet bandwidth varies widely at the country level. In 2021, Kenya had the highest international bandwidth in Africa, 18,479 kilobits per second, almost three times that of Egypt, which had the second highest. Further, in 12 of 29 African countries with data, international bandwidth was below the African average (ITU, 2023). Underuse of submarine cables at the country level is a key driver of these outcomes. Only a small fraction of the 230.5 terabits per second of bandwidth capacity available to Africa through submarine cables is currently used (Hamilton Research, 2023).

Figure 5. International bandwidth usage per internet user, by world region, 2015 and 2022



Source: Based on data from ITU (2023).

Box 2. The state of Africa's submarine fibre optic cables

Prior to 2009, Africa was served by only one submarine cable—the South Atlantic 3/South Africa Far East (SAT3/SAFE) cable, which was deployed along the West Coast in 2002. The continent thus relied heavily on scarce and expensive satellite networks for internet connectivity (ECA, 2017; ITU, 2021).

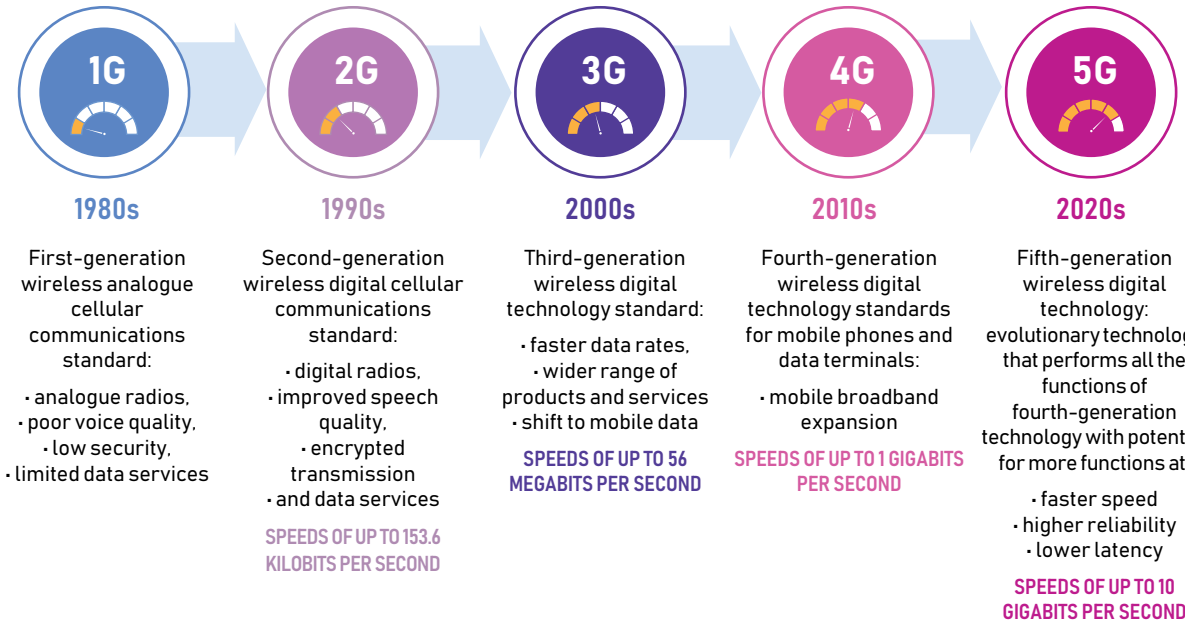
Placement of submarine cables has risen, including along the East Coast (see Many Possibilities, 2023), driven by the widespread adoption of mobile phones across the continent, which has catalysed demand for bandwidth and telecom revenue; increased lending from international and private financiers focused on developing fibre optic networks; and submarine cable suppliers' focus on opportunities in Africa, which has led to attractive prices for new projects to stimulate demand (ECA, 2017). As of 2019, submarine cable supplied 92.2% of the 8.814 terabits per second of bandwidth that Sub-Saharan Africa uses (Hamilton Research, 2023).

Some existing submarine cables have been upgraded, boosting the capacity of the wavelengths they support. For instance, the capacity of the Africa Coast to Europe (ACE) cable, installed in 2012, was upgraded 10-fold in 2016, resulting in a bandwidth glut in some West African countries that prompted them to market excess capacity to neighbouring countries (ITU, 2018).

2.1.2.2. Type of technology

The quality and speed of broadband connections differ between fixed and mobile technologies. Fixed broadband networks generally have higher data capacity and are faster and more reliable than mobile broadband networks (ITU, 2022). Nonetheless, technological advances have improved the network capacity and speed of mobile broadband networks (figure 6), which are more prevalent in Africa (see above sections).

Figure 6. Global evolution of mobile technologies, 1980s–2020s

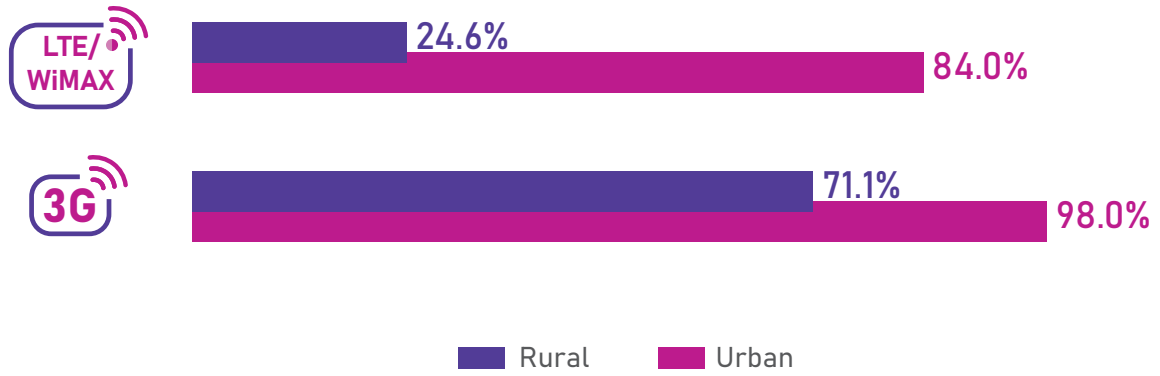


Source: Based on GSMA (2022b) and Internet Society (2015).

Several African operators have upgraded their second generation (2G) networks to third and fourth generation (3G and 4G) networks. This has been driven in part by higher demand and smartphone adoption, as well as regulation in some countries that allows refarming[5] of the existing spectrum to make it technology neutral[6] and allocation of the 700/800 megahertz-band spectrum freed up by the migration from analogue to digital broadcasting (the so-called "digital dividend") (GSMA 2023a, 2022b; ITU, 2018).

In 2022, approximately 82% of Africa's population was covered by at least a 3G network, compared with more than 95% in the Americas, Arab States, Asia-Pacific and Europe. Coverage by a 4G network in Africa was around 50% —far below the more than 90% in America, Asia-Pacific and Europe (ITU, 2023). Coverage by 3G and 4G networks is, however, higher in urban areas of Africa than in its rural areas (figure 7). The adoption of 5G networks in Africa is still at the infancy stage. In March 2023, commercial 5G services were available in only 10 African countries (GSMA, 2022b; Telegeography, 2023).

Figure 7. Percentage of the African population covered by at least 3G or LTE/WiMAX network, by rural or urban location, 2022



Source: Based on data from ITU (2023).
Note: 3G refers to third-generation mobile broadband networks. LTE/WiMAX is long-term evolution/Worldwide Interoperability for Microwave Access, the underlying technology for fourth-generation (4G) networks.

A major barrier to rolling out 4G networks in Africa is the lack of compatible devices. Most devices in Africa can use only 2G or 3G networks, and 4G-enabled devices are expensive. Some firms have introduced new financing models to accelerate the transition to 4G. For instance, Safaricom launched a 4G smartphone package in partnership with Google aimed at customers currently using 2G-enabled devices (GSMA, 2022b).

The rollout of 5G networks in Africa is likely to be constrained by similar factors, such as affordability of 5G-enabled devices and lack of digital skills. Some 5G-based services (such as metaverse applications) whose device ecosystem is underpinned by augmented reality or virtuality reality and other cutting-edge technologies are not yet fully established in Africa (GSMA, 2022b).

5. Reframing is the repurposing of frequency bands previously allocated for 2G mobile services (using Global System for Mobile communications technology) to a new generation of mobile technologies, including 3G (using Universal Mobile Telecommunications Framework technology) and 4G (using long-term evolution technology).

6. Technology neutrality allows licence holders to evolve the technology deployed and the services delivered as markets develop.

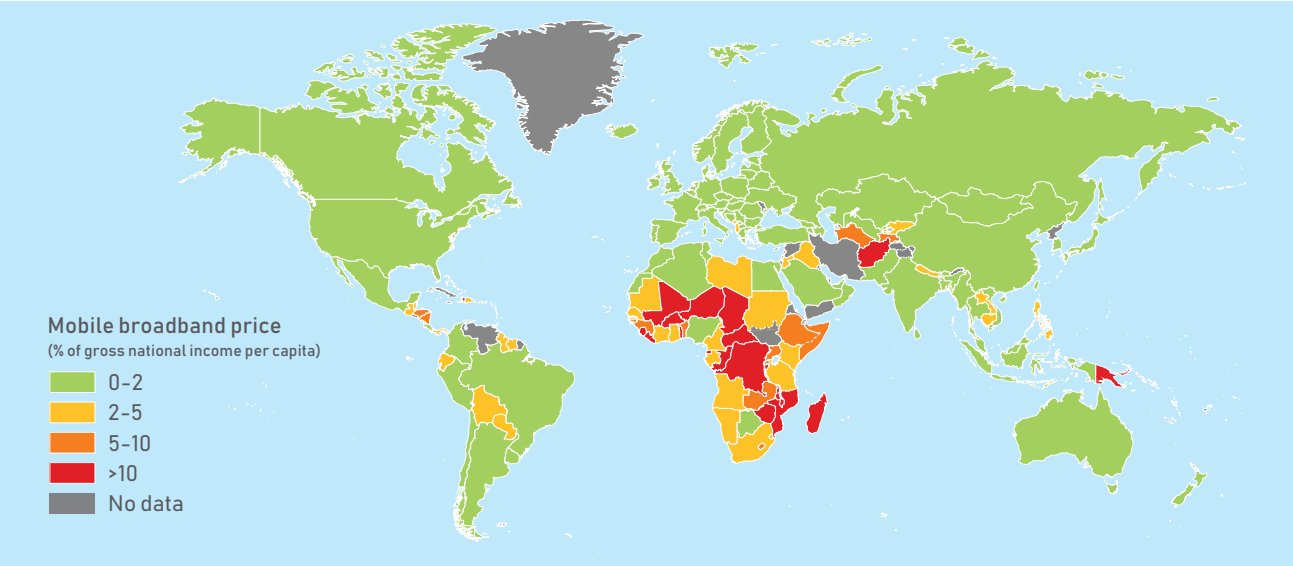
2.1.3. Affordability

2.1.3.1. Broadband services

Affordability of broadband services is crucial for engendering internet connectivity, which is positively correlated with expansion of digital trade (see above sections). The price of broadband has fallen over time, but huge disparities persist —particularly across countries and regions with different incomes. Based on this, the Broadband Commission[7] has a goal of making entry-level broadband services available in developing countries for less than 2% of monthly gross national income per capita by 2025 (Broadband Commission, 2022).[8]

Africa has the least affordable broadband services relative to income among world regions, and few African countries have met the target for broadband affordability (figures 8 and 9). Although affordability of the mobile broadband is particularly relevant due to its prevalence in the region, in 2021, only five African countries met the 2% target through mobile broadband, and none met the target through fixed broadband (which tends to cost more).

Figure 8. Entry-level data-only mobile broadband price, by country, 2021

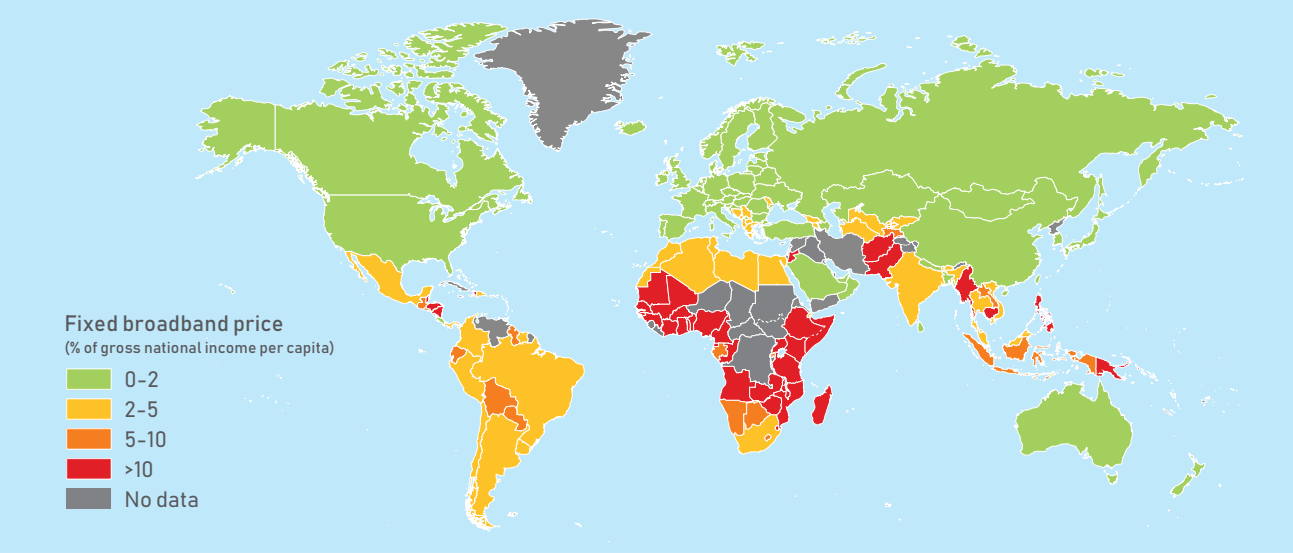


Source: Based on data from ITU (2022).
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed by the parties. A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

7. The Broadband Commission was established by the International Telecommunication Union, the United Nations Educational, Scientific and Cultural Organization, H.E. President Paul Kagame of Rwanda and Mr. Carlos Slim Helú of Mexico to boost the importance of broadband on the international policy agenda and expand broadband access to every country.

8. Expressing prices as a percentage of monthly gross national income per capita shows their size relative to a country's economy, indicating affordability at the country level. Considering a country's income or consumption distribution could provide further insights.

Figure 9. Fixed broadband basket price, by country, 2021



Source: Based on data from ITU (2022).
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Patterns of affordability result from structural factors such as disposable income, population distribution and physical geographic features that are unlikely to change in the short or medium term, as well as from factors such as a competitive environment and regulatory frameworks that are subject to policy interventions that can have an effect in the short or medium term (ITU, 2022). The Broadband Commission recognizes competition as the most effective mechanism to lowering prices and increasing affordability for most of the population. The commission urges countries to develop pro-competitive policies by offering potential subsidies and tiered services,[9] promoting fair and non-discriminatory access to essential facilities (such as the local loop or submarine cables) and facilitating the entry of new operators in the market,[10] among other options.

Taxation regimes for products related to broadband and ICT infrastructure tend to affect investment in the sector and, consequently, the affordability of broadband services. Only four African countries (Egypt, Mauritius, Morocco and Seychelles) are signatories to the Information Technology Agreement, which aims to reduce tariffs and import duties on ICT products. The agreement covers approximately 97% of world trade in ICT products (Lemma et al., 2022).[11] The average tariff across Africa for products covered under the agreement is 6%, with tariff peaks reaching 25% (table 3). This shows that import tariffs remain a major cost barrier to the ICT sector (and by extension digital trade) across the region.

9. This is common in some developed countries. For instance, more than 16 million US households are enrolled in the federal government's Affordable Connectivity Program, which offers a $30 discount on broadband services to qualifying low-income households (see https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/).

10. This is particularly crucial where an incumbent operator dominates the sector.

11. Information Technology Agreement concessions are included in participant World Trade Organization schedules of concessions, and tariff concessions are provided on a most favoured nation basis, so even countries that have not joined the agreement can benefit from tariff elimination.

AfCFTA State Parties that have yet to submit their Category C list of tariff schedules under the Protocol on Trade in Goods need to ensure that products related to internet infrastructure are not part of the excluded list of tariff offers.

Table 3. Ad valorem most favoured nation import tariffs on Information Technology Agreement products within Africa, by product, 2021

Product	Average (%)	Maximum (%)
Aerials, broadcasting, telecommunications and related equipment	8	25
Computers	8	20
Electric sound or visual equipment	11	25
Industrial robots	3	20
Machinery, circuits, semiconductors, resistors, capacitors and similar equipment	5	25
Other	4	20
Average across all products	6	25

Source: ECA (2021).

2.1.3.2. Mobile devices

The type of device people own has a major impact on how (and whether) they use the internet. Although it is possible to access the internet on a feature phone, internet use on a smartphone is typically much richer, more regular and varied (GSMA, 2022c).

Despite smartphone prices decreasing globally, they remain high in Africa, limiting access to mobile technology and the internet for numerous people. In many African countries, the cost of smartphones represents a considerable proportion of average monthly income. In a sample of 68 countries, devices were least affordable in Africa, at 62.8% of average monthly income, compared with 11.7% in the Americas and 16.2% in Asia-Pacific (excluding India) (Alliance for Affordable Internet, 2020). However, device affordability varies widely across African countries (table 4). The high cost of smartphones limits access to digital opportunities, including participation in digital trade, for low-income individuals and marginalized communities. Women and people in rural areas face even greater challenges in affording smartphones.

Table 4. Average smartphone prices and affordability in Africa, by country, 2020

Country	Price ($)	Affordability (% of monthly gross national income per capita)	Country	Price ($)	Affordability (% of monthly gross national income per capita)
Botswana	26.02	4.03	Liberia	20.00	40.00
Namibia	34.18	7.81	Kenya	58.10	43.04
Mauritius	83.05	8.27	Mozambique	18.76	51.15
Gabon	50.58	8.93	Egypt	120.65	51.71
Lesotho	17.96	15.62	Guinea-Bissau	37.94	60.70
South Africa	84.04	17.63	Comoros	67.44	61.31
Morocco	45.97	17.85	Uganda	41.98	81.24
Tunisia	62.42	21.40	Benin	59.01	81.39
Zambia	27.63	23.19	Democratic Republic of the Congo	33.74	82.63
Algeria	86.97	25.70	Madagascar	31.77	86.65
Ghana	49.17	27.70	Burkina Faso	53.11	96.56
Cabo Verde	85.16	29.62	Côte d'Ivoire	133.19	99.28
Guinea	20.70	29.92	Central African Republic	48.73	121.81
United Republic of Tanzania	29.09	34.23	Niger	59.85	189.01
Cameroon	41.98	34.98	Burundi	51.68	221.48
Mali	25.29	36.56	Sierra Leone	265.20	636.48

Source: Alliance for Affordable Internet (2020).
Note: The price is based on the cost of the cheapest available smartphone at the time of the survey. Affordability refers to the average device price.

Efforts to improve device affordability are essential for driving digital inclusion, economic growth and social development in Africa. This requires a multifaceted approach involving government policies, market competition and targeted initiatives to ensure that affordable smartphones are accessible to a wider population, enabling them to fully participate in the digital economy. Policies could include subsidizing the cost of devices for underserved populations and borrowing from best practices in countries in other regions where such interventions have been successful. Costa Rica's Hogares Conectados program uses universal service and access funds[12] to make devices more affordable for low-income households.

Collaboration between the public and private sectors, along with civil society organizations, is crucial for addressing device affordability. By working together, stakeholders can develop strategies and initiatives to increase affordability and bridge the digital divide. Innovative financing models, such as instalment payment plans and subsidy programs, can help individuals spread the cost of devices over time and thus make smartphones more accessible to those who cannot afford a large upfront cost.

12. Universal service and access funds are public funds financed primarily by mobile network operators and other telecommunications companies that are intended to expand communications services to underserved areas and populations (Thakur and Potter, 2018).

2.2. Data-related infrastructure

2.2.1. Internet exchange points

IXPs are physical locations where backbone operators, internet service providers (ISPs), hosting companies, governments and content providers (such as Google, Meta and Netflix)[13] interconnect their networks and exchange internet and data traffic directly through common switching infrastructure in a process known as peering (Internet Society, 2023; UNCTAD, 2021).[14] This eliminates the need to exchange local internet and data traffic overseas because the information is rerouted domestically or regionally by offloading it from expensive international links onto more affordable local links (Internet Society, 2017, 2023; ITU, 2018, 2022). The benefits of IXPs include:[15]

BETTER QUALITY INTERNET SERVICES

due to low latency (that is, time to retrieve data) because the servers are located closer to the user.

For instance, in Rwanda, accessing a local website is 40 times faster than accessing a website hosted in Europe or the United States (less than 5 milliseconds compared with more than 200 milliseconds).

This has resulted in greater visitor engagement, with more page views per session and return views.

LOWER COST OF ACCESS

for consumers because exchanging locally destined internet traffic among ISPs (rather than back and forth over costly overseas links) reduces the need for international bandwidth, and countries do not have to pay international transit fees to access overseas content.

GREATER RELIABILITY

because the national internet can remain up and running even if international connectivity is disrupted, as long as top-level domain-name servers are hosted in the country.

Africa has 83 IXPs (though 24 are inactive) spread across 45 countries (see annex 1). This reflects concerted regional efforts to establish IXPs. The Programme for Infrastructure Development in Africa (PIDA) priority action plan highlights the need for IXPs to provide Africa adequate internet node exchanges to maximize internal traffic.[16] In line with this, the African Regional Action Plan on Knowledge Economy (ARAPKE) endorsed the African Internet Exchange System as one of its flagship projects.[17] The system aims to keep internet traffic local by providing the capacity building and technical assistance required to establish national and regional IXPs in Africa (AU, 2014). As of the end of 2018, 17 new IXPs had been set up through the project.[18]

13. Other kinds of organizations are joining IXPs due to improved performance. For example, the Uganda Internet Exchange Point hosts the National Research and Education Network, allowing teachers, students and researchers to quickly exchange information among themselves and the Uganda Revenue Authority to enable faster access to online tax filing.

14. ISPs normally do not need to make peering arrangements with each potential partner.

15. These benefits from the presence of an IXP are not always assured. For example, the monopolistic structure of the telecommunications sector might result in unaffordable internet charges regardless of the existence of an IXP (UNCTAD, 2021).

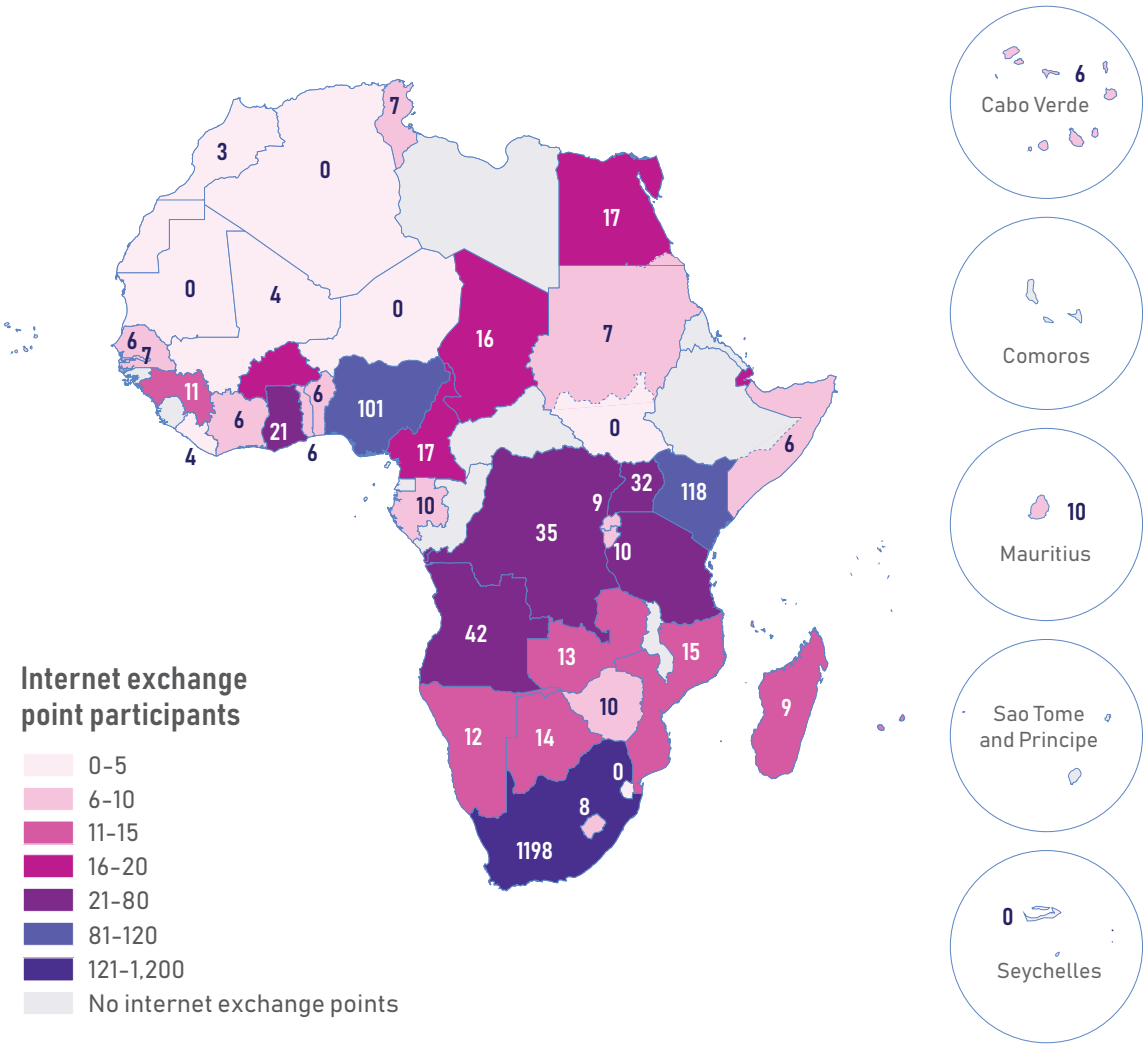
16. See PIDA (2012) for additional information.

17. AU Executive Decision EX.CL/434 (XIII).

18. https://www.eu-africa-infrastructure-tf.net/activities/grants/axis-african-internet-exchange-system.htm.

These IXPs have very few participants (that is, service providers using IXPs). Excluding South Africa, which accounts for 63% of all IXP participants, average membership per IXP in Africa is about 10 —far below the world average of 57 (figure 10; see also annex 1). Among the factors inhibiting the full exploitation of IXPs are restrictive regulatory frameworks, lack of competition and limited resources. In some countries, regulatory frameworks allow only ISPs to participate in traffic and data exchanges, yet onerous ISP licensing procedures can limit the emergence of new ones. One case in point is government-operated IXPs or IXPs located in state-owned facilities that discourage international content and cloud providers from participating. Moreover, incumbent operators that dominate international internet gateways are sometimes reluctant to participate in IXPs because they benefit when other ISPs use their transit facilities (ITU, 2018, 2022).

Figure 10. The number of internet exchange point participants in Africa, by country, 2023



Source: Based on data from Packet Clearing House (2023).
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2.2.2. Data centres

The growth of digital trade goes hand in hand with the increase in data generated and the computing equipment that firms need to support and optimize their operations. Therefore, many firms —particularly those operating in multiple locations— bring their devices and equipment to data centres to manage costs and ensure fast and secure access to data.

Data centres generally host networked computer servers, storage systems and computing infrastructure that store, process and distribute large amounts of data.[19] There are several categories of data centres, and a firm may use more than one type, depending on its workloads and business needs (Amazon Web Services, 2023; IBM, 2023; IEA, 2022; ITU, 2022):

COLOCATION DATA CENTRES
(also known as multi-tenant data centres)

These are operated by companies that rent or lease out space for data storage and provide network capacity and power and cooling equipment to keep down server temperatures.

The leading operators usually have certifications for security and reliability. Tenants bring their own information technology equipment.

These data centres are often used by firms that lack the space and expertise to deploy and manage some or all of their information technology infrastructure on premises and that prefer not to host infrastructure using the shared resources of a public cloud data centre.

ENTERPRISE (ON-PREMISES) DATA CENTRES

These are single-tenant facilities owned by a company to store data. These are located at company's site or in a dedicated off-site facility, and the company is responsible for deployment, monitoring and risk management.

Many companies choose to use their own on-site data centres because they offer more control over information security and can more easily comply with regulations such as the EU General Data Protection Regulation.

CARRIER DATA CENTRES

These are often used by telecommunication operators to host client data.

Historically, these centers locked clients into using only the operator's data centre services, but more telecommunication operators are now providing "carrier-neutral" connectivity.

CLOUD DATA CENTRES

These house information technology infrastructure resources for shared use by multiple customers—from a handful of customers to millions—through an internet connection.

Many of the largest cloud data centres (called hyper scale data centres) belong to major content and cloud providers such as Amazon, Facebook, Google, Meta and Microsoft (which together account for over half of the total).

Being closer to a data centre translates to higher service performance due to less latency and lower costs related to international bandwidth. More importantly, the location of data centres is a key issue in cross-border data flows. Requiring data to be stored in a particular territory is one method used to regulate cross-border data flows (UNCTAD, 2021).

19. Key design components include routers, switches, firewalls, storage systems, servers and application delivery controllers.

2.2.2.1. Colocation data centres

Very few data centres are domiciled in Africa. Of the 5,064 colocation data centres globally, only 2% are in Africa, concentrated in Southern, North and East Africa. A third of Africa's colocation data centres are in South Africa (table 5). In addition, Africa has only 91 carrier-neutral data centres (Construct Africa, 2023), meaning African data are largely processed and stored outside the region. This affects digital and data sovereignty and raises data transfer costs.

Africa needs to increase its data centre capacity to approximately 1,200 megawatts by 2030 to meet the digital economy's growth potential (Africa Infrastructure Investment Managers, 2023). The Digital Transformation Strategy for Africa (2020–2030) calls for establishing of data centre infrastructure that can host mission-critical servers and computer systems to support the development of a local digital ecosystem (AU, 2020).

The hefty financial resources (coupled with a lack of expertise) required to set up data centres has hindered their expansion in the region. The cost of building a medium data centre in Africa ranges from about $10 million to $20 million; larger and more complex data centres could cost much more, as much as $100 million. Nonetheless, companies such as Africa Data Centres, MainOne, Onix Data Centres, Rack Centre and Raxio Group have raised hundreds of millions of dollars to build new data centres or take over existing infrastructure (Velluet and Beaubois-Jude, 2021). Several development partners have also funded the development of government data centres,[20] though firms are often reluctant to use state-owned facilities (ITU, 2022). The US International Development Finance Corporation has committed up to $300 million in loans to expanding Africa Data Centres facilities in select African countries (DFC, 2022).[21]

The number of data centres in Africa is expected to grow exponentially, driven by rapid digitalization due to increased internet connectivity and a burgeoning dynamic and tech-savvy youth population. Africa has greater scope for increased digitalization than other markets, which are becoming more mature. It remains to be seen whether these data centres will continue to be concentrated in the same markets as today; additional investors are still setting up data centres in South Africa, which already leads the region. This is because locations of data centres are influenced by such factors as international internet bandwidth, reliability and cost of electricity, climate, regulatory frameworks (particularly those related to cross-border data flows and data protection) and political stability (ITU, 2022).

2.2.2.2. National data centres

National data centres[22] are becoming increasingly important for countries around the world, driven by the growth of digital technologies, the need for secure data storage and processing and the growing demand for more efficient and effective information technology infrastructure.

20. For instance, in 2021, China loaned Senegal $18 million for a government data centre, with Chinese company Huawei providing equipment and technical support. The World Bank provided $24 million to the government of Togo for the country's first world-class data centre in the same year.

21. The first disbursement of $83 million was made in August 2022 to support data centre expansion.

22. These centres are large-scale computing facilities that store and process vast amounts of data for a wide range of purposes, including government operations, business operations, research and more.

Many African countries have established national data centres to centralize computing resources, reduce costs and improve service delivery. Services provided by these data centres include cloud computing, data storage, disaster recovery and security. These services are critical for governments and businesses alike, enabling them to store and process large amounts of data while ensuring data integrity, confidentiality and availability.

While many African countries have established national data centres (table 5), the level of development of these centres and the services they provide vary widely. Some countries have highly advanced data centres on par with those in developed countries, while others are still developing the infrastructure.

Table 5. National data centres and colocation data centres in Africa, by country, 2023

Country	Has national data centre?	Number of colocation data centers	Country	Has national data centre?	Number of colocation data centers
Algeria	Yes	5	Liberia	Yes	0
Angola	Yes	7	Libya	Yes	1
Benin	Yes	0	Madagascar	Yes	0
Botswana	Yes	0	Malawi	Yes	0
Burkina Faso	Yes	0	Mali	Yes	0
Burundi	No	0	Mauritania	No	0
Cameroon	Yes	1	Mauritius	Yes	10
Cabo Verde	Yes	0	Morocco	Yes	5
Central African Republic	No	0	Mozambique	Yes	0
Chad	Yes	0	Namibia	Yes	0
Comoros	No	0	Niger	Yes	0
Congo	No	0	Nigeria	Yes	11
Côte d'Ivoire	Yes	0	Rwanda	Yes	1
Democratic Republic of the Congo	Yes	2	Sao Tome and Principe	No	0
Djibouti	Yes	0	Senegal	Yes	1
Egypt	Yes	15	Seychelles	Yes	0
Equatorial Guinea	No	0	Sierra Leone	Yes	0
Eritrea	No	0	Somalia	No	0
Eswatini	Yes	0	South Africa	Yes	31
Ethiopia	Yes	0	South Sudan	No	0
Gabon	Yes	0	Sudan	Yes	0
Gambia	No	0	United Republic of Tanzania	Yes	2
Ghana	Yes	5	Togo	Yes	0
Guinea	Yes	0	Tunisia	Yes	2
Guinea-Bissau	No	0	Uganda	Yes	1
Kenya	Yes	9	Zambia	Yes	0
Lesotho	Yes	0	Zimbabwe	Yes	1

Source: Data Center Map (2023).

2.2.2.3. Cloud computing

Cloud computing allows firms and institutions to have virtual on-demand access to computing resources (such as applications, servers, data storage and networks) hosted at a remote data centre and managed by a cloud services provider (IBM, 2023). Businesses tend to pay for only the cloud resources they use, absolving them of the costs related to setting up, running and maintaining their own cloud infrastructure. They can therefore access advanced technology that increases their efficiency while focusing on core activities instead of extra tasks related to running a data centre or cloud infrastructure. Moreover, they can scale up their businesses with speed and agility without investing in additional computing resources. This is why so many companies (including micro, small and medium firms) have adopted cloud computing. Like data centres, the proximity of cloud servers to end-users reduces latency, which in turn improves service quality (ITU, 2021; UNCTAD, 2013).

Africa's cloud ecosystem is dominated by US-based cloud services providers such as Amazon Web Services, Google Cloud and Microsoft Azure, mainly due to the massive upfront investment required to establish cloud infrastructure. These global firms have hyper-scale cloud data centres, most of which are in developed countries with stringent data protection and sovereignty regulations (ITU, 2022). These firms use local companies as intermediaries in some markets. More recently, some global firms have shown interest in setting up cloud centres in Africa. In 2022, Google launched Google Cloud in Africa,[23] based in South Africa.[24] In 2019, Microsoft launched its African cloud centre, also based in South Africa. Some local firms in Africa (such as Host Africa and Liquid Intelligent Technologies) are involved in the cloud economy, but their higher prices make local businesses (especially start-ups) to rely on the global firms.

Several risks are associated with massive over-reliance on a few external firms (in this case, the global service providers) in cloud computing. First, having only a few incumbents in the sector reduces competition and could result in higher prices and consumer exploitation. Second, cloud service disruption (such as outages) poses systemic risks to vital sectors and national economies. Third, first-party applications and services may receive unfair privileges over third-party equivalents through service bundling, preferential pricing, and technical and operational barriers. Fourth, it may be difficult to oversee and regulate cloud provider activities, especially due to their complex, opaque and rapidly evolving operations, technology and business practices (Carnegie Endowment for International Peace, 2022). The Digital Transformation Strategy for Africa (2020–2030) recommends establishing cloud computing infrastructure in Africa (AU, 2020).

23. Google Cloud regions allow users to deploy cloud resources from specific geographic locations and access several services, including cloud storage, Compute Engine and key management systems.

24. It is also building Dedicated Interconnect sites, which link users' on-premises networks with Google's grid, in Nairobi (Kenya), Lagos (Nigeria), and Cape Town and Johannesburg (South Africa) to provide full-scale cloud capabilities for customers and partners in Africa (Njanja and Kene-Okafor, 2022).

2.3. Digital payment systems

The ability of consumers and businesses to make online payments and transactions is critical in digital trade. The availability and uptake of online payment options and methods vary across regions and countries and are linked to financial inclusion and the efficiency and interoperability of payment systems, among other factors.

In developed regions, credit and debit cards dominate digital payments, whereas in most developing regions (including Africa), cash on delivery is the main payment method. This reflects the fact that a large proportion of people in most African countries lack a bank account, which is often a precondition for acquiring a credit or debit card. At least half the population in just five African countries (i.e., Mauritius (90%), South Africa (84%), Libya and Namibia (66% each), and Kenya (51%) have accounts at financial institutions (World Bank, 2021).

Financial technology (fintech)[25] has radically changed the financial services ecosystem through major innovations that promote financial inclusion. A case in point is mobile money,[26] which has bolstered financial inclusion in Africa by removing barriers to opening an account at a financial institution. Mobile money users do not need to own a bank account. Continued growth of mobile money as means of payment is crucial for increased uptake of digital trade (Lemma et al., 2022).[27]

This section provides an overview of mobile money payment systems as well as emerging innovative fintech, instant payment systems and related operational bottlenecks.

2.3.1. Mobile money

Africa remains at the forefront of the mobile money industry. In 2022, the region had about 781 million registered accounts and accounted for 69% of global mobile money transactions by volume (GSMA, 2023b). Nonetheless, the prevalence at the country and regional levels varies (figure 11). East Africa is considered the powerhouse of mobile money in Africa. M-PESA, launched by Safaricom in Kenya in March 2007, was the first mobile money service in Africa. Thereafter, Vodacom launched M-PESA in United Republic of Tanzania in 2008, and MTN introduced mobile money in Uganda in 2009 and Rwanda in 2010. In 2022, East Africa had the most registered mobile money accounts (390 million) among African regions (GSMA, 2023a).

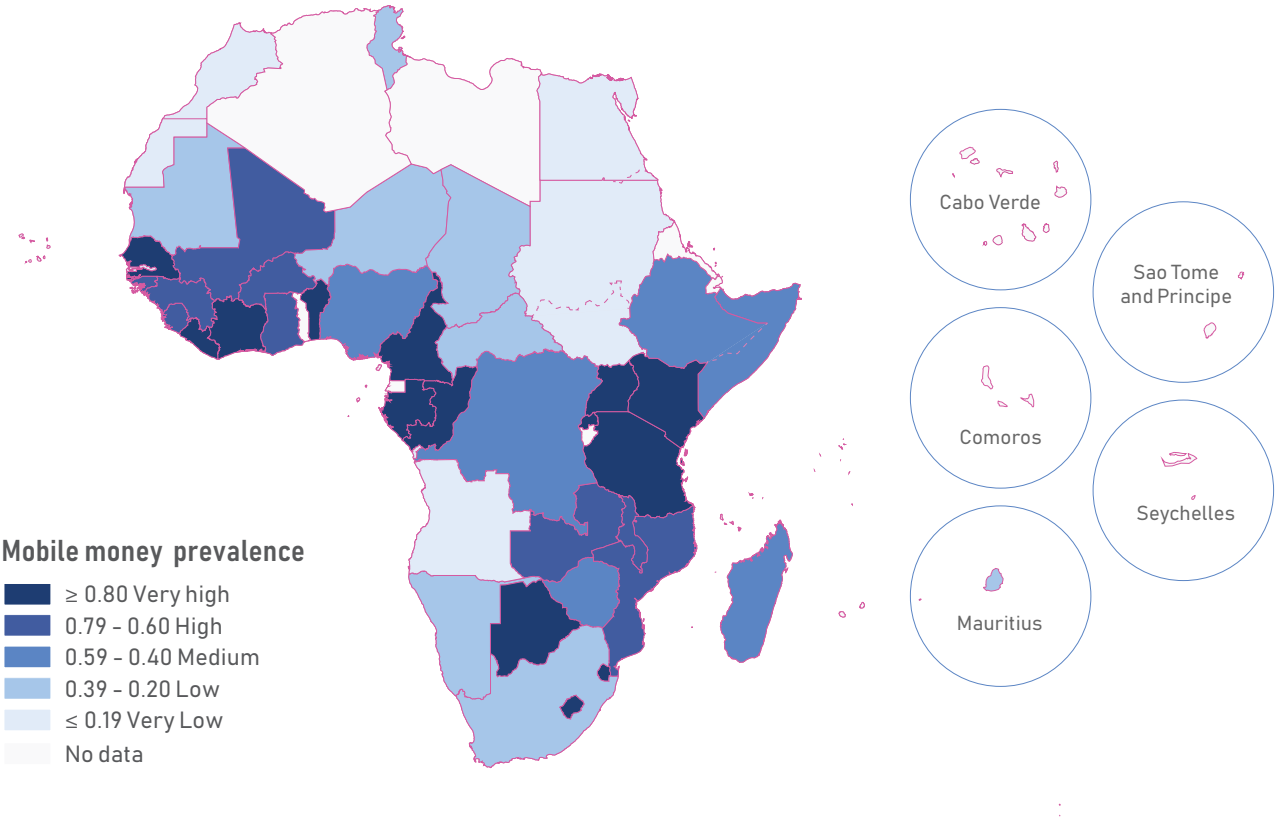
Mobile money has also gained prominence in West Africa, which has the second most registered mobile money accounts (290 million) in Africa. Côte d'Ivoire, Ghana and Senegal are the region's mobile money leaders, followed by Benin, Burkina Faso and Mali (GSMA, 2023b).

25. Fintech companies use new technology and innovation with available resources to compete in the marketplace previously dominated by traditional financial institutions and intermediaries such as banks to deliver financial services. Fintech companies include both startups and established financial and technology companies trying to replace or enhance the use of incumbent companies' financial services (ECA, 2018).

26. Mobile money refers to using cellular or mobile phones for money transfers, payments and more sophisticated financial activities such as credit, savings and insurance (UNCTAD, 2012).

27. For instance, in Kenya, mobile money is used more often than credit cards for e-commerce, but cash on delivery remains the main method.

Figure 11. Mobile money prevalence in Africa, by country, 2022



Source: Based on data from GSMA (2023b).
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

The adoption of enabling regulatory frameworks by some countries is fuelling further growth of mobile money in Africa. Mobile money use in Nigeria has steadily grown since the Central Bank of Nigeria introduced the payments service bank licence in 2018, which allows mobile network operators to offer licensed financial services. The National Bank of Ethiopia has also introduced regulations allowing mobile network operators and other entities to offer mobile money services. This led Ethio Telecom to launch the telebirr service in 2021 (GSMA, 2023b), while Safaricom launched M-PESA in August 2023.

2.3.2. Emerging fintech

Africa's fintech ecosystem is dominated by mobile money services offered by mobile network operators. Recent years have seen a proliferation of fintech start-ups providing innovative payment solutions —a positive development for intra-Africa digital trade because it provides sellers and buyers alternative cross-border payment solutions.

Fintech has inherent risks, including those related to consumer protection, data privacy, cybersecurity, money laundering and counterterrorism financing. Concerns about data privacy stem from the business model of the fintech firms, which relies on automated processing of huge

quantities of personal data, sometimes by foreign companies based in jurisdictions with different approaches to data privacy.[28] Fintech business models can also lead to uncertainty among customers regarding who is responsible for redressing errors and handling complaints. This is compounded by the fact that financial services from some start-ups are unregulated, exposing customers to financial losses outside the remit of consumer protection authorities (AFI, 2023). This is particularly the case where the fintech landscape is evolving faster than regulatory frameworks.

Digital technologies have also led to the emergence of digital currencies[29] (such as cryptocurrency and central bank digital currencies), which can be used to settle business transactions or for cross-border funds transfers. This has widened digital payment options—essential in digital trade. Twelve national central banks and two regional banks[30] in Africa are considering central bank digital currencies (IMF, 2022). The digital currency ecosystem is also associated with risk, but the AfCFTA Protocol on Digital Trade can be used to promote and regulate (including addressing the risks of) fintech in Africa.

2.3.3. Instant payment systems

Instant payment systems (IPSs) are open-loop payment systems that enable the transmission of irrevocable, low-value and digital push payment messages through a set of procedures, rules and technical standards. The final funds are available to the payee in near–real time, 24 hours a day, seven days a week, or as close to that as possible (AfricaNenda, ECA and World Bank, 2022). IPSs facilitate person-to-person transfers, bill payments, merchant transactions and government services. They have also simplified payment processes, reduced transaction times and enhanced convenience for individuals and businesses. More importantly, the interoperability of IPS allows users to seamlessly transact across different payment platforms, promoting financial connectivity and integration.

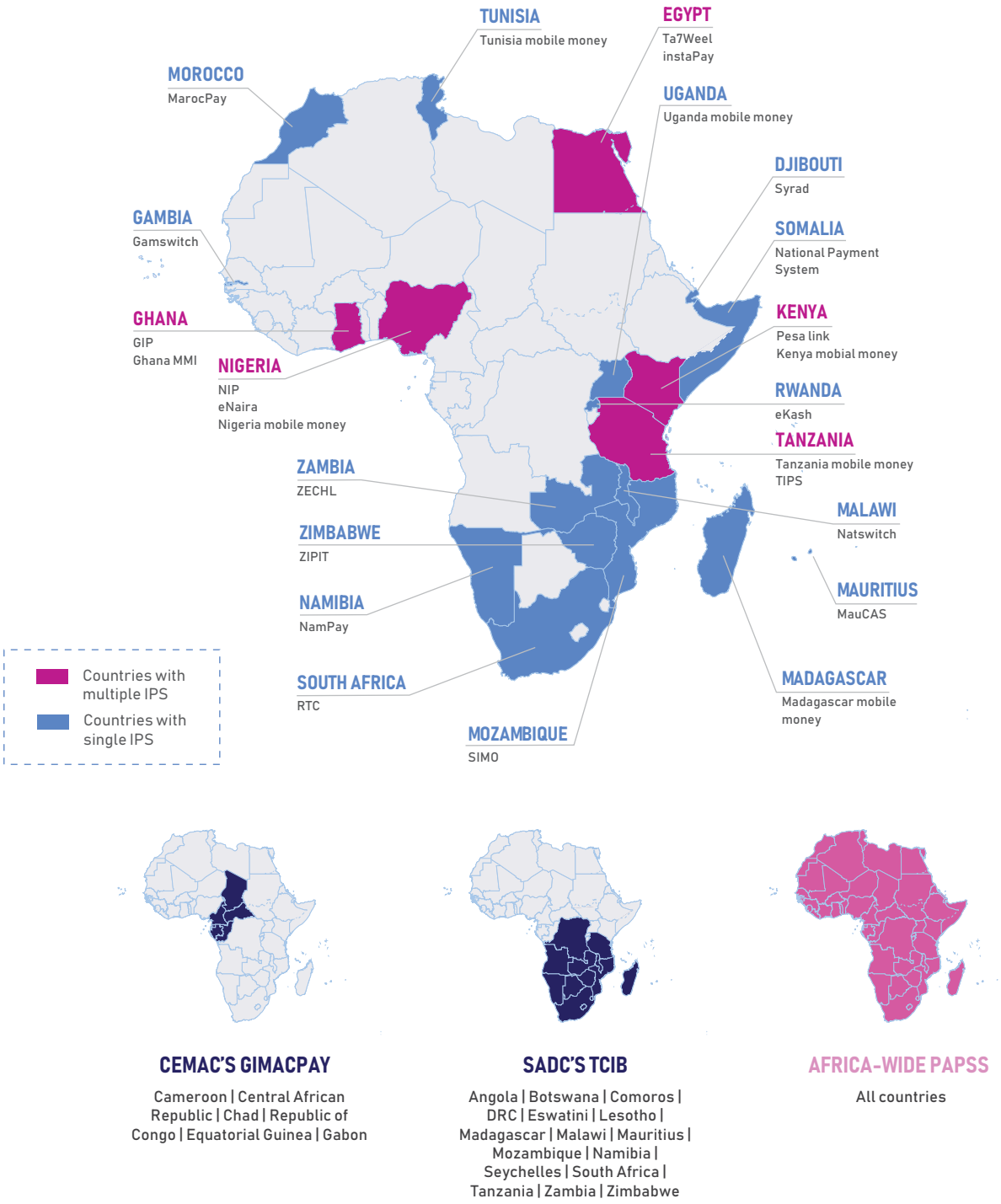
IPSs in Africa reflect the growing trend towards digital payments and financial inclusion. Several countries and regions have made substantial progress in developing and implementing IPS to meet the evolving needs of individuals, businesses and the overall economy. As of June 2022, there were 26 live domestic systems spread across 20 countries and 3 live regional systems in Africa (figure 12). Although some countries (Egypt, Ghana, Kenya, Nigeria and Tanzania) have multiple IPS, interoperability between IPS is possible only in Ghana.

28. These issues are discussed at length in AFI (2021).

29. These are new forms of electronic money that do not require physical transfer of cash (IMF, 2022).

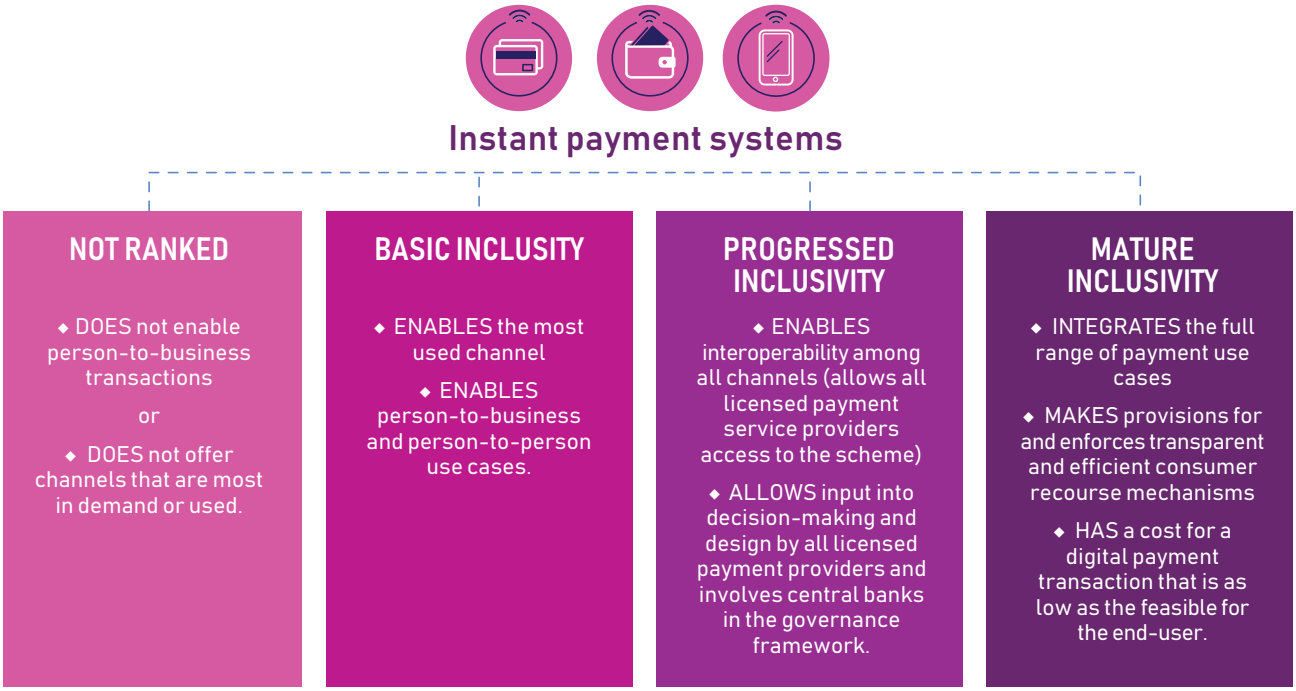
30. The Central Bank of Algeria, the Bank of Ghana, the Bank of Tanzania, the Central Bank of Egypt, the Central Bank of Kenya, the Central Bank of Mauritius, the Central Bank of Morocco, the Central Bank of Nigeria, the Central Bank of Rwanda, the Central Bank of Tunisia, the Central Bank of Uganda, the South African Reserve Bank, the East African Community and the West African Monetary Institute.

Figure 12. Africa's instant payment systems (IPS) landscape, June 2022



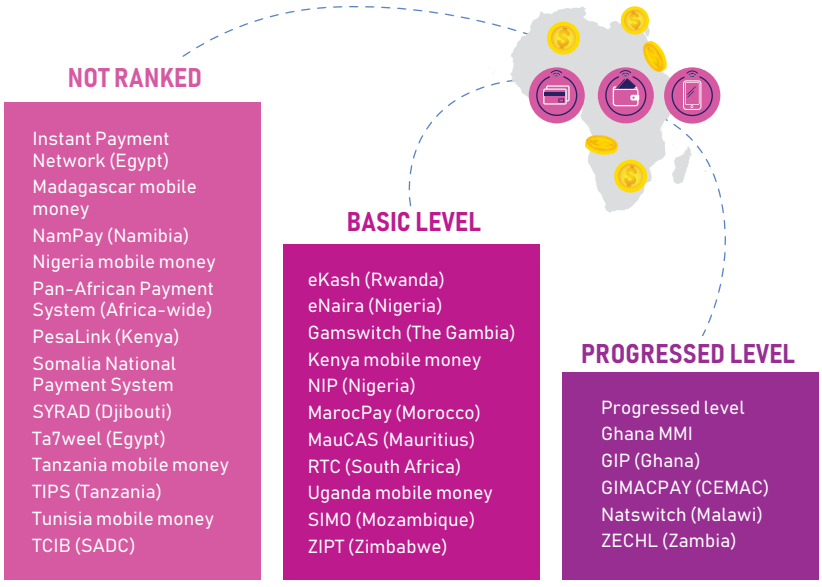
Source: Extracted from AfricaNenda, ECA and World Bank (2022).
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

IPS inclusivity is determined by its functionality, which dictates how end-users' payment needs are met through channels, instruments and use cases. It can be assessed using the following classification (AfricaNenda, ECA and World Bank, 2022):



Most IPSs in Africa are not ranked or meet only the basic-level inclusivity (table 6). Currently, no IPSs are fully mature in terms of inclusivity, due mostly to their relatively young age and shortcomings around inclusive governance. However, the five progressed IPSs are all on their way to maturity.

Table 6. Inclusivity classification of instant payment systems in Africa, 2022



Source: AfricaNenda, ECA and World Bank (2022).

Leveraging a multistakeholder approach is crucial to ensure that IPSs are inclusive and meet end-users' needs. By engaging multiple stakeholders, including financial service providers, regulators and technology providers, IPSs can be tailored to address the specific requirements of various user segments. Enhancing the value proposition of IPSs for larger players requires a short- and long-term vision that demonstrates the market and ecosystem value for participants. Continuous consultation with digital financial service providers is essential to drive buy-in and ensure active participation in IPSs.

Managing cost drivers is crucial to keep per unit transaction costs down. This can be achieved by assessing the existing payment infrastructure for integration or interoperability potential between systems, particularly in countries with smaller populations. Market analysis can help determine the appropriate integration of use cases based on end-user needs. Evaluating the market for optimal messaging standards, such as ISO 20022, or exploring the use of translation services can contribute to cost optimization. In addition, supporting a wide range of use cases and channels preferred by the majority of consumers is vital. Special attention should be given to developing low-cost solutions for non-smartphone users, as they account for a large share of the population in many African countries.

Addressing regulatory hurdles is important for fostering competition and innovation in the IPS space. Ensuring pro-poor governance, where all participants have an equal opportunity for input into system rules and decisions, promotes inclusivity. Consolidation should be encouraged among participants using a risk-based customer due diligence approach at the local level, while establishing roundtable discussions at the regional level to harmonize customer due diligence practices. Clear guidelines should be provided to end-users on recourse mechanisms, and additional charges for disputes should be minimized.

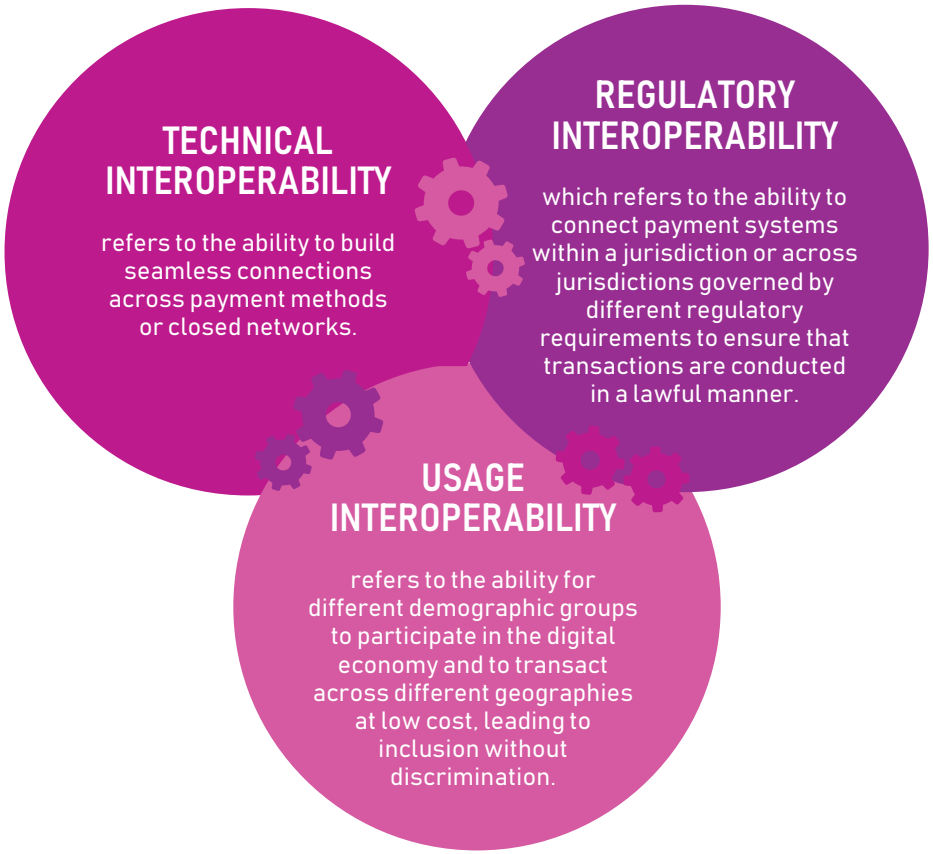
Mitigating cybersecurity threats is crucial to build trust and confidence in IPS. Adopting consumer protection measures to address digital scams and cybercrimes is essential. Real-time fraud protection mechanisms should be integrated, and tools such as transaction receipts can keep consumers informed of transaction statuses.

Focusing on these levers will help ensure that IPS in Africa are inclusive, cost-effective, secure and aligned with end-users' needs, thereby driving financial inclusion and supporting broader economic development goals.

2.3.4. Operational bottlenecks

2.3.4.1. Interoperability

The lack of interoperability of payment systems may prevent sellers—especially small and medium enterprises—from venturing into markets beyond their national borders due to the increased time, costs and complexity associated with making payments. This could hinder growth of intra-Africa digital trade. There are several types of interoperability systems, but this study focuses on account-to-account interoperability, which refers to the ability to transfer money between mobile money accounts across mobile money providers or between a mobile money provider and a bank or other financial services provider (GSMA, 2020). Account-to-account interoperability can be assessed through three interoperability lenses:



Regulatory interoperability comprises domestic and cross-border regulatory interoperability. Laws and regulations governing domestic interoperability can make payment interoperability a policy goal or mandate, assure all payment firms that meet regulatory obligations equal access to the network and set standards for joining the network. They can also provide equal opportunities to all payment firms by preventing abuse of monopoly power and applying the principle of "same risk, same regulation" across payment methods to level the playing field.

Cross-border regulatory interoperability depends on regulatory convergence, which can be achieved through regional and international agreements. For example, the European Union Payment Services Directive created one of the largest integrated payment markets in the world. The Digital Economy Partnership Agreement among Chile, New Zealand and Singapore is the first international agreement to commit to improving digital payment interoperability among state parties (WEF, 2022b). The AfCFTA Protocol on Digital Trade could borrow from these examples and include provisions on enhancing cross-border regulatory interoperability in Africa.

Some regional economic communities in Africa have initiatives to facilitate cross-border payments. The Common Market for Eastern and Southern Africa (COMESA) Regional Payment and Settlement System is expected to greatly expand intra-COMESA trade by facilitating online payments of all intra-COMESA transactions. As of March 2022, 9 of 21 COMESA countries were live on the platform (COMESA, 2022). The East African Community (EAC) Payment System was launched in 2014 to enhance the efficiency and safety of payments and settlement of intraregional payments to boost regional trade, but members have been reluctant to trade in each other's currency, impeding its use. At the continental level, the Pan-African

Payment and Settlement System (PAPSS), which provides payment and settlement services to commercial banks and payment service providers across Africa,[31] is expected to facilitate cross-border payments and consequently promote intra-Africa trade. As of August 2023, 9 central banks and 41 commercial banks were live on the Pan-African Payment and Settlement System.

2.3.4.2. Other bottlenecks

Additional bottlenecks that could affect the growth and advancement of fintech firms include:

- **Localization requirements.** Local hosting requirements by regulators due to supervisory oversight, data privacy and national security concerns often increase capital spending costs related to hosting hardware, software and related infrastructure, as well as maintenance costs. Yet, using cloud services is associated with several benefits, including lower costs for end-users, which could advance financial inclusion.
- **Taxation.** Introducing new tax regimes (table 7) targeting mobile money services has raised transaction costs, making them less affordable. This may also discourage investment in the sector (GSMA, 2023b).

Table 7. Mobile money taxation policies in African countries, 2013–2022

Year	Country	Tax value/rate
2013	Uganda	10% of transaction fee
2015	Côte d'Ivoire	18% of transaction fee
2018	Zimbabwe	2% of value transferred
	Kenya	12% of transaction fee
	Uganda	0.5% of value withdrawn
2019	Congo	1% of transaction value
	Democratic Republic of the Congo	3% of total revenue
	Côte d'Ivoire	2% of total revenue
2021	Côte d'Ivoire	18% of transaction fee
	United Republic of Tanzania	10–2,000 Tanzanian shillings (based on transaction value), as of 1 October 2022
2022	Cameroon	0.2% of transaction value
	Ghana	1.5% of transactions over 100 Ghanaian cedi ($13)
	Benin	5% of mobile financial transaction revenue, with a minimum tax base per transaction category

Source: GSMA (2023b).

31. For more information, see https://papss.com/.

2.4. Digital platforms

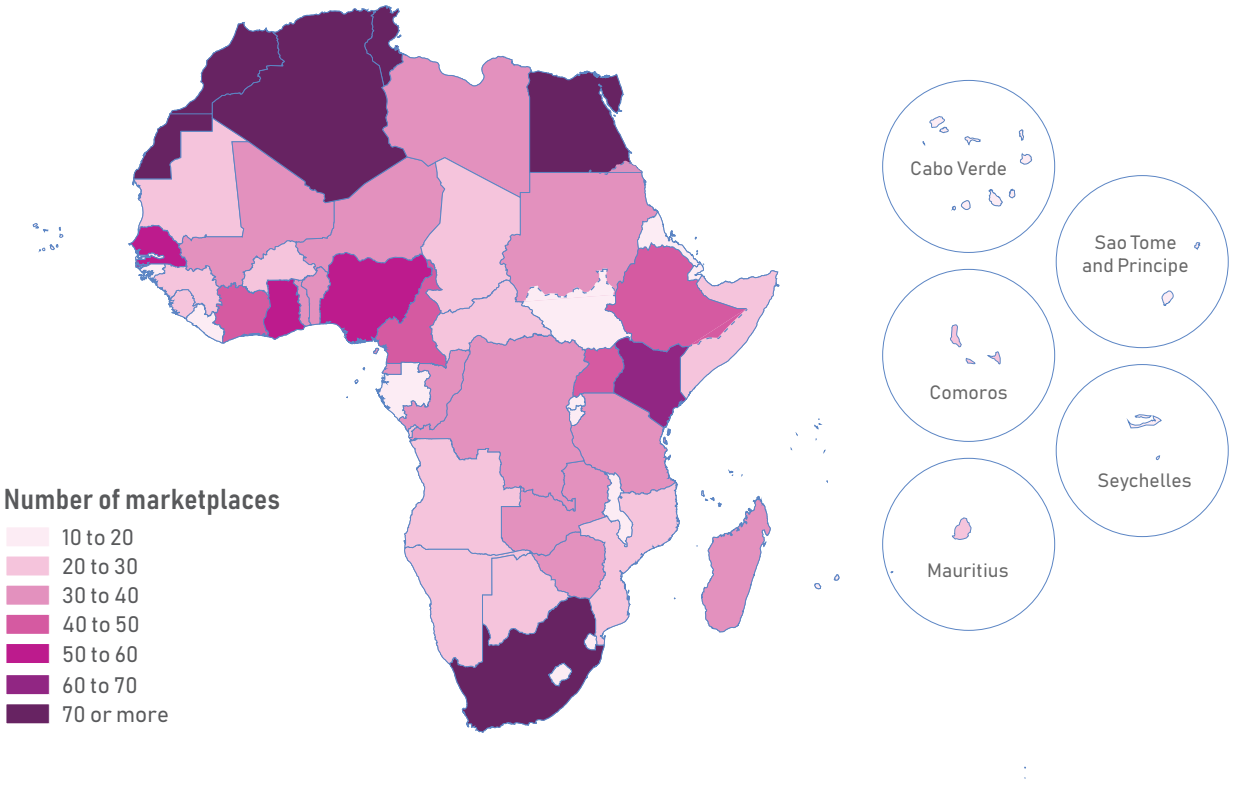
Digital platforms are an essential element of digital infrastructure because they facilitate access to goods and services that are offered online by the government or private sector and delivered digitally or physically. More importantly, the data extracted from these platforms can improve a firm's competitive advantage by providing valuable insights on consumer behaviour that can be used to innovate and offer new, better and more customized products and services.

Due to the dearth of data on digital platforms, especially service-oriented platforms, in Africa, the scope of this section is limited to business-to-consumer digital trade platforms for physical goods (commonly known as online marketplaces), e-government platforms used to provide government services and trade facilitation portals.

2.4.1. Online marketplaces

Every African country has at least one online marketplace, but the number of marketplaces per country varies widely (figure 13). Algeria, Egypt, Morocco, South Africa and Tunisia each have 70 or more online marketplaces —nearly five times the number in Eritrea, Sao Tome and Principe, and South Sudan— which accounted for about 80% of total marketplace traffic in Africa in 2020 (ITC, 2021).

Figure 13. Number of online marketplaces in Africa, by country, 2020



Source: Based on data from ITC (2021).
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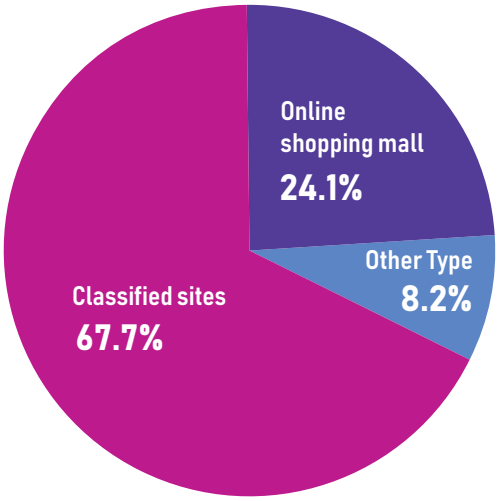
Two-thirds of the online marketplaces in Africa are classified sites where goods are advertised online but paid on delivery (figure 14).[32] Of the 50 online marketplaces in Africa with the most traffic in 2019, 35 were classified sites (see annex 2). In general, classified sites link potential buyers and sellers of products, but transactions are not made through the platforms. Potential buyers often have to contact the seller to arrange for payment and delivery of goods due to the absence of integrated payment solutions and other services. Transactional marketplaces, which integrate payments and other services, account for less than a third of online marketplaces in Africa.

Figure 14. Online marketplaces in Africa, by type, 2019



Source: Based on data from ITC (2020).

Global digital platforms[33] dominate digital trade worldwide. The picture is different in Africa, because most of the leading online marketplaces operate at the national level (figure 15; see also annex 2), though some may have been acquired by global firms. This likely curtails cross-border digital trade. The AfCFTA Protocol on Digital Trade should promote African-owned platforms at the national, regional and continental levels, as directed by the African Union Assembly of Heads of States and Government. Regional economic communities are also promoting regional marketplaces.

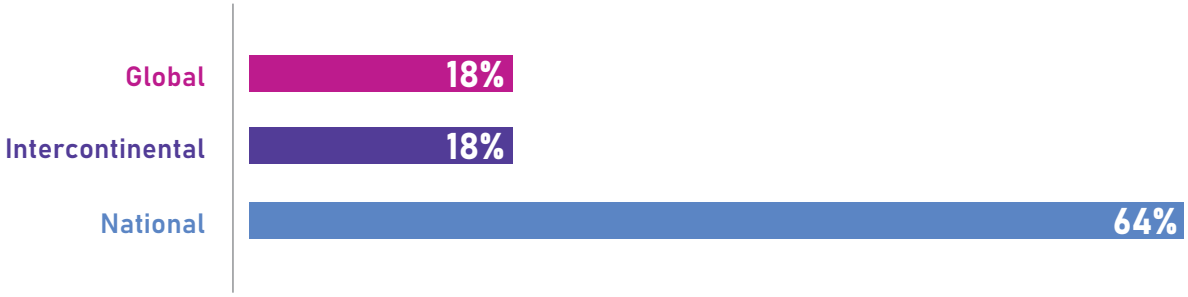
There are on-going efforts to promote cross-border digital trade. The COMESA Digital Free Trade Area and the EAC Regional E-Commerce Strategy aim to position regional platforms for cross-border transactions. In 2021, the COMESA Federation of Women in Business and the AE Trade Group launched the online platform Sokokuu for traders in the region (COMESA, 2021). The African Export–Import Bank, the AfCFTA Secretariat and ECA have developed the African Trade Exchange (ATEX), a business-to-business and business-to-government platform to facilitate intra-Africa trade. In response to Africa's acute food crisis, the exchange was

32. Although in some quarters, classified sites are not considered part of digital trade, they give a clear indication of the sites used to access goods online.

33. For example, Alibaba, Amazon, Apple, Google, Meta, Microsoft and Tencent.

repurposed to enable bulk procurement of basic commodities to ensure countries' access to scarce supplies in a transparent manner.

Figure 15. Geographic scope of the 50 online marketplaces in Africa with the most traffic, 2019

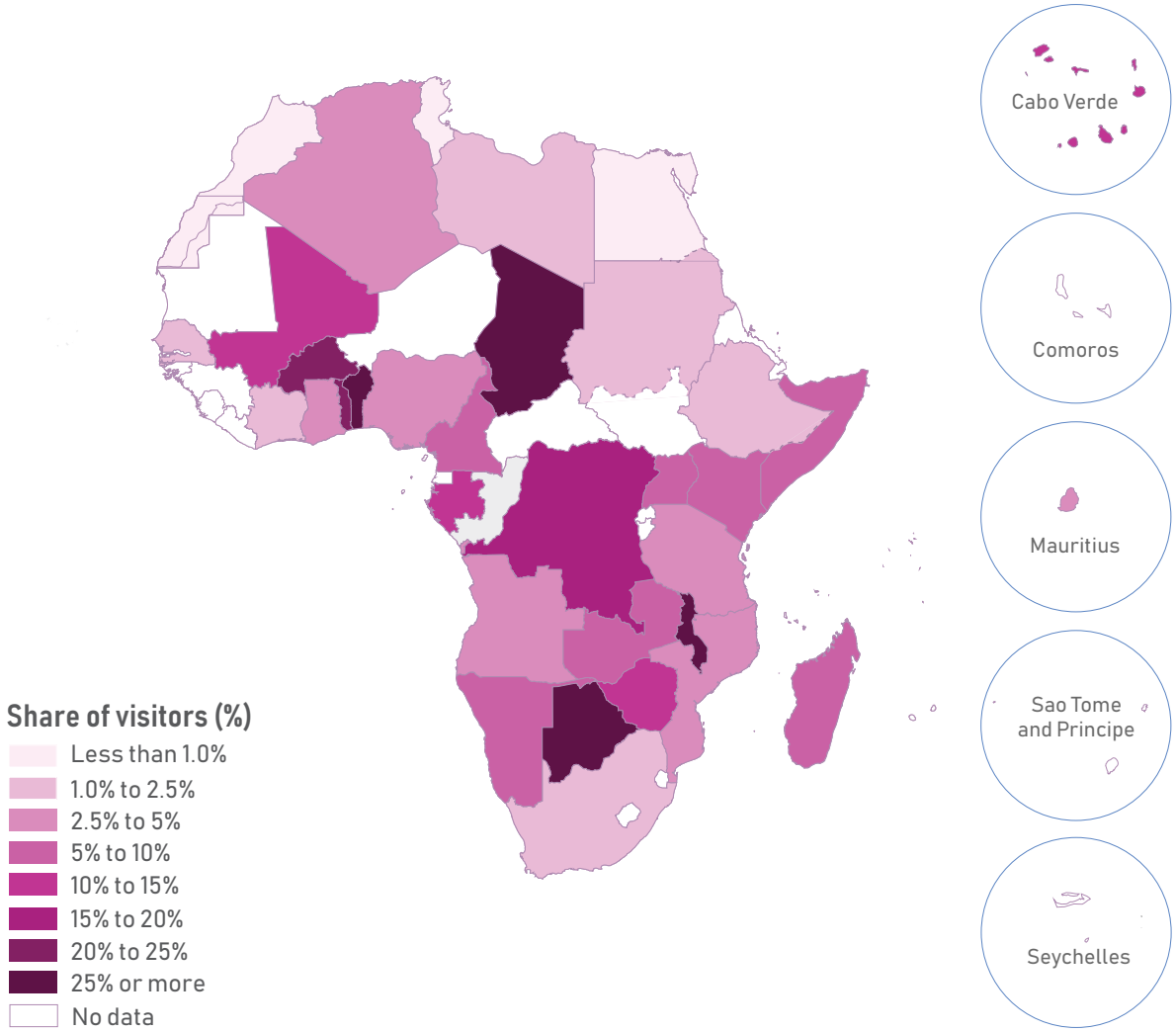


Source: Based on data from ITC (2020).
Note: National refers to marketplaces operating in one country. Intracontinental refers to marketplaces operating in more than one country in Africa. Global refers to marketplaces operating in more than one country on multiple continents.

In line with the fact that most of the online marketplaces in Africa operate at the national level, the users of these platforms (both sellers and buyers) are drawn largely from domestic markets—even in the countries with the highest marketplace traffic, such as South Africa. The share of foreign visitors to most online marketplaces in Africa is less than 10% (figure 16). Some countries require a local address or a country-specific phone number, limiting foreign sellers' participation in online marketplaces. Thus in 2019, about 57% of the marketplaces in Africa allowed only domestic sellers (ITC, 2021).

Promoting intra-Africa trade in the AfCFTA requires ensuring that national online marketplaces can scale up to operate at the intraregional or continental level and are open to sellers and buyers from other African countries. Capacity building is also needed to make sellers, buyers and other stakeholders aware of the benefits of cross-border digital trade.

Figure 16. Visitors to online marketplaces from other African countries, 2019



Source: Based on data from ITC (2021).
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

Several benefits can be derived from owning an online marketplace platform. Chief among them is the ability to collect, process and convert data into digital intelligence that can be used to increase a firm's competitive advantage. Despite these benefits, about 87% of the online marketplaces in Africa are owned by third parties or intermediaries (ITC, 2020). These intermediaries help businesses that engage in digital trade in Africa (especially micro, small and medium enterprises) obtain greater market access while overcoming obstacles such as lack of capital required to develop and run the platforms.

2.4.2. E-government platforms

E-government platforms are associated with efficient and effective delivery of government services, in addition to greater civic engagement and accountability. African governments are adopting e-government mechanisms to enhance access to and delivery of services for citizens and within government departments.

The E-Government Development Index assesses e-government development across three dimensions: scope and quality of online services, status of telecommunication infrastructure and inherent human capital. It shows that e-government development is uneven across Africa (see annex 3). South Africa leads in e-government development, followed by Mauritius and Seychelles. These three countries have long-term digital government strategies aligned with their national policies and the Sustainable Development Goals (UNDESA, 2022).

Of the three E-Government Development Index dimensions, status of telecommunication infrastructure is the main constraint to e-government development: only 8 of 54 African countries have values above .5 (on a scale of 0 to 1) (see annex 3). This points to the need for African countries to address digital infrastructure deficits to boost the ability of governments and citizens to use e-government platforms.

Rwanda, South Africa and Kenya lead in scope and quality of online services (see annex 3). Public institutions in Rwanda offer 98 services online—far above the African average of 12 (UNDESA, 2022). Both Rwanda and Kenya have implemented one-stop e-government platforms that allow the public to access various services online through a single portal. However, use of services from these platforms remains low, particularly among people who do not own a mobile phone, do not use the internet or lack digital skills (World Bank, 2019).

2.4.3. Trade facilitation portals

Trade facilitation portals provide online step by step descriptions of import, export and transit procedures from the trader's point of view. They are a key tool for transparency, the cornerstone of all the Trade Facilitation Agreement provisions. For traders, they gives a detailed picture of what needs to be done to comply with national regulations, while for policymakers, they help in identification of unnecessary redundancies and administrative bottlenecks.

Benin, Burundi, Kenya, Mali, Nigeria, Rwanda, United Republic of Tanzania and Uganda are among the countries that have implemented national trade facilitation portals under the auspices of national trade facilitation committees, which benefit from a shared vision of trade procedures between public institutions and the private sector.

Examples of continental and regional portals developed to aid trade activities among African countries include:

- **African Union Commission Digital Trade and Investment Portal.** Developed to facilitate engagement among businesses within and outside Africa, this digital trade and investment portal was created primarily to serve international exporters, importers, manufacturers, traders, services providers and merchants looking to establish contacts with their business counterparts in Africa.
- **AfCFTA Portal.** The official portal of the AfCFTA, it serves as a platform for businesses to access information on tariffs, rules of origin, trade regulations and market opportunities within the AfCFTA framework.
- **African Export–Import Bank's African Trade Portal.** An online platform to promote and facilitate intra-Africa trade, it provides information on trade opportunities, market intelligence, trade finance solutions and access to a network of African businesses.

- **Tradeforum Africa.** An online business-to-business marketplace connecting African exporters with international buyers, it offers a platform for businesses to showcase products, negotiate trade deals and expand their market reach.
- **Export Portal.** A global business-to-business e-commerce platform enabling businesses to engage in international trade. It provides a secure and transparent marketplace for buyers and sellers from various countries, including African nations, to conduct trade transactions.

2.5. Delivery-related (logistics) infrastructure

Reliable and efficient delivery-related (logistics) infrastructure is vital for digital trade. Logistics infrastructure is a key variable (proxied by postal reliability) in the United Nations Conference on Trade and Development (UNCTAD) Business-to-Consumer E-Commerce Index, which measures a country's preparedness to support online shopping. Delivery-related infrastructure facilitates movement of goods ordered online within national borders and across countries, so it is a prerequisite for the growth of digital trade in the AfCFTA.

2.5.1. Logistics Performance Index

The World Bank's Logistics Performance Index provides a multidimensional assessment of a country's logistics landscape based on six indicators:

I. Customs: efficiency of the customs clearance process.

II. Infrastructure: quality of trade and transport-related infrastructure.

III. International shipments: ease of arranging competitively priced shipments.

IV. Logistics quality: competence and quality of logistics services.

V. Tracking and tracing: ability to track and trace consignments.

VI. Timeliness: frequency with which shipments reach the consignee within the scheduled or expected timeframe.[34]

Only Côte d'Ivoire, Rwanda and South Africa have overall Logistics Performance Index scores above the world average of 2.87 (on a scale of 1, low, to 5, high) (table 8). This shows that poor logistics infrastructure remains a challenge for enterprises engaging in cross-border digital trade across Africa. A cursory look at the indicators contributing to the overall score reveals that most African countries perform well in terms of timeliness, but customs and infrastructure are the main bottlenecks affecting the African logistics ecosystem.

Implementing the activities and programmes in the priority clusters such as trade facilitation and trade-related infrastructure identified in the Boosting Intra-African Trade Action Plan will go a long way in minimizing these bottlenecks. Best practices that promote efficient custom processes could be scaled up to the continental level. Case in point is the single window systems in some countries and regions that have simplified and expedited the export process (box 3).

34. The Logistics Performance Index is based on a worldwide survey of operators on the ground (global freight forwarders and express carriers), providing feedback on the logistics "friendliness" of the countries in which they operate and those with which they trade.

Table 8. Logistics Performance Index scores for select African countries, 2018

Country	Overall score	Customs score	Infrastructure score	International shipments score	Logistics quality and competence score	Tracking and tracing score	Timeliness score
South Africa	3.38	3.17	3.19	3.51	3.19	3.41	3.74
Côte d'Ivoire	3.08	2.78	2.89	3.21	3.23	3.14	3.23
Rwanda	2.97	2.67	2.76	3.39	2.85	2.75	3.35
Egypt	2.82	2.60	2.82	2.79	2.82	2.72	3.19
Kenya	2.81	2.65	2.55	2.62	2.81	3.07	3.18
Benin	2.75	2.56	2.50	2.73	2.50	2.75	3.42
Mauritius	2.73	2.71	2.80	2.12	2.86	3.00	3.00
Sao Tome and Principe	2.65	2.71	2.33	2.42	2.65	2.78	3.01
Djibouti	2.63	2.35	2.79	2.45	2.25	2.85	3.15
Burkina Faso	2.62	2.41	2.43	2.92	2.46	2.40	3.04
Cameroon	2.60	2.46	2.57	2.87	2.60	2.47	2.57
Mali	2.59	2.15	2.30	2.70	2.45	3.08	2.83
Malawi	2.59	2.43	2.18	2.55	2.68	2.67	2.98
Uganda	2.58	2.61	2.19	2.76	2.50	2.41	2.90
Tunisia	2.57	2.38	2.10	2.50	2.30	2.86	3.24
Ghana	2.57	2.45	2.44	2.53	2.51	2.57	2.87
Comoros	2.56	2.63	2.25	2.49	2.21	2.93	2.80
Morocco	2.54	2.33	2.43	2.58	2.49	2.51	2.88
Nigeria	2.53	1.97	2.56	2.52	2.40	2.68	3.07
Zambia	2.53	2.18	2.30	3.05	2.48	1.98	3.05
Congo	2.49	2.27	2.07	2.87	2.28	2.38	2.95
Algeria	2.45	2.13	2.42	2.39	2.39	2.60	2.76
Togo	2.45	2.31	2.23	2.52	2.25	2.45	2.88
Democratic Republic of the Congo	2.43	2.37	2.12	2.37	2.49	2.51	2.69
Sudan	2.43	2.14	2.18	2.58	2.51	2.51	2.62
Chad	2.42	2.15	2.37	2.37	2.62	2.37	2.62
Gambia	2.40	2.08	1.82	2.71	2.21	2.81	2.71
Madagascar	2.39	2.32	2.16	2.19	2.33	2.61	2.73
Guinea-Bissau	2.39	2.01	1.78	2.53	2.28	2.78	2.86
Mauritania	2.33	2.20	2.26	2.19	2.19	2.47	2.68
Equatorial Guinea	2.32	1.91	1.88	2.88	2.25	2.13	2.75
Lesotho	2.28	2.36	1.96	2.21	2.03	2.37	2.70
Senegal	2.25	2.17	2.22	2.36	2.11	2.11	2.52
Liberia	2.23	1.91	1.91	2.08	2.14	2.05	3.25
Somalia	2.21	2.00	1.81	2.61	2.30	2.23	2.20
Guinea	2.20	2.45	1.56	2.32	2.07	2.70	2.04
Gabon	2.16	1.96	2.09	2.10	2.07	2.07	2.67
Central African Republic	2.15	2.24	1.93	2.30	1.93	2.10	2.33
Zimbabwe	2.12	2.00	1.83	2.06	2.16	2.26	2.39

Country	Overall score	Customs score	Infrastructure score	International shipments score	Logistics quality and competence score	Tracking and tracing score	Timeliness score
Libya	2.11	1.95	2.25	1.99	2.05	1.64	2.77
Eritrea	2.09	2.13	1.86	2.09	2.17	2.17	2.08
Sierra Leone	2.08	1.82	1.82	2.18	2.00	2.27	2.34
Niger	2.07	1.77	2.00	2.00	2.10	2.22	2.33
Burundi	2.06	1.69	1.95	2.21	2.33	2.01	2.17
Angola	2.05	1.57	1.86	2.20	2.00	2.00	2.59

Source: World Bank (2023).
Note: Scores range from 1, low performance, to 5, high performance.

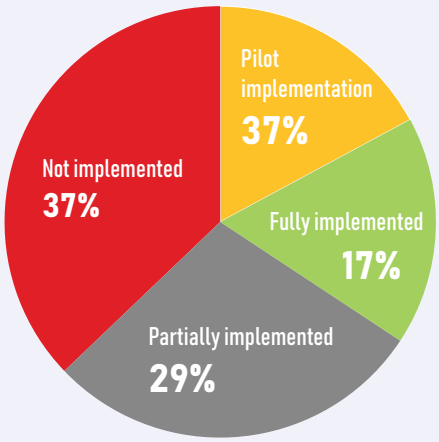
Box 3. Single-window systems

The African Alliance for Electronic Commerce defines a single window as "a national or regional system, mainly built around an information technology platform initiated by a government or ad hoc authority, to enable the facilitation of import, export and transit-related formalities, by providing a single point for lodging standardized information and documents, in order to meet all official demands and facilitate logistics." This definition is based on the commonly cited definition from United Nations Centre for Trade Facilitation and Electronic Business Recommendation No. 33, adopted in 2004, and the one adopted by the World Customs Organization (AAEC, 2017).

Benefits from single-window systems include simpler and more efficient information flows among relevant parties and reduced paperwork, compliance costs and trade facilitation time. These outcomes are likely to improve the logistical component of cross-border digital trade, which is particularly important for boosting intra-Africa trade under the African Continental Free Trade Area (AfCFTA).

Few African countries have an electronic single-window system (see figure below). The only countries with fully implemented systems from the surveyed sample are Burkina Faso, Côte d'Ivoire, Kenya, Morocco, Mozambique and Rwanda.

Stages of electronic single window implementation in Africa, 2021



Source: Based on data from UN Global Survey on Digital and Sustainable Trade Facilitation (2022).
Note: The analysis is based on 35 African countries.

Some regional economic communities have mechanisms to support single windows systems. In the East African Community, the Customs Union Protocol, Regional Customs Management Act and implementation of the Single Customs Territory have provided the legal and regulatory framework for a regional electronic customs data exchange to reduce the cost of intraregional trade flows among partner states (Burundi, Kenya, Rwanda, South Sudan, United Republic of Tanzania and Uganda). Likewise, the Common Market for Eastern and Southern Africa Secretariat is developing an electronic single-window system under its trade facilitation programme. In the context of the AfCFTA, issues related to electronic single-window systems are covered under Annex 4 of the Protocol on Trade in Goods (Annex on Trade Facilitation). Article 18 of Annex 4 states that State Parties should "endeavour to establish and maintain a single window, enabling traders to submit documentation and/or data requirements for importation, exportation, or transit of goods through a single-entry point to the participating national authorities." Establishing and maintaining single-window systems by State Parties would boost and facilitate intra-Africa digital trade.

2.5.2. Postal network

Postal networks have an integral role in trade logistics. The national postal infrastructure in most countries spreads across both urban and rural areas and is connected to the wider international postal network, making it an ideal system for delivering physical products that have been ordered online (UNCTAD, 2015).

The Universal Postal Union Integrated Index for Postal Development assesses postal development along four indicators:

I. Reliability: speed of delivery and predictability.

II. Reach: a country's postal connectivity with the rest of the world in terms of formal relationships and volume exchanged.

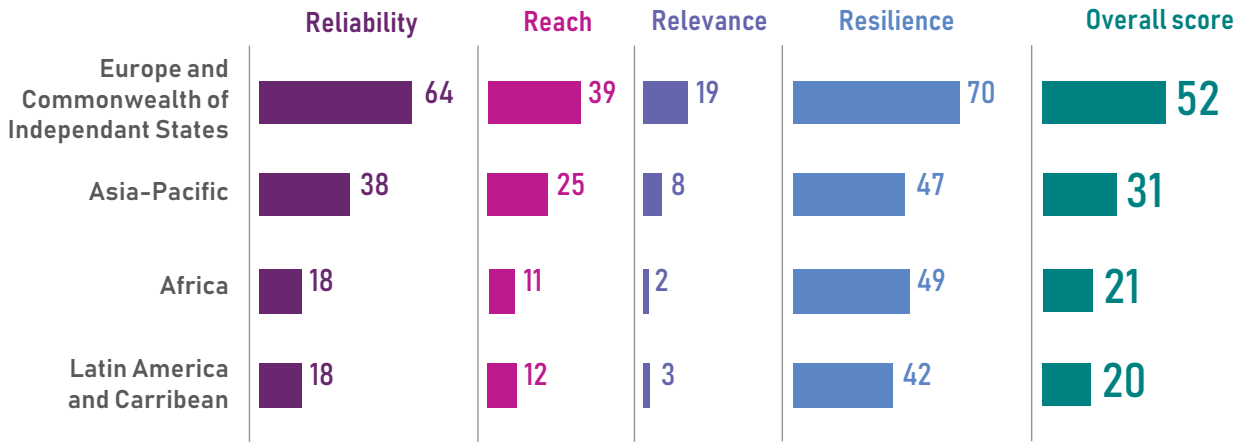
III. Relevance: intensity of demand for postal services in relation to the world's leading operators.

IV. Resilience: postal capacity to overcome economic, social, technology and environmental shocks in a sustainable way.

Africa ranks lower than other world regions on most indicators, especially relevance and reach (figure 17). This limits Africa's postal network's attractiveness as a viable means of delivery, especially in cross-border digital trade. Indeed, several alternative methods exist for parcel delivery. Larger businesses have developed their own distribution measures, but this option is out of reach for most of micro, small and medium enterprises. Courier companies and motorbikes are used for parcel delivery in most countries. As a result, the e-logistics platform market in Africa is growing considerably. Expanding digital infrastructure and increasing technology solutions are driving the implementation and use of e-logistics platforms (box 4). However, a cross-cutting issue affecting all these modes of physical delivery is poor addressing systems in most African countries. To counter this, buyers sometimes pick up their parcels at designated collection points.

While these alternative delivery options are needed for digital trade growth, they might not be scalable to achieve universal access —particularly for underserved communities. The imperative for national postal network infrastructure can thus not be overemphasized (UNCTAD, 2015). In line with this, a core objective of the Pan-African Postal Union is to make the postal sector an essential component of the digital economy and socioeconomic inclusion.

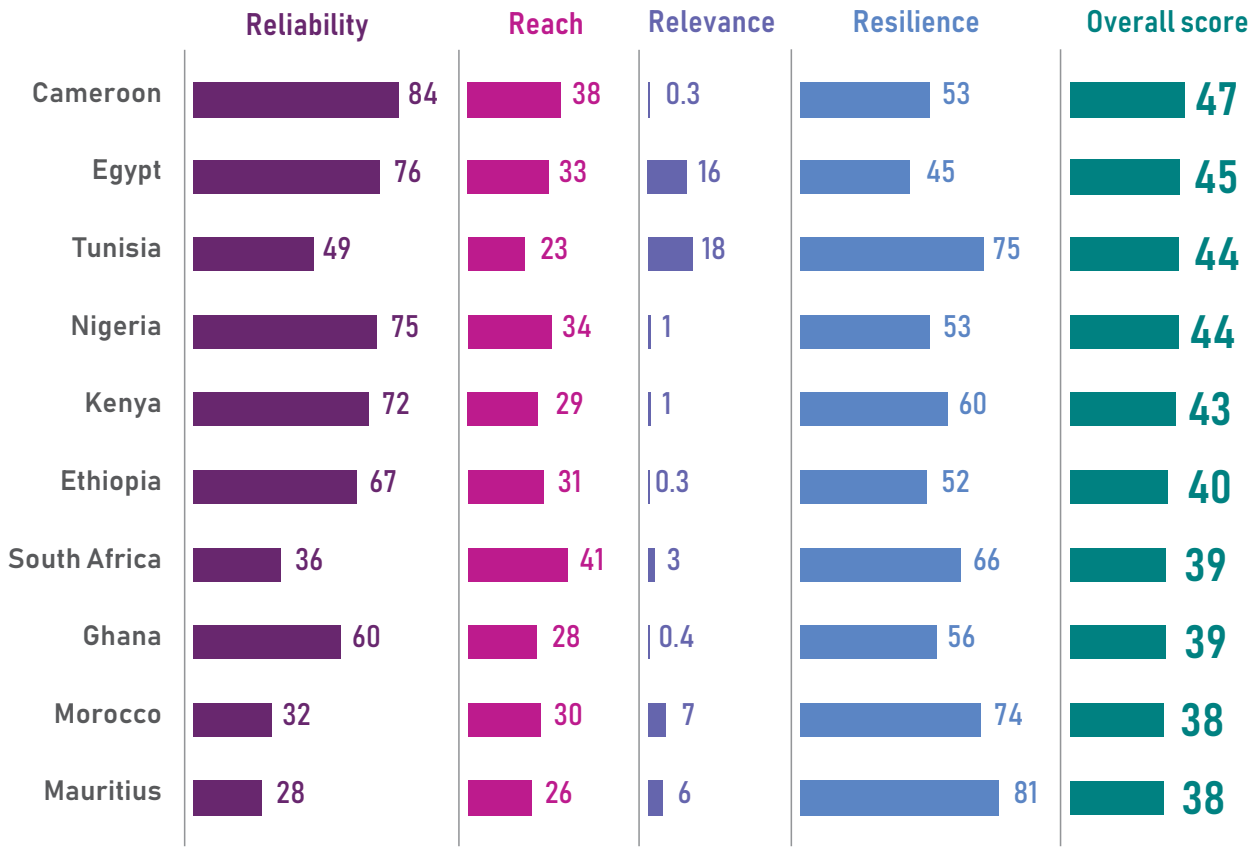
Figure 17. Universal Postal Union Integrated Index for Postal Development scores, by indicator and world region, 2021



Source: Based on data from UPU (2022).
Note: Scores range from 1, low, to 100, high.

Cameroon, Egypt, Tunisia, Nigeria and Kenya have the highest Integrated Index for Postal Development scores in Africa (figure 18) largely due to various initiatives that they have put in place. In July 2020, Egypt Post introduced a service that enables small and medium enterprises to ship products through its post offices and request payment on delivery, which can be received in a savings or current account in Egypt Post or on a prepaid electronic card, with notification by mobile text message once the money is deposited (Farouk, 2022). The Nigerian Postal Service adopted the what3words service to overcome poor addressing systems. Many streets in Nigeria are unnamed, and many house numbers on named streets are inconsistent or non-existent. What3words uses a three-word address system to describe a location. This has increased postal service efficiency, with average delivery times of 2 days for express mail, 3.6 days for letters and 4.4 days for parcels (Lemma et al., 2022).

Figure 18. Universal Postal Union Integrated Index for Postal Development scores for the 10 highest scoring African countries, by indicator, 2021



Source: Based on data from UPU (2022).
Note: Scores range from 1, low, to 100, high.

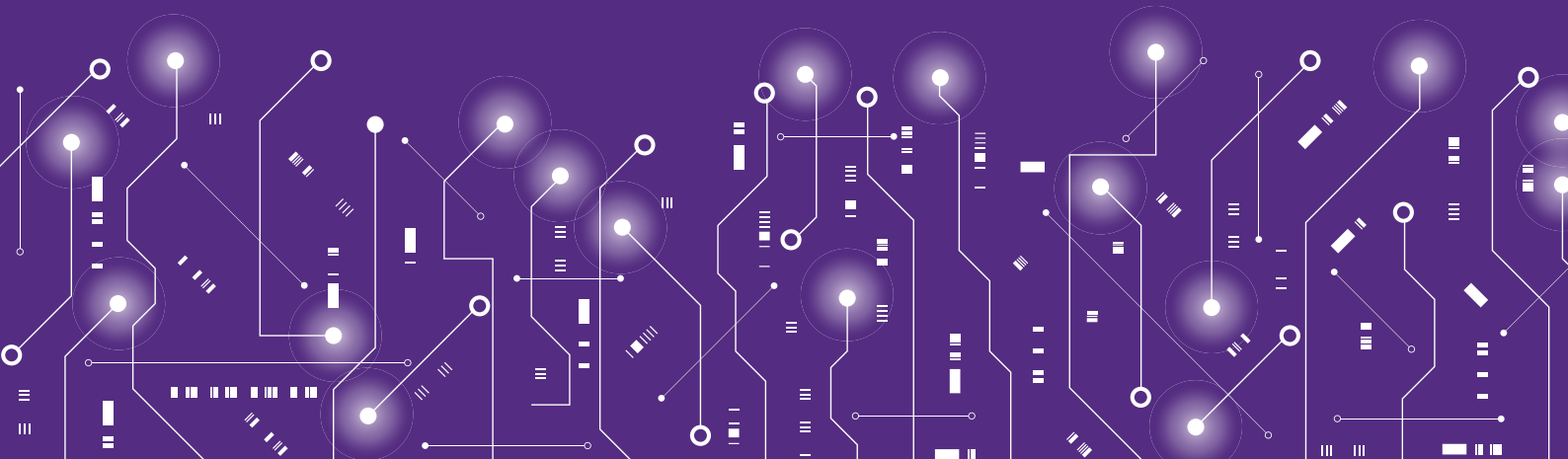
Box 4. Factors contributing to the current state of e-logistics platforms in Africa

Several factors contribute to the current state of e-logistics platforms in Africa:

- **Adoption by logistics service providers.** Logistics service providers, including freight forwarders, transport companies and third-party logistics providers, are recognizing the benefits of e-logistics platforms. They are investing in digital solutions to streamline their operations, enhance customer service and improve overall logistics efficiency.
- **Government support.** Governments across Africa are realizing the importance of efficient logistics operations for economic growth and trade facilitation. They are promoting e-logistics platforms through supportive policies, incentives and investment in infrastructure development. This support is driving the implementation of digital logistics solutions across the region.
- **Connectivity and technology infrastructure.** Reliable internet connectivity and technology infrastructure are crucial for successful e-logistics platforms. Africa has witnessed considerable improvements in this regard, with increased internet penetration and digital infrastructure, including fourth- and fifth-generation networks and data centres. These advancements provide the foundation for e-logistics platforms.
- **Collaboration and partnerships.** Collaboration among stakeholders, including logistics providers, technology companies, government agencies and trade facilitation organizations, is essential for e-logistics platforms. Public-private partnerships and industry collaborations are fostering innovation, knowledge sharing and integration of different logistics functions into a unified platform.
- **Focus on sustainability.** E-logistics platforms in Africa are addressing sustainability concerns by promoting environmentally friendly practices. By optimizing routes, e-logistics platforms reduce carbon emissions and enhance the sustainability of trade movements.

E-logistics platforms in Africa are still evolving. Despite all the progress, challenges such as infrastructure gaps, regulatory frameworks and data security concerns need to be addressed. Continued investment in digital infrastructure, capacity building and collaboration among stakeholders will further advance the e-logistics platform market in Africa and support efficient and sustainable trade movements.

3. REGULATORY AND LEGISLATIVE FACTORS AFFECTING AFRICA'S DIGITAL INFRASTRUCTURE



Regulatory frameworks play a key role in creating a conducive environment for digital infrastructure development and, by extension, digital trade. This section discusses the restrictiveness of African countries' legal and regulatory frameworks or the lack of strong and updated pro-digital policies combined with regulatory heterogeneity that hamper the development of Africa's nascent digital ecosystem. The analysis relies on the Regional Digital Trade Integration Index (RDTII)[35], which assesses the digital trade policy environment and various regulatory measures affecting digital trade integration, and the Digital Service Trade Restrictiveness Index (Digital STRI)[36], which captures cross-cutting impediments that affect all types of digitally traded services.[37]

3.1. The Regional Digital Trade Integration Index

The RDTII is a composite index comprising 12 pillars that is used to evaluate the digital trade regulatory environment (figure 19). The rationale behind the RDTII is that lower regulatory barriers for digital trade and higher network openness can foster digital trade integration.

Each RDTII pillar uses a number of indicators as proxies for the regulatory environment in a policy area (see figure 19). The score for each pillar is the weighted average of scores for the respective indicators. The index and indicator scores range from 0, enabling, to 1, restrictive, and are based on a review of existing policies and regulation. A score greater than 0 indicates at least one of the following conditions:

I. Differential treatment between domestic and foreign providers of ICT goods, digital goods or online services, despite being in the same or similar circumstances.

II. Additional regulatory compliance costs to services provided online, relative to those provided offline.

III. Absence of international norms—such as an international agreement, legislation or legal mechanism considered important for developing digital trade.

An assessment using data from 29 African countries suggests that the main restrictions to digital trade and digital trade integration in Africa are in:

- Measures governing internet intermediary liability (score of .47)
- Regulations related to domestic data policies and privacy (score of .45).
- Effective tariffs and trade defence measures applied on ICT goods imported from elsewhere in Africa (score of .43).

RDTII scores vary substantially across both pillars and countries (see annex 4). Yet, a heterogeneous regulatory environment may hamper the development and growth of the digital trade sector.

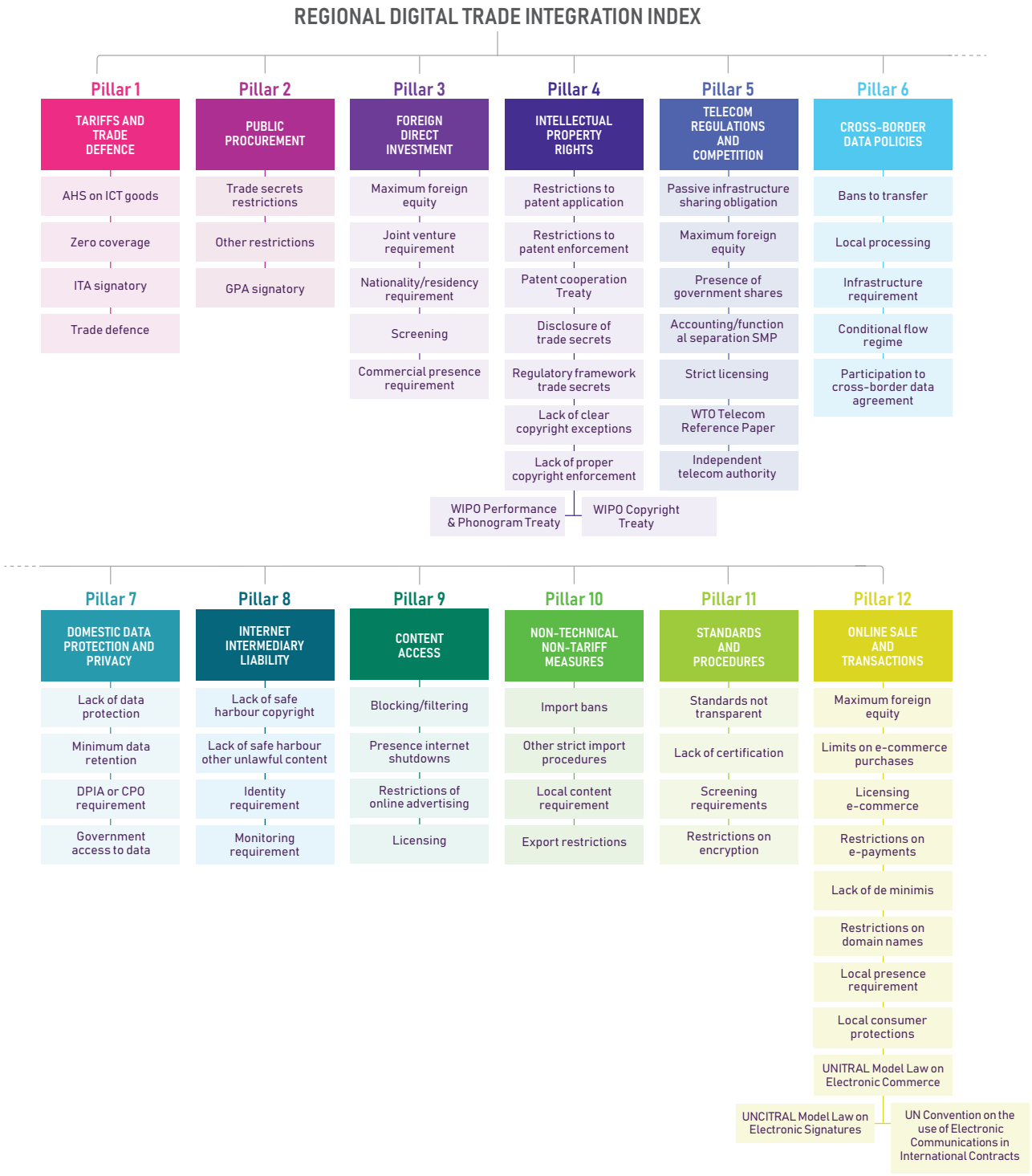
35. RDTII was created by ECA, the United Nations Economic and Social Commission for Asia and the Pacific and the United Nations Economic Commission for Latin America and the Caribbean, working closely with the European University Institute.

36. The Digital STRI was created by the Organisation for Economic Co-operation and Development using data collected by ECA for African countries (barring South Africa).

37. Since late 2020, as part of its Digital Trade Regulatory Integration project in Africa, ECA's African Trade Policy Centre has collected, compiled and analysed data on the digital regulatory environment in Africa. Thus far, 29 African countries have been covered: Botswana, Burundi, Cameroon, Chad, Congo, Democratic Republic of the Congo, Egypt, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Kenya, Madagascar, Malawi, Morocco, Mozambique, Namibia, Nigeria, Lesotho, Liberia, Rwanda, Senegal, Sierra Leone, United Republic of Tanzania, Togo, Uganda, Zambia and Zimbabwe). Work is ongoing in the remaining African countries. For more information, see https://dtri.uneca.org/eca/home#home.

The remainder of this section dives deeper into four RDTII pillars that directly or indirectly impact digital infrastructure.

Figure 19. Regional Digital Trade Integration Index pillars and indicators



Source: Authors' illustration.
Note: AHS is average of effectively applied tariffs. ICT is information and communication technology. ITA is Information Technology Agreement. GPA is Government Procurement Agreement. IPRs is intellectual property rights. WIPO is World Intellectual Property Organization. SMP is significant market power. WTO is World Trade Organization. DPIA is data protection impact assessment. DPO is data protection officer. UNCITRAL is United Nations Commission on International Trade Law.

3.1.1. Tariffs and trade defence (pillar 1)

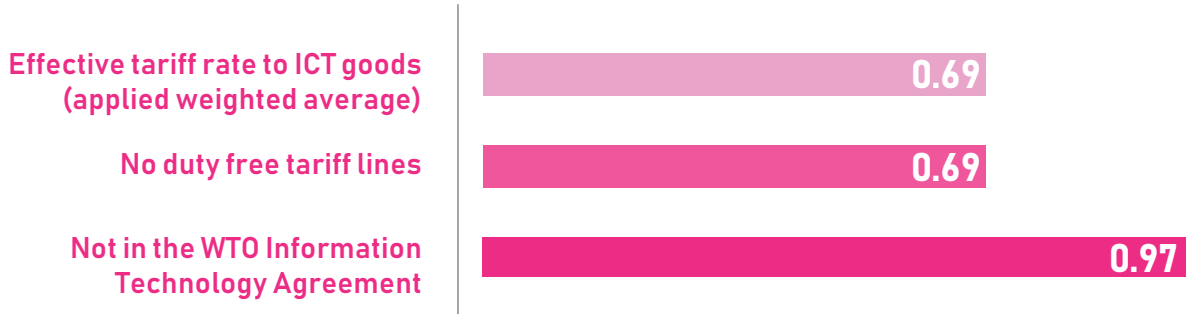
Tariffs on ICT goods likely slow the development of Africa's digital infrastructure ecosystem by making them less affordable (see section 2). Participating in the WTO Information Technology Agreements (the original 1996 agreement and its 2015 extension) is a close proxy for tariff measures on ICT goods. For a sample of 29 African countries, not participating in the agreements was the largest contributing factor to the restrictiveness of pillar 1 on tariffs and trade defence measures applied on ICT goods (figure 20). This is not surprising because only Egypt and Morocco are party to the original 1996 Information Technology Agreement.[38]

Pillar 1 also includes effectively applied tariffs on ICT goods imported from other African countries. The score of .69 suggests that these tariff rates are high (see figure 20), which is likely to limit intra-Africa imports of ICT equipment and reduce affordability of these products. Among the 29 sample countries, the most restrictive regimes in terms of applied tariff rates are Cameroon, Chad, Ethiopia, Gabon and Senegal, which each have an RDTII score of 1.00 (ECA, forthcoming).

Further, the score for coverage of no duty-free tariff lines on ICT goods is high (see figure 20). This suggests that most countries in the sample apply zero duties to a small percentage of tariff lines for ICT goods (less than 30% of tariff lines). Only 11 of 29 countries (Botswana, Burundi, Eswatini, Malawi, Mozambique, Namibia, Lesotho, Rwanda, United Republic of Tanzania, Uganda and Zambia) exempt duties on imports for at least 70% of tariff lines for ICT goods (ECA, forthcoming). To liberalize trade in ICT goods in the AfCFTA, countries should avoid including ICT goods under the excluded list of tariffs offers.

No African country imposes trade defence measures in the form of anti-dumping duties, countervailing duties or safeguard measures on ICT goods.

Figure 20. Composition of the Regional Digital Trade Integration Index score for tariffs and trade defence in Africa (Pillar 1)



Source: Computations based on Digital Trade Restrictiveness Index data.
Note: Data are based on 29 countries, as of December 2022.

38. Although Mauritius and Seychelles have also ratified the Information Technology Agreement, they are not among the countries covered in the analysis.

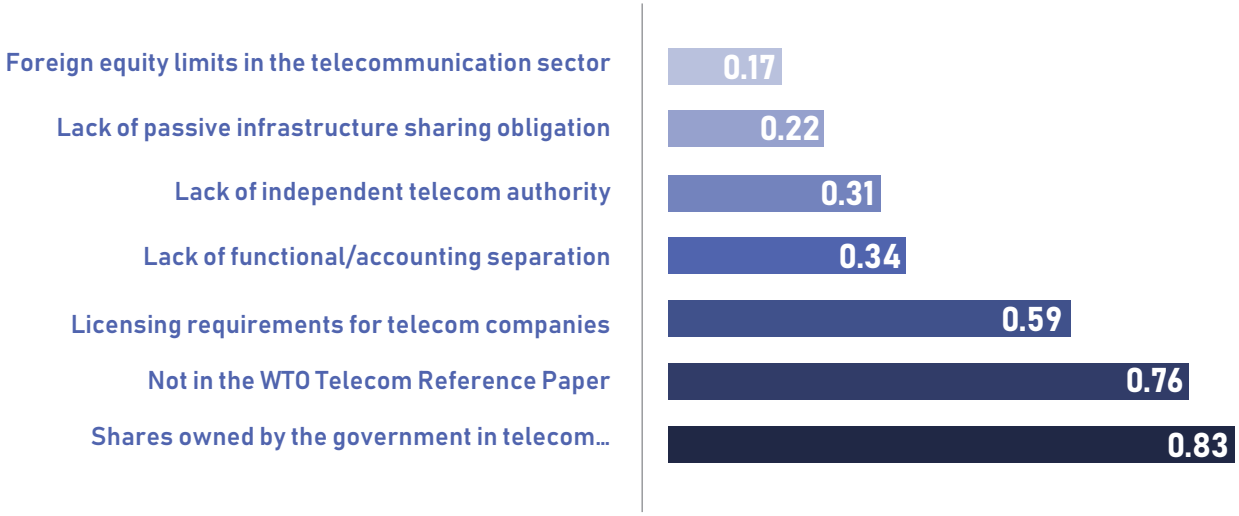
3.1.2. Telecom regulations and competition (pillar 5)

A favourable investment and competition landscape is likely to boost investment in Africa's telecommunications sector. Limited telecommunications liberalization, as proxied by shares owned by governments, countries not appending the WTO Telecom Reference Paper[39] to their own schedule of commitments under the WTO General Agreement on Trade in Services and strict licensing requirements undermine competition in the telecom sector (figure 21).

Despite the benefits of liberalizing the telecommunication sectors, the only countries whose governments do not hold shares in their telecommunications sector are Madagascar and Rwanda. The governments in 21 of the 29 sampled countries own more than 50% of shares of at least one telecommunication company (ECA, forthcoming). Only seven countries (Egypt, Ghana, Kenya, Liberia, Morocco, Senegal and Uganda) have appended the WTO Telecom Reference Paper to their own schedule of commitments under the WTO General Agreement on Trade in Services.

The low RDTII score for lack of passive infrastructure sharing[40] obligations (see figure 20) is attributable to the fact that, except for Ethiopia, Ghana, Kenya, Lesotho, Liberia, Nigeria and Sierra Leone, sampled countries have a mandatory regime for passive infrastructure sharing to promote a favourable investment and competition landscape in the telecommunication sector (ECA, forthcoming)

Figure 21. Composition of the Regional Digital Trade Integration Index score for telecom regulations and competition in Africa (Pillar 5)



Source: Computations based on Digital Trade Restrictiveness Index data.
Note: Data are based on 29 countries, as of December 2022.

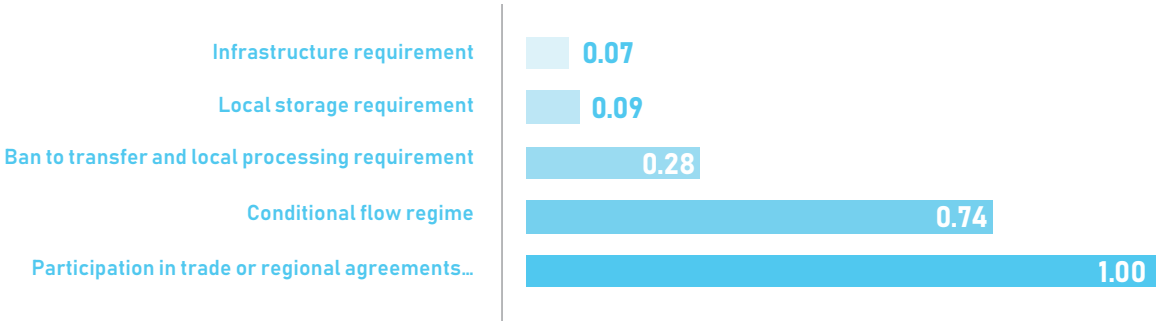
39. This is a set of regulatory principles that is legally binding only for WTO members that have committed to it by appending the document, in whole or in part, to their schedule of commitments. The Reference Paper provided a blueprint for telecommunications reform that largely reflected "best practice" in sector regulation at the time, when competition was being introduced, and in large part continues to do so today.

40. Passive infrastructure sharing is the process through which the passive elements of network infrastructure, such as mast, sites, cabinet, power and conditioning, are shared with other operators. An obligation in this regard can reduce the cost of network deployment, migration to new technologies and the deployment of mobile broadband, in addition to promoting competition between mobile operators and service providers (BEREC, 2018; ITU, 2008)

3.1.3. Cross-border data policies (pillar 6) and domestic data protection and privacy (pillar 7)

Cross-border data policies and domestic data protection and privacy point to data governance issues that could have an impact on investment in data-related infrastructure such as data centres in Africa. None of the sampled countries has joined a trade or regional agreement committing to open transfers of cross-border data flows (figure 22). Further, a conditional flow regime[41] on data seems prevalent, and few countries have specific regulations banning local processing requirements of personal or specific data.

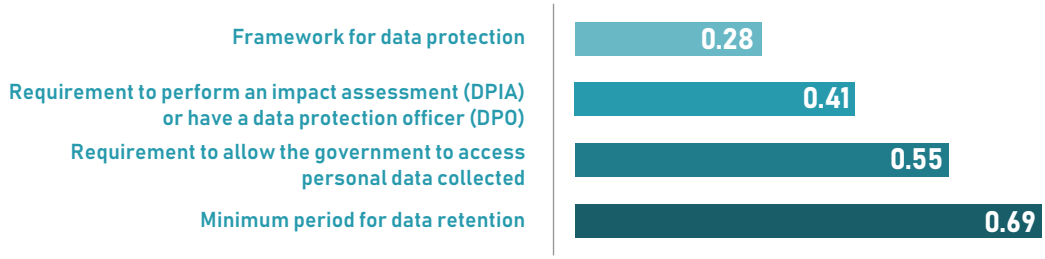
Figure 22. Composition of the Regional Digital Trade Integration Index score for cross-border data policies in Africa (Pillar 6)



Source: Computations based on Digital Trade Restrictiveness Index data.
Note: Data are based on 29 countries, as of December 2022.

Pillar 7 encompasses data protection and data privacy policies, which are essentially two sides of the same coin. Data protection refers to the responsibility of entities to apply safeguard mechanisms to the handling of data, whereas data privacy refers to individuals' right to retain control over how their personal data are collected and used (PECC and Access Partnership, 2021). The most restrictive policy under pillar 7 is the minimum data retention period (figure 23), which ranges from 180 days (Egypt for personal and traffic data) to 20 years (Botswana for banking data).

Figure 23. Composition of the Regional Digital Trade Integration Index score for domestic data protection and privacy in Africa (Pillar 7)

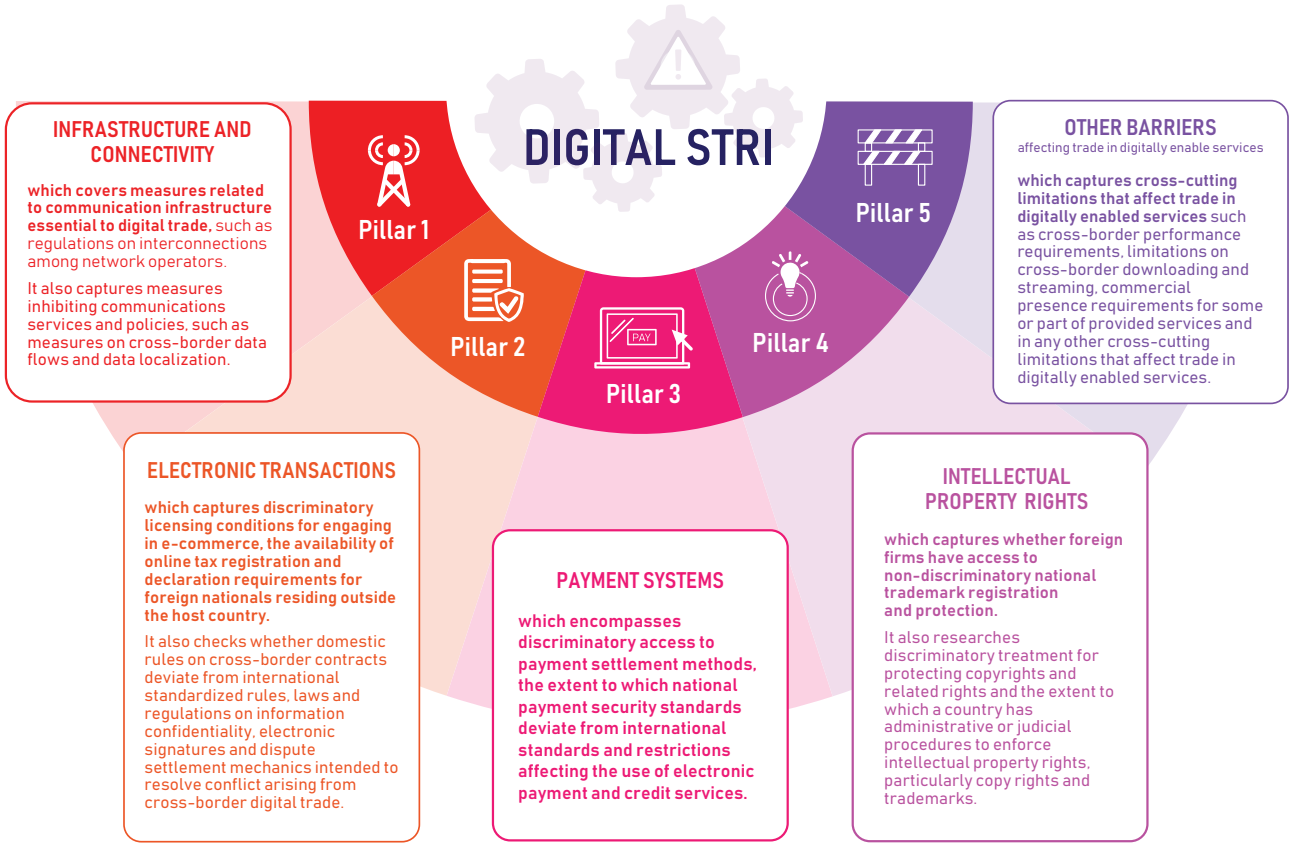


Source: Computations based on Digital Trade Restrictiveness Index data.
Note: Data are based on 29 countries, as of December 2022.

41. Data can be transferred based on the following principles: if the foreign country has enough protection of the privacy, freedoms and fundamental rights of individuals; if the adequacy of protection provided by the country of origin can be respected; if the transfer is not massive; and if the user has consented. Data can also be transferred to a foreign country that does not guarantee enough protection, subject to certain safeguards (such as consent of the data subject, necessity of transfer and the like).

3.2. Digital Services Trade Restrictiveness Index (Digital STRI)

The Digital STRI provides a glimpse of countries or regions whose legal frameworks are considered more restrictive to digital trade and digital services trade. It captures cross-cutting impediments that affect all types of services traded and are grouped under five pillars:



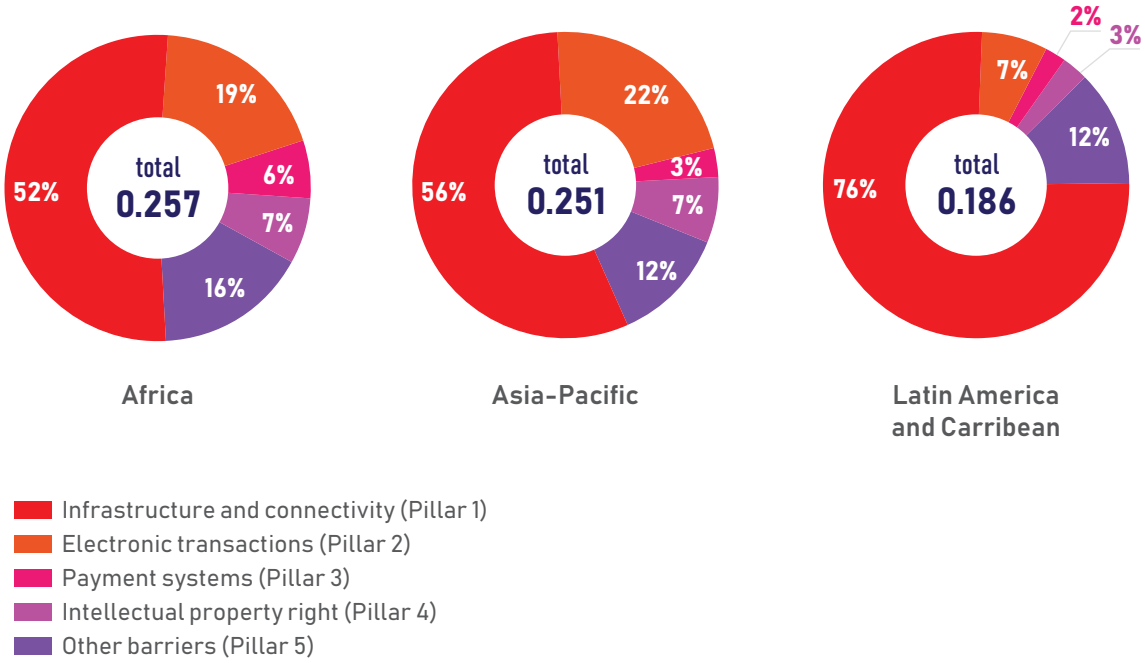
Digital STRI values range from 0, no restriction, to 1, restrictions in place.[42] Restrictions to digital services trade in Africa are relatively moderate, based on its score of .257—but higher than in Asia-Pacific, with a score of .251, and Latin America and the Caribbean, with a score of .186 (figure 24).

Infrastructure and connectivity are the dominant challenges to digital services trade in Africa, accounting for slightly more than half of all restrictions (see figure 24). Restrictions on cross-border data flows (from prohibiting data transfer abroad to lacking appropriate frameworks to protect transferred data) and restrictive conditions for communication services are the main drivers of the infrastructure and connectivity restrictions in Africa. Regulations related to local or commercial presence requirements to provide cross-border services and to limitations on

42. Weights are subsequently assigned to the measures to reflect their relative importance in digital trade transactions. The weighting scheme used for calculating the Digital STRI relies on expert judgement.

online content or downloads and live streaming under the "other barriers" pillar account for 19% of overall restrictions. The policy area with the third highest number of restrictions is electronic transactions, which account for 16% of overall restrictions and are driven by the inability of non-resident foreign service providers to register or file their taxes online.

Figure 24. Main barriers to digital services trade per policy area, by world region, 2021



Source: OECD et al. (2021).

Box 5. Results of the econometric modelling analysis based on the Regional Digital Trade Integration Index and the Digital Service Trade Restrictiveness Index

A study by ECA (2023) examines the relation between the regulatory regime for digital trade imposed by African countries and digital trade flows using a gravity model and heterogeneity indices. This will aid in identifying policies that negatively affect digital trade and how regulatory harmonization across different policy areas could support digital trade in Africa. The econometric analysis is based on regulatory measures contained in the Digital Trade Integration database and its upcoming associated index, whose methodology was developed by the European University Institute based on data collected by ECA for 29 African economies.

The findings suggest that the regulatory environment correlates with Africa's digital trade flows, since restrictions applied by African countries are negatively associated with digital trade. Egypt, Nigeria and Ethiopia have the most restrictive policies, while Ghana, Morocco and Uganda impose the highest number of enabling policies. Democratic Republic of the Congo, Lesotho, Liberia and Madagascar have few restrictions but few enabling policies as well. The restrictiveness of policies matters more for digital trade than the number of restrictive policies. High restrictiveness is correlated with lower trade.

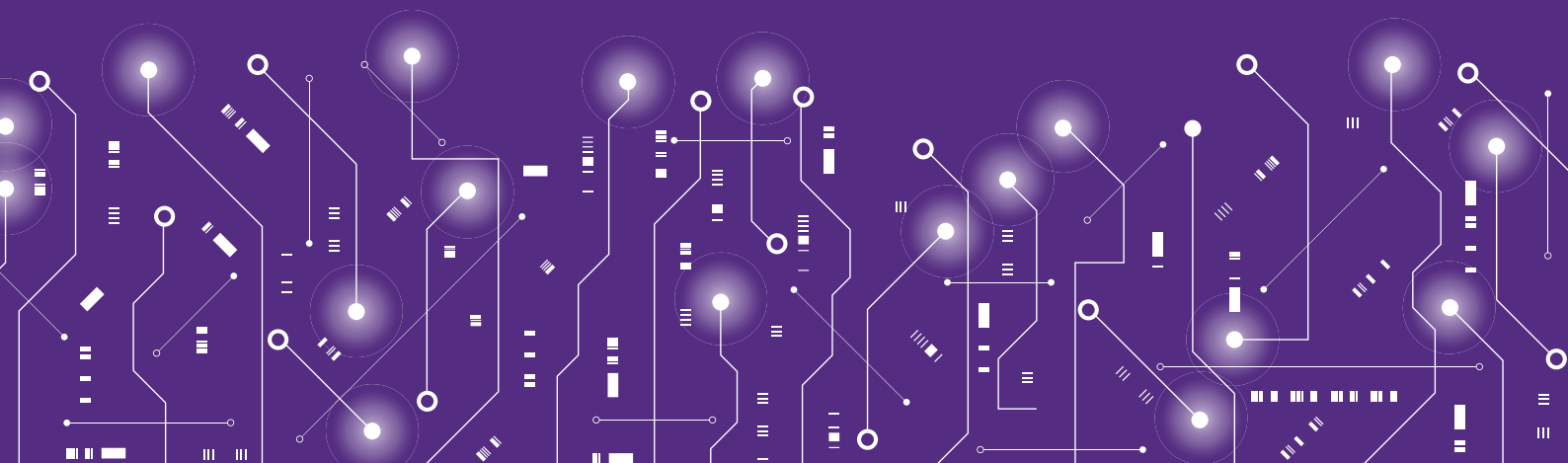
Moreover, substantial heterogeneity across countries is also associated with lower intraregional digital trade, and regulatory heterogeneity matters more when the regulatory environment for digital trade is less restrictive. In this sense, better regulatory harmonization in the region would have a stronger impact on digital trade. So, quantitative trade restrictions, public procurement, cross-border data restrictions, and tariffs and trade defence measures—which are the least heterogenous across countries—are key policy areas to reform. Intermediary liability policies and domestic data regulation are the most heterogenous and restrictive regulations.

Heterogeneity in the pillars on public procurement, foreign direct investment, intellectual property rights and quantitative trade restrictions has a high and significant negative correlation with digital trade in Africa. Heterogeneity in policies on telecom infrastructure and cross-border data polices, intellectual property rights, restrictions on online advertising and performance requirements has a statistically significant correlation with intraregional trade in digital-enabled services.

At the country level, Egypt, Ethiopia, Nigeria, Morocco, Rwanda and Senegal have the highest heterogeneity, as well as a restrictive regulatory environment. In contrast, Botswana, Chad, Eswatini, Gambia, Malawi, Togo and Zambia have the highest regulatory similarity with other countries in Africa.

These findings from the econometric analyses suggests that regulatory harmonization efforts in the ongoing African Continental Free Trade Area negotiations of the Digital Trade Protocol are expected to stimulate intraregional digital trade flows.

4. CONCLUSIONS AND RECOMMENDATIONS



Africa lags behind most regions globally in the development and uptake of digital infrastructure, but regional data mask heterogeneity at the country level, as well as by rural-urban area and gender. While some countries have made much headway in developing their digital infrastructure, others are still struggling. Since digital infrastructure is inextricably linked to digital trade, distribution of the gains from digital trade is likely be uneven. To ensure that no one is left behind under the AfCFTA Agreement, the infrastructure gap across African countries must be closed.

Countries should double down on efforts to implement the policy recommendations and proposed actions outlined in existing regional and continental strategies and instruments. For instance, the Digital Transformation Strategy for Africa (2020–2030) provides recommendations to boost Africa's digital transformation and connectivity. They include actions to promote interconnectivity and infrastructure sharing, establish essential digital infrastructure such as cloud computing, create favourable regulatory environments, improve affordability of broadband and devices, invest in green ICT, implement policy reforms for the postal sector, enhance education curricula to align with digital skills and provide technology and internet access to schools (AU, 2020).

Concerted efforts should be directed to promoting the affordability of broadband services and devices. Countries should develop a pro-competitive environment through offering subsidies and tiered services, promoting fair and non-discriminatory access to essential facilities (such as the local loop or submarine cables) and facilitating the entry of new operators by liberalizing telecom licensing requirements and diversifying telecom company ownership (particularly where the sector is dominated by an incumbent operator). Countries should also fully exploit IXPs, which often improve the quality of internet services at an affordable cost; this can be achieved through enabling regulatory frameworks and competition among operators.

Countries that have yet to submit their Category C list under their AfCFTA tariff schedules should ensure that products related to internet infrastructure are not part of the excluded list of tariff offers. This is because import tariffs remain a considerable cost barrier to the ICT sector (and by extension digital trade).

This study findings further reveal how data centres and cloud centres that are domiciled in Africa are concentrated in a handful of countries and regions. This affects regulations on data localization. Some countries might be unable to meet data localization requirements because they lack the necessary infrastructure in their jurisdictions yet face a heavy financial burden to set up and run data centres and cloud centres. The importance of data —especially in the context of the ongoing Fourth Industrial Revolution— highlights the need to establish data centres and cloud computing infrastructure in Africa. This should go hand in hand with the relevant skills development.

At the same time, most business-to-consumer online marketplaces in Africa operate at the national level. Increased cross-border digital trade requires African-owned platforms at the national, regional and continental levels. An important first step is regulatory frameworks that favour establishing and operating cross-border digital trade platforms across Africa.

Generally, investment is needed at all levels of the education system, including primary and secondary schools, vocational training centres and universities, to boost digital literacy (especially among girls and women), as well as to build the pool of experts in Africa with the knowledge to develop, operate and maintain digital infrastructure. Bootcamps and innovation hubs can also be

leveraged to promote digital literacy and skills development. For instance, ECA has been organizing Connected African Girls Coding Camps, which have enabled more than 25,000 young women and girls across Africa to acquire skills in animation, web development, the internet of things, robotics and three-dimensional printing.

A multistakeholder approach should also be leveraged in developing digital infrastructure (for example, establishing data centres, which require hefty resources) in Africa. Moreover, AfCFTA State Parties and non–State Parties should create a conducive environment to attract private investment in digital infrastructure in their countries.

Existing best practices (in terms of regulatory frameworks and initiatives) already adopted at the national and regional levels that promote digital infrastructure development can be scaled up to the continental level, since the regional economic communities are expected to be the building blocks of the AfCFTA

5. ANNEX

Annex 1. Internet exchange points in Africa as of March 2023

Country	Internet exchange point name (year founded)	Participants	Country	Internet exchange point name (year founded)	Participants
Algeria	Algeria Internet Exchange	0	Mauritius	Mauritius Internet Exchange (2005)	10
Angola	AngolaIXP (2006)	21	Morocco	Casablanca Internet Exchange (2019)	3
	Ponto de Intercambio Internet Angola (2006)	0		Maroc Internet Exchange (2016)	0
	ANGONIX (2015)	21	Mozambique	Mozambique Internet Exchange (2002)	15
Benin	Benin IX (2013)	6	Namibia	Windhoek IXP (2014)	12
Botswana	Botswana Internet Exchange (2005)	14	Niger	Niger Internet Exchange	0
Burkina Faso	BFIX Ouagadougou (2015)	12	Nigeria	Internet Exchange Point—Lagos (2006)	61
	BFIX Bobo-Dioulasso (2021)	6		Ibadan Internet Exchange (2002)	0
Burundi	BurundiX Internet Exchange Point (2014)	0		Internet Exchange Point—Abuja (2012)	10
	Burundi Internet Exchange Point (2017)	8		Internet Exchange Point—Port Harcout	4
Cameroon	Douala IXP (2018)	7		West African Internet Exchange (2018)	26
Cameroon	Cameroon Internet Exchange Point (2014)	10		Internet Exchange Point of Nigeria—Kano	0
Cabo Verde	Assosiacao Cabo Verde Internet Exchange Point (2022)	6	Republic of Congo	Congo Brazzaville IX (2013)	4
Chad	N'Djamena Internet Exchange Point (Feb 2023)	16		CG-IX Pointre-Noire	0
Côte d'Ivoire	Cote d'Ivoire Internet Exchange Point (2006)	0	Rwanda	Rwanda Internet Exchange (2003)	9
	Cote d'Ivoire Internet Exchange Point (2013)	6	Senegal	Senegal IX (2017)	6

Source: Packet Clearing House (2023).

Country	Internet exchange point name (year founded)	Participants
Democratic Republic of the Congo	Kinshasa Internet Exchange (2012)	18
	Lubumbashi Internet Exchange (2019)	10
	Goma Internet Exchange (2021)	7
Djibouti	Djibouti Internet Exchange (2016)	18
Egypt	Cairo Internet Exchange (2002)	7
	Cairo Regional Internet Exchange (2002)	0
	Middle East Internet Exchange (2007)	10
	Egypt Internet Exchange	0
Eswatini	Swaziland Internet Exchange (2004)	0
	Mbabane Internet Exchange (2014)	0
Gabon	Gabon Internet Exchange (2014)	10
Gambia	Serrekunda Internet Exchange Point (2013)	7
Ghana	Ghana Internet Exchange (2005)	21
Guinea	IXP-GUINEE (2019)	11
Kenya	Kenya Internet Exchange Point (2001)	76
	AMS-IX East Africa (2010)	0
	Mombasa Internet Exchange Point (2016)	17
	Asteroid Mombasa (2018)	25
	LINX Nairobi	0
Lesotho	Lesotho Internet Exchange	0
	Lesotho Internet Exchange Point (2017)	8
Liberia	Liberia Internet Exchange Point (2015)	4
Madagascar	Madagascar Global Internet Exchange (2016)	9
Mali	Mali IXP (2018)	4
Mauritania	Mauritania IX	0
	RMIX	0
Seychelles	Seychelles Internet Exchange Point	0
Somalia	Somali Internet Exchange Point (2018)	6
South Africa	NAPAfrica Johannesburg (2012)	529
	NAPAfrica Cape Town (2012)	266
	Johannesburg Internet Exchange (1996)	126
	Cape Town Internet Exchange (2009)	73
	Durban Internet Exchange (2012)	77
	Hub	0
	Grahamstown Internet Exchange (2005)	0
	South African IXP	0
	NAPAfrican Durban (2014)	127
South Sudan	South Sudan IXP	0
Sudan	Sudan Internet Exchange Point (2011)	7
United Republic of Tanzania	TIX Tanzania—Dar es Salaam (2003)	42
	TIX Tanzania—Arusha (2006)	6
	Mwanza Internet Exchange Point (2016)	12
	Dodoma Internet Exchange Point (2018)	4
	Zanzibar Internet Exchange Point (2018)	3
Togo	Togo Internet Exchange Point (2017)	6
Tunisia	Tunisian Internet Exchange Point (2011)	5
	Enfidha Internet Exchange (2013)	2
Uganda	Uganda Internet Exchange (2003)	32
Zambia	Zambia Internet Exchange Point (2006)	13
Zimbabwe	Zimbabwe Internet Exchange (2001)	0
	Harare Internet Exchange (2017)	10

Annex 2. Characteristics of the top 50 marketplace platforms in Africa, by traffic, 2019

Rank	Platform name	Transactional or non-transactional[a]	Geographic scope[b]	Open for sellers in other countries?	Type of marketplace
1	Jumia	Transactional	Intracontinental	Yes	Online shopping mall
2	Ouedkniss	Non-transactional	National	Yes	Classified site
3	Gumtree	Non-transactional	Global	No	Classified site
4	Souq	Transactional	Global	No	Online shopping mall
5	OLX	Non-transactional	Global	No	Classified site
6	Takealot.com	Transactional	National	Yes	Deals site
7	JiJi	Non-transactional	Intracontinental	No	Classified site
8	Avito	Non-transactional	National	No	Classified site
9	Cars.co.za	Non-transactional	National	No	Classified site
10	Tayara	Non-transactional	National	No	Classified site
11	Autotrader.co.za	Non-transactional	National	No	Classified site
12	OpenSooq.com	Non-transactional	Global	No	Classified site
13	Makro South Africa	Transactional	National	No	Online shopping mall
14	Bidorbuy	Transactional	National	Yes	Online shopping mall
15	Konga.com	Transactional	National	No	Online shopping mall
16	Chaosads.com	Non-transactional	Global	No	Classified site
17	PriceCheck	Non-transactional	Intracontinental	No	Price comparison site
18	MoroccoAnnoces.com	Non-transactional	National	No	Classified site
19	Junkmail	Non-transactional	National	No	Classified site
20	Hatla2ee.com	Non-transactional	Global	No	Classified site
21	OneDayOnly Offers	Transactional	National	Unclear	Deals site
22	Locanto	Non-transactional	Global	Yes	Classified site
23	Zando	Transactional	National	Yes	Online shopping mall
24	Jumia Deals	Non-transactional	Intracontinental	No	Classified site
25	MOTEUR.ma	Non-transactional	National	No	Classified site
26	Tonaton.com	Transactional	National	No	Classified site
27	ContactCars	Non-transactional	National	No	Classified site
28	Cheki	Non-transactional	Intracontinental	No	Classified site
29	Loot	Transactional	National	No	Online shopping mall
30	Nile Motors	Non-transactional	National	Yes	Classified site
31	Kilimall	Transactional	Intracontinental	Yes	Online shopping mall
32	AutoMart	Non-transactional	National	No	Classified site
33	expat-dakar.com	Non-transactional	National	Yes	Classified site
34	Pricena	Non-transactional	Global	No	Price comparison site
35	automobile.tn	Non-transactional	National	No	Classified site
36	KiKUU	Transactional	Intracontinental	No	Online shopping mall
37	pigiame.co.ke	Non-transactional	National	No	Classified site
38	Carfind.co.za	Non-transactional	National	No	Classified site
39	Mekina.net	Non-transactional	National	No	Classified site

Rank	Platform name	Transactional or non-transactional[a]	Geographic scope[b]	Open for sellers in other countries?	Type of marketplace
40	ezega.com	Non-transactional	National	Yes	Classified site
41	Tunisie-annonce.com	Non-transactional	National	Yes	Classified site
42	Craigslist	Non-transactional	Global	Yes	Classified site
43	Naija Auto Co.	Non-transactional	National	No	Classified site
44	CoinAfrique	Non-transactional	Intracontinental	No	Classified site
45	BusinessGhana	Non-transactional	National	Yes	Classified site
46	Surf4cars	Non-transactional	National	No	Classified site
47	Masoko	Transactional	National	No	Online shopping mall
48	Afrimalin.com	Transactional	Intracontinental	No	Classified site
49	Vendo.ma	Non-transactional	National	No	Price comparison site
50	Modern Ghana	Non-transactional	National	Yes	Classified site

Source: Based on data from ITC (2020)
a. Transactional marketplaces offer integrated payment solutions, while non-transactional marketplaces do not.
b. National refers to marketplaces operating in one country. Intracontinental refers to marketplaces operating in more than one country in Africa. Global refers to marketplaces operating in more than one country on multiple continents.

Annex 3. Africa's E-Government Development Index values, 2022

Country	E-Government Index	Telecommunication Infrastructure Index	Online Service Index	Human Capital Index
Africa	**.41**	**.35**	**.37**	**.49**
South Africa	.74	.69	.75	.77
Mauritius	.72	.76	.63	.77
Seychelles	.68	.82	.44	.78
Tunisia	.65	.66	.60	.69
Morocco	.59	.67	.47	.64
Egypt	.59	.56	.57	.64
Ghana	.58	.59	.54	.62
Cabo Verde	.57	.55	.50	.65
Algeria	.56	.61	.37	.70
Kenya	.56	.43	.68	.56
Gabon	.55	.63	.36	.67
Botswana	.55	.68	.27	.69
Rwanda	.55	.32	.79	.53
Côte d'Ivoire	.55	.52	.55	.57
Namibia	.53	.51	.43	.65
Zambia	.50	.39	.44	.67
Zimbabwe	.47	.38	.38	.65
Nigeria	.45	.39	.53	.44
Cameroon	.45	.37	.39	.59
Eswatini	.45	.36	.32	.67
Senegal	.45	.50	.49	.35
Uganda	.44	.25	.52	.56
Lesotho	.44	.38	.35	.60
Benin	.43	.32	.52	.44
Togo	.42	.28	.43	.55
United Republic of Tanzania	.42	.27	.47	.51
Sao Tome and Principe	.41	.32	.24	.68
Angola	.38	.20	.47	.46
Congo	.37	.22	.32	.57
Guinea	.36	.34	.44	.30
Madagascar	.36	.18	.35	.54
Burkina Faso	.35	.39	.37	.28
Malawi	.34	.18	.36	.49
Mali	.34	.44	.37	.22
Libya	.34	.16	.10	.75
Burundi	.32	.14	.34	.48

Country	E-Government Index	Telecommunication Infrastructure Index	Online Service Index	Human Capital Index
Mauritania	.32	.46	.10	.39
Mozambique	.31	.15	.36	.43
Gambia	.31	.45	.15	.33
Democratic Republic of the Congo	.31	.15	.23	.54
Sudan	.30	.32	.21	.36
Liberia	.29	.11	.34	.42
Ethiopia	.29	.15	.37	.34
Djibouti	.28	.28	.22	.35
Comoros	.28	.33	.03	.47
Equatorial Guinea	.27	.14	.18	.50
Sierra Leone	.26	.26	.28	.25
Guinea-Bissau	.26	.35	.06	.36
Niger	.24	.14	.39	.19
Chad	.19	.12	.27	.18
Eritrea	.17	.08	–	.43
Central African Republic	.14	.08	.10	.24
Somalia	.13	.11	.29	–
South Sudan	.09	–	.05	.20

Source: UNDESA (2022).
Note: – means data are not available. The values in each index range from 0 to 1 and are grouped into 4 levels (very high values range from 0.75 to 1.00 inclusive, high values range from 0.50 to 0.7499 inclusive, middle values range from 0.25 to 0.4999 inclusive and low values range from 0.0 to 0.2499 inclusive).

Annex 4. Regional Digital Trade Integration Index score for African countries, by pillar, 2022

Country	Pillar 1	Pillar 2	Pillar 3	Pillar 4	Pillar 5	Pillar 6	Pillar 7	Pillar 8	Pillar 9	Pillar 10	Pillar 11	Pillar 12
Botswana	.08	.48	.28	.21	.35	.19	.45	.13	.00	.00	.20	.20
Togo	.40	.08	.34	.50	.34	.19	.55	.13	.17	.00	.10	.25
Mozambique	.08	.08	.42	.39	.50	.19	.32	.63	.21	.10	.10	.25
Lesotho	.08	.48	.45	.32	.21	.19	.09	.75	.00	.00	.00	.35
Eswatini	.08	.18	.24	.38	.35	.08	.45	.63	.58	.00	.00	.21
Cameroon	.80	.18	.04	.38	.49	.46	.45	.50	.25	.19	.40	.25
Madagascar	.55	.28	.07	.26	.21	.19	.09	.88	.00	.00	.20	.25
Chad	.80	.18	.07	.39	.41	.19	.23	.25	.79	.10	.10	.26
Uganda	.15	.08	.42	.14	.51	.19	.23	.50	.71	.21	.20	.13
Zambia	.11	.28	.07	.31	.21	.58	.55	.38	.63	.00	.10	.20
Ghana	.71	.28	.21	.19	.21	.19	.55	.13	.21	.00	.50	.16
Malawi	.16	.28	.24	.60	.28	.27	.68	.13	.00	.19	.50	.33
Namibia	.08	.18	.38	.60	.44	.08	.68	.00	.00	.00	.50	.23
Rwanda	.13	.28	.07	.32	.35	.69	.55	.25	.54	.10	.10	.16
Morocco	.16	.68	.41	.33	.15	.19	.32	.38	.83	.29	.40	.30
Liberia	.77	.58	.04	.31	.44	.13	.45	.63	.21	.00	.00	.33
Gambia	.44	.68	.04	.38	.35	.19	.68	.63	.21	.00	.20	.16
Democratic Republic of the Congo	.60	.18	.08	.71	.43	.08	.45	.75	.42	.00	.10	.24
Burundi	.12	.08	.00	.44	.56	.08	.45	1.00	.63	.10	.20	.35
Senegal	.80	.48	.04	.28	.28	.69	.32	.38	.33	.10	.70	.26
Congo	.78	.08	.38	.44	.35	.19	.09	.75	.17	.10	.80	.30
Kenya	.25	.58	.27	.44	.57	.58	.45	.75	.21	.10	.10	.19
United Republic of Tanzania	.12	.48	.24	.44	.35	.08	.91	.50	.63	.00	.50	.21
Zimbabwe	.77	.28	.27	.53	.49	.19	.45	.63	.71	.00	.20	.30
Gabon	.80	.18	.41	.50	.26	.56	.23	.75	.58	.10	.10	.31
Sierra Leone	.71	.58	.41	.51	.65	.58	.68	.25	.08	.00	.20	.18
Ethiopia	.80	.28	.47	.57	.65	.08	.68	.13	.58	.21	.50	.50
Nigeria	.74	.68	.34	.56	.43	.58	.55	.25	.54	.21	.70	.26
Egypt	.28	.28	.92	.63	.66	.69	.55	.75	.63	.79	.65	.54
Group average	.43	.32	.26	.42	.40	.30	.45	.47	.37	.10	.29	.26

Source: Based on Digital Trade Restrictiveness Index data.
Note: A higher score suggests more regulatory interventions that may increase the cost of regulatory digital trade integration. Pillar 1 is tariffs and trade defence, pillar 2 is public procurement, pillar 3 is foreign direct investment, pillar 4 is intellectual property rights, pillar 5 is telecom regulations and competition, pillar 6 is cross-border data policies, pillar 7 is domestic data protection and privacy, pillar 8 is internet intermediary liability, pillar 9 is content access, pillar 10 is non-technical non-tariff measures, pillar 11 is standards and procedures and pillar 12 is online sales and transactions.

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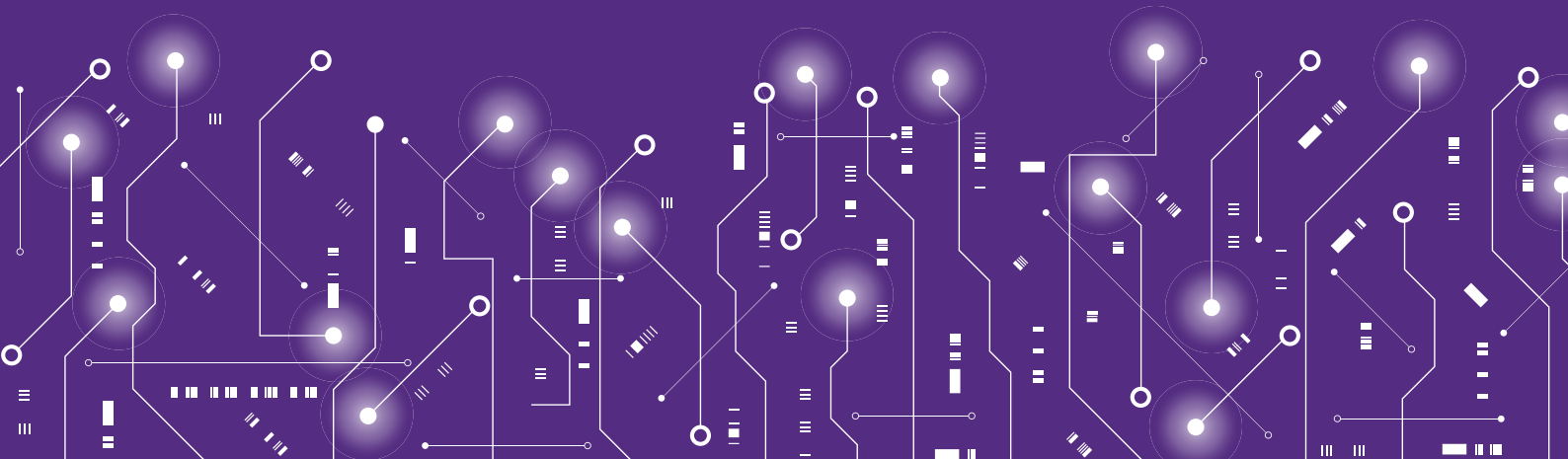

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