Towards improved access to broadband in Africa

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Executive summary

African countries are striving to create a digital economy to foster new drivers of economic and social transformation, innovation, governance, and regional integration. Progress on this score is critically dependent on infrastructure, notably broadband infrastructure, and access to it. Africa has enormous infrastructure gaps, including broadband infrastructure, and access to broadband services, where they exist, is also very expensive. Accordingly, building broadband infrastructure and making broadband services accessible and affordable have been major policy preoccupations of African Governments.

Broadband services are delivered using various technologies throughout the continent. The infrastructure used mostly to provide broadband includes asymmetric digital subscriber line technology over the copper access network, the 3G and 4G (recently being rolled out in many countries) mobile networks, Fibre to the Node networks and Fibre to the Premises networks. With landing of the submarine fibre optic cables, the terrestrial networks have been dominating and satellite broadband networks have been declining. With the extraordinary penetration of mobile on the continent and the limited availability, mobile broadband subscriptions have grown exponentially, leaving the fixed broadband penetration progressing very slowly.

The present report presents an analysis, based on secondary data and government documents, progress in Africa in building broadband infrastructure and in promoting access to it. The findings presented in this document are based on a detailed analysis of the data for the coverage of broadband customer access networks, along with their likely performance, given the known constraints. The analysis also uses the available information to measure broadband availability in terms of the infrastructure currently in place, and the policy and regulatory environment at both the national and regional levels, for enabling improved broadband access.

Overall, the analysis found that, while there is impressive growth in mobile broadband access in African countries, there is very limited access to fixed broadband. In many countries, fixed broadband does not exist. As a result, the continent has the least affordable broadband services in the world. However, the increasing number of countries with national broadband plans in place shows the intention to improve access and affordability through various measures.

The report considers not only broadband availability, but also its quality, which is affected by several factors. It also provides an analysis measuring availability through the infrastructure currently in place and the possible achievable speeds over that infrastructure as the measure of quality. In this regard, with the increased access to international connectivity through fibre optic submarine cables, Africa has been the fastest-growing region, with international bandwidth demand increasing 69 per cent compounded annually_between 2009 and 2013. This enables important regional cooperation and collaboration to enhance availability and to ensure optimal use of the available infrastructure for the benefit of the continent. In this regard, the report

contains a discussion of the important role for broadband in the context of fostering regional integration.

The impact of broadband pricing and regulation is also discussed as key to improving access at the national and regional levels. The structure of pricing in itself can both cause and address the challenges. The importance of both regulation and competition is highlighted.

Lastly, the report makes a set of recommendations for consideration by African stakeholders, especially by policymakers and decision makers, in order to improve access to broadband on the continent and to unleash the contribution of broadband to the African transformation agenda.

CHAPTER 1: Background and context

1.1 Introduction

African countries have long recognized the importance of information and communications technologies (ICT), such as broadband access and services, for their development and structural transformation. In 1999, the Economic Commission for Africa (ECA) organized the first African Development Forum on the theme "The challenge of globalization and the information society". The Forum helped to create an African consensus to assess the opportunities, address the challenges and develop a plan of action to ensure that Africa does not fall behind in the information society.

This subject was taken up years later by the African Union. At its 2010 Summit, African Union Heads of State and Government adopted a declaration on ICT, declaring the sector a top priority for the development of the continent. In the declaration, member States and development partners were encouraged to acknowledge telecommunications and ICT services as basic public utility infrastructure (African Union, 2010). The importance of ICT is reiterated in the African Union's Agenda 2063, the continent's long-term strategy for structural transformation.

African countries have made significant advances in access to ICT, although at a pace still far behind other regions of the world. Broadband technology is critical for expanding access. The diffusion of broadband technology, defined as the technology that enables the high-speed transfer of data, is inextricably linked to the emergence of the Internet. While, in the early days, gaining access to the Internet was done primarily through dial-up connections,[1] consumer and enterprise demand promoted the evolution of technologies that facilitated access at higher speeds.

As technology advances and new applications and services emerge, the ability for broadband technology to influence the economy expands. Investment in broadband infrastructure and services has a direct impact on the economy. Factors driving growth, such as innovation, firm efficiency and productivity, competition and globalization, offer indirect impacts (Atkinson, 2007). Studies confirm that broadband has the highest effect on growth by, at 1.38 per cent of gross domestic product (GDP) in low-income and middle-income economies, compared with the effects of the Internet (1.12 per cent), mobile telephony (0.81 per cent) and fixed telephony (0.73 per cent).

Apart from the economic benefits seen in its impact on GDP, broadband has a positive impact on many socioeconomic sectors. In the agriculture sector, for example, farmers increasingly rely on this technology to obtain an accurate measure of and control over the amount of minerals in the soil. They also rely on the Internet to forecast weather conditions, market their products and find high-quality and cheap supplies. In non-agriculture industries, business people and entrepreneurs view the services as necessary to the future of their activities and invest resources in areas in which they

[1] Dial-up technology refers to Internet access over conventional voice telephone lines at speeds that do not exceed 56 Kbps.

can conduct e-commerce business online. Such consumer spending was expected to grow to $1.4 trillion by 2015.[2]

Mobile Internet (mobile broadband) is particularly important for Africa. On the one hand, it brings millions of users online in many countries, given the limitations in the coverage of the fixed network, On the other hand, it enables new innovative services on the basis of mobile access to the Internet, using all features embedded into the smart devices and accessible through apps. The continent has to overcome many challenges, however, before it can fully harness the potential of broadband for its development aspirations.

In response to these challenges, the Economic Commission for Africa (ECA) conducted the present study to support member States in their efforts to deploy broadband technology for their development and structural transformation. The report contains a number of recommendations for consideration and adoption by African Governments and their development partners, including recommendations on the way forward.

The report consists of several chapters. This first chapter provides the background and context for the study. Chapter two reviews the state of broadband infrastructure and services in Africa, with specific emphasis on growth trends, penetration rates (both fixed and mobile broadband), access and usage, investment expenditure and business models that operators use and how these affectuptake and use of broadband services, including the issue of affordability.

Practically all African countries have adopted broadband policy as a means of driving the diffusion and uptake of the technology. Chapter three reviews the status of development of broadband policy and strategies in Africa and the various goals that countries set in extending access to broadband, including the various innovative policies and regulatory frameworks to enhance widespread and universal access and use. Chapter four contains an exploration of the role for broadband technology in fostering African regional integration and cooperation. It focuses on how regional strategies and policies, including harmonization of regulatory frameworks, are important in uptake and use of broadband on the continent and for enabling its special role in facilitating regional integration and cooperation.

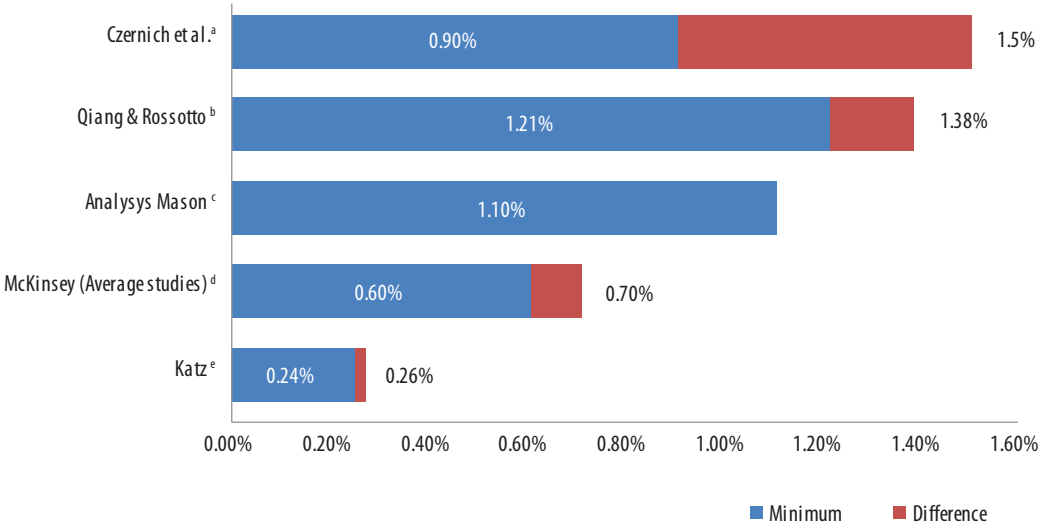
Chapter five looks at pricing and regulation issues as the key determinant factors in the expansion and widespread adoption and use of broadband technology. Lastly, chapter six provides a summary of the findings and key recommendations for consideration by African policymakers and decision makers.

1.2 Rationale for improved access to broadband in Africa

Several studies demonstrate that broadband penetration and broadband quality are important factors for economic growth. According to a World Bank study, it is estimated that every 10 per cent increase in broadband penetration in low-income and

[2] See www.invesp.com/blog/ecommerce/how-big-is-ecommerce-industry.html.

Figure I: Impact on GDP of an increase of 10 per cent in broadband penetration (Per cent)



Source: Czernich and others (2009); Zhen-Wei Qiang and Rossotto (2009); Analysys Mason (2010); Beardsley and others (2010); Katz and others (2010).

[a] Sample of the 20 countries of the Organization for Economic Cooperation and Development.

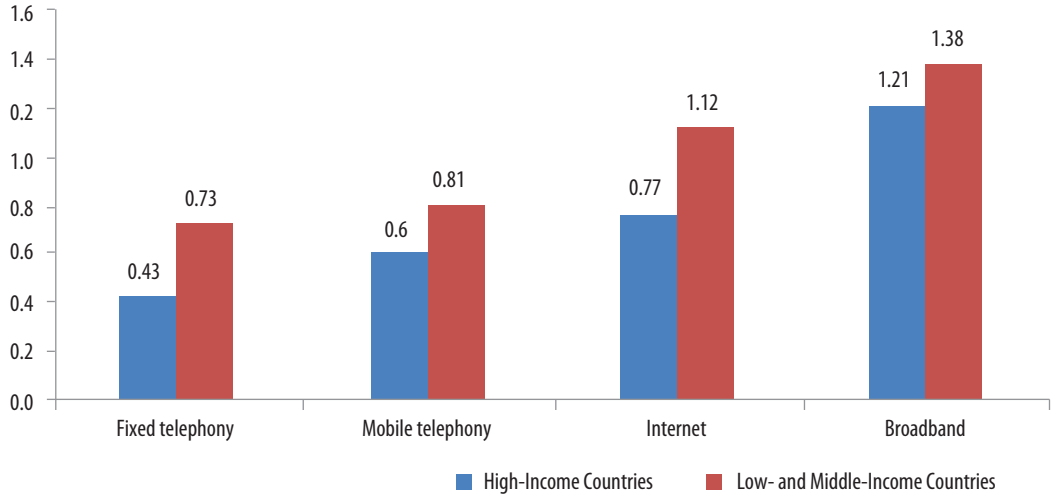
[b] Various countries; upper range applies to developing countries and lower range applies to developed countries.

[c] Limited to mobile broadband impact in India.

[d] Average of five country studies. Australia, Egypt, Malaysia, New Zealand and the United Kingdom of Great Britain and Northern Ireland (various sources for 2003 and 2004 and Zhen-Wei Qiang and Rossotto (2009)).

[e] Includes only Germany.

Figure II: Growth effects of the ICT sector (Per cent)



Source: Adapted from Zhen-Wei Qiang and Rossotto (2009).

middle-income countries results in a commensurate increase of 1.38 per cent of GDP (Kim and others, 2010). The study also demonstrates that broadband has a potentially higher growth effect than other ICT, as shown in figure I.

Table 1: Research results regarding the impact of broadband on growth

Country/ Region	Study	Data	Impact
United States of America	Crandall and others (2007)	48 states in the United States, 2003-2005	No statistically significant impact on GDP growth
	Thompson and Garbacz (2008)	46 states in the United States, 2001-2005	A 10 per cent increase in broadband penetration was linked to a 3.6 per cent increase in efficiency
Organization for Economic Cooperation and Development (OECD)	Czernich and others (2009)	25 OECD countries, 1996-2007	Broadband adoption elevated per capita GDP by between 1.9 and 2.5 per cent
	Koutroumpis (2009)	22 OECD countries, 2002-2007	A 10 percentage point increase in broadband penetration produced between a 0.7 and 1 per cent increase in GDP growth
Germany	Katz and others (2010)	424 counties in Germany, 2000-2006	A 10 per cent increase in broadband penetration produced a 0.255 per cent increase in GDP growth
Developed countries	Zhen-Wei Qiang and Rossotto (2009)	Developed counties from a sampling of 120 countries, 1980-2002	A 10 per cent increase in broadband penetration produced a 1.21 per cent increase in GDP growth
Low-income and middle-income countries	Zhen-Wei Qiang and Rossotto (2009)	Remaining countries (low-income and middle-income developing economies) from a sampling of 120 countries, 1980-2002	A 10 per cent increase in broadband penetration contributed 1.38 per cent to economic growth
United Kingdom of Great Britain and Northern Ireland broadband impact studya	SQW (2013)	The study covers all the areas from least densely populated to most densely populated (density decile, using census data) in the United Kingdom since 2008	The availability and uptake of faster broadband speeds will add some £17 billion to the annual gross value added by 2024

Source: Broadband Commission for Digital Development (2012b). a SQW (2013).

Other studies also reveal the economic impact of broadband deployment directly, through jobs created by the establishment of broadband infrastructure and, indirectly, as a result of "spillover" externalities, such as increased productivity and new products and services through accelerated innovation (Broadband Commission for Digital Development, 2012a).

Governments are also increasingly leveraging broadband to provide online services in which citizens can receive information and interact with the public service administration. Broadband facilitates such civic engagement and provides Governments with ease in performing specific functions, such as tax collection and civic registrations. Broadband enables government-to-citizen, government-to-government and government-to-business engagement. By facilitating access to economic opportunities and social welfare in developing countries, mobile broadband, for example, has been driving

Box 1: Example of broadband effects on economic growth in South Africa

In July 2010, the Government of South Africa issued a broadband policy for the country. The policy provides that, by 2019, 15 per cent of the country's households will have direct access to broadband of at least 256 Kbps download speed, with broadband reaching within 2 km of the remaining households. A 2010 study by Analysys Mason reviewed the likely direct and indirect effects that this broadband policy might have on the South African economy. The study found that wireless broadband could increase the country's GDP by 1.8 per cent, or more than $9.4 billion, by 2015. In addition, wireless broadband was expected to create some 28,000 new jobs directly, not including jobs created outside the communications industry.

As a result, the direct effect alone of wireless broadband (i.e., spending on broadband services and broadband-enabled devices) increased the GDP of South Africa by 0.71 per cent by 2015, or $3.7 billion. The biggest impact on GDP, however, was expected to come from productivity and efficiency gains.

Source: World Bank (2012).

financial inclusion through mobile banking and mobile money in Africa and supporting new ways of delivering health care in many developing nations (GSMA, 2016).

As the continent looks ahead to achieving sustainable development that embraces green growth strategies, broadband also contributes to a more energy-efficient future in which connected homes and businesses are able to monitor and reduce their electricity consumptions, which, in turn, helps to realize energy savings, among other benefits. These are just a few examples of the benefits of broadband to showcase why countries are increasingly investing in expanding its access and use.

Nevertheless, while Africa made remarkable advances in the growth of the mobile market, it has not been replicated in the Internet sector, give that access to broadband has been very limited. While fixed broadband has been growing continuously since 2012 because of the significant investment made in optical fibre infrastructure in Africa, the penetration rate remains below 1 per cent, compared with 27 per cent in Europe.

The main reasons for this low level of broadband penetration in Africa are limited availability and the price of the services. In 2013, Africa had the least affordable broadband services, with the average fixed price at approximately 64.3 per cent of gross national income per capita, which is almost three times the world average of 22.1 per cent. It is only in four countries (Gabon, Mauritius, Seychelles, and South Africa) that the price for fixed broadband is below 5 per cent of gross national income per capita. In more than half the African countries, the prices are more than 40 per cent of gross national income per capita.

Given that several international submarine cables have become operational in Africa since 2009, the bottlenecks in the broadband chain have improved. Nevertheless, regulatory action to open international gateways to competition, including for the regional backbone and access networks, could lower barriers to entry into the market, which could stimulate competition in broadband services.

Africa has been the fastest-growing region in international bandwidth demand, which increased 69 per cent, compounded annually, between 2009 and 2013. While international bandwidth demand, measured in terms of used international capacity, reached 138 Tbps in 2013, which represents a 4.5-fold increase from the 30 Tbps of demand used globally in 2009, the pace of annual international bandwidth demand growth has slowed around the world and declined to 39 per cent in 2013.

By contrast, international bandwidth in Africa increased by 20 times from 2009 and reached 2.034 Tbps by December 2015. In North Africa alone, bandwidth increased 36 per cent by 2015, while in sub-Saharan Africa it grew by 39 per cent. Submarine cables have been designed with vast capacity, and by mid-2015 barely 8 per cent of capacity was being utilized.

International bandwidth in Africa is expected to continue growing, given the projected growth in mobile broadband and the associated growth in mobile data traffic. According to the 2012 annual report of GSMA (2012), by 2017, half of the 8.5 billion mobile connections would be in 3G or 4G. While the mobile-cellular population coverage is getting better, operators are yet to deploy mobile Internet-capable networks as widely as the mobile voice services. This is evident by the fact that 3G population coverage in sub-Saharan Africa remains at 42 per cent of the level of mobile-cellular networks (Internet Society, 2015).

For Cisco (2016), global mobile data traffic grew 74 per cent in 2015, reaching. 3.7 exabytes per month by the end of 2015, up from 2.1 exabytes per month at the end of 2014. Mobile data traffic has grown 4,000 times since 2005 and almost 400 million times since 2000. This will put operators under pressure to expand access and the capacity of network backbone to meet the growing demand for bandwidth.

At the global level, several initiatives are in progress, aimed at the accelerated penetration of high-speed Internet and its dissemination in the various sectors of the economy. For example, in response to the call of the previous Secretary-General to step up efforts to meet the Millennium Development Goals, the International Telecommunication Union (ITU) and the United Nations Educational, Scientific and Cultural Organization formed the Broadband Commission for Digital Development.

The Commission published a report in 2013 entitled ""Transformative solutions for 2015 and beyond", which contained an analysis of national broadband plans for 138 countries and highlighted how broadband had positively changed the world by transforming and improving people's living conditions.

National backbone remains a major supply bottleneck and may be the weak link in the emerging African broadband infrastructure value chain. There has been progress in expanding the national backbone in Africa, with Angola, Botswana, Burundi, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Rwanda, the Sudan, South Africa, Uganda and the United Republic of Tanzania among the countries that have launched plans since 2013 to develop their national backbone networks. A wide gap remains for a number of countries in Central and West Africa.

The regional backbone has attracted only limited private sector interest because of the diversity of regulatory frameworks and the unattractiveness of some of the routes that are prone to high sunk costs. Nevertheless, at the subregional level, fibre backbones have been growing in Southern Africa, which acts as a hub for surrounding countries. In West Africa, Ghana, Nigeria, and Senegal act as the connectivity hubs in that subregion.

Given that broadband network investment tend to follow regional trade and economic activities, with the goal of connecting profitable urban centres rather than rural and underserved areas, the major regional broadband gap is in West, Central and East Africa. In this regard, while Africa is striving towards improving intraregional trade and economic integration, the role of broadband in enhancing regional integration is of paramount importance.

1.3 Methodology

The various approaches and analytical techniques considered in this study include existing surveys and administrative data, case studies, panel studies, the use of focus groups, direct observation and document examination. To this end, the research relied primarily on secondary sources of data, namely, data gathered and maintained by internationally mandated organizations by ITU, the World Bank and others. These data were supplemented and verified by primary data from official policy and other documents from member States._The "secondary" reference documents were used mainly contextually to examine data gathered on key aspects of world events that have an impact on policy analysis.

As stated by Duke (2002), Tait (2010) and Yanow (2000), written documents are key primary sources in interpretive studies and are of paramount importance in policy research. To this end, documents and literature from government authorities and institutions, mainly ministries in charge of ICT, from as many countries as possible have been consulted. In addition, relevant sources of information to assess current and future trends in the ICT sector globally and at the continental level have been reviewed. In this regard, data have been collected from the databases of international organizations and research institutions that gather primary data on the ICT and telecom industry.

1.4 Conclusion

Broadband has been increasingly recognized in many countries as critical infrastructure, such as railways, roads and others that enable rapid socioeconomic growth. To this effect, the development of broadband infrastructure and services needs to be guided by carefully designed national and regional broadband plans and strategies, with specific targets in terms of coverage, quality, economic impact and other socioeconomic outcomes.

This report is therefore structured to provide an account of the status of broadband infrastructure and services on the continent, as reflected in the national plans and strategies towards achieving such development. The regional context of broadband, and the progress on its contribution to regional integration and cooperation are also highlighted. Lastly, as key determinants of improved access, price and regulation are addressed in the recommendations for consideration by African policymakers and decision makers.

CHAPTER 2: Review of the state of broadband infrastructure and services in Africa

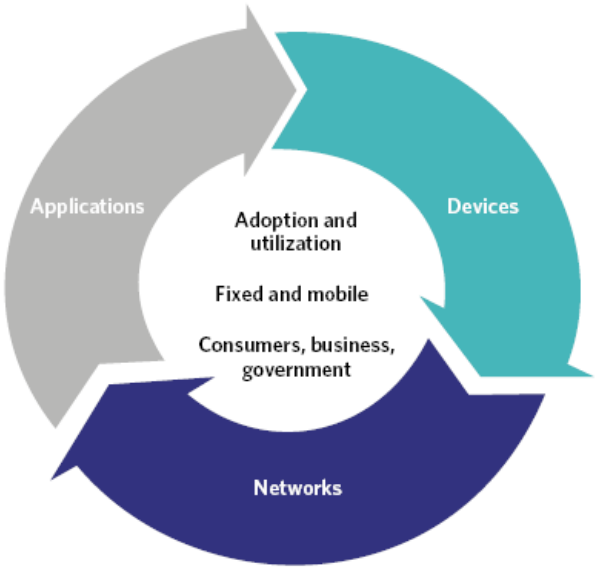
2.1 Introduction

Traditionally, the term broadband referred to high-speed communications networks that connected end users at a data transfer speed greater than 256 Kbps. For example, the United States Federal Communications Commission recently proposed to raise the minimum speeds allowed for broadband from 4 Mbps down and 1 Mbps up to 25 Mbps down and 3Mbps up. Apart from the quantitative indicators, a number of qualitative indicators, such as class of service and quality of service, are now associated with broadband definitions. These cover applications and services that are made possible only by broadband technology, as well as the likely impact that broadband has on socioeconomic development. In a related topic, these indicators are what constitute the "broadband ecosystem", as shown in figure III.

The World Bank has been promoting the concept of an ecosystem of users, services, networks and applications, positing that growth in broadband availability results from interactions in the demand and supply chain, with the intention of accelerating access and increasing adoption and use (Kim and others, 2010).

This chapter provides a general overview of broadband infrastructure and services in Africa, growth trends in the penetration rate, (both fixed and mobile broadband), access

Figure III: Broadband ecosystem



Source: Federation Communications Commission. Available from http://www.broadband.gov/plan/3-current-state-of-the-ecosystem/.

and usage statistics, investment expenditure and how universal access is enabled through public ICT access points.

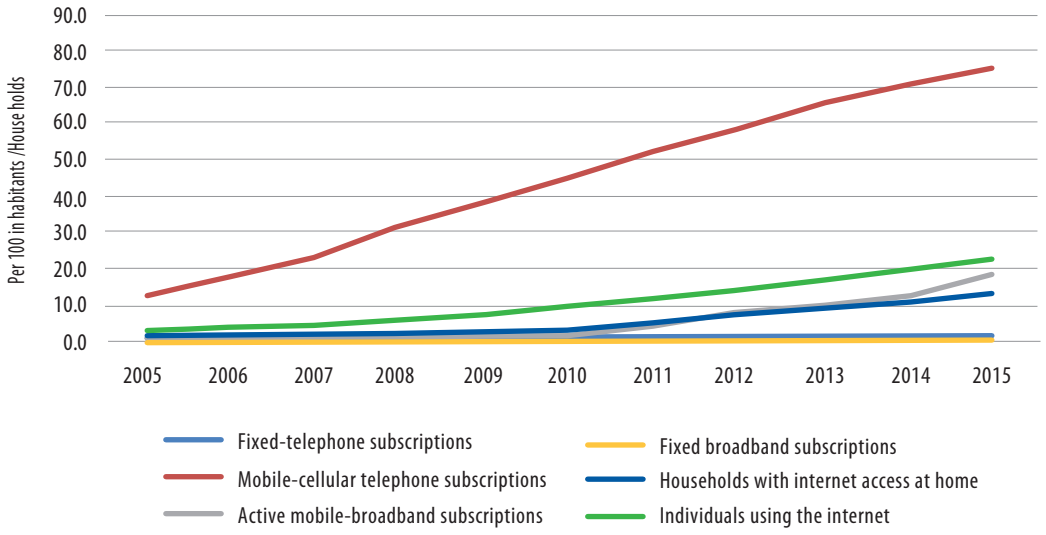
2.2 Trends in broadband access and use in Africa

During the period 2005-2010, Africa's ICT infrastructure significantly improved, with growing access to ICT, although at a rate still far behind other regions of the world. In 2015, it was estimated that there were 2.04 billion users of social media around the world; that number was expected to increase to 2.22 billion in 2016.[3]

Overall, it is estimated that approximately 9 per cent of Africans use social media. South Africans are among the world leaders in time spent on social networks, with an average of 3.2 hours a day, compared with a global average of 2.4 hours. The active Facebook user population in Africa grew by 20 per cent, to 120 million, in June 2015, from 100 million in September 2014. Some 4.5 million of these users are based in Kenya, 15 million in Nigeria and 12 million in South Africa. More than 80 per cent of users gain access to Facebook from their mobile phones. By 2018, between 50 and 70 per cent of the African population could have access to a smartphone (Ericsson, 2017).

ICT penetrationcontinued to grow, with an increase in mobile-cellular subscriptions from 63 per cent in 2013 to 76.2 per cent in 2015. Active mobile-broadband subscriptions almost doubled, from 10.9 per cent in 2013 to 19 per cent in 2015, and individuals using the Internet increased from 16.7 per cent in 2013 to 22.5 per cent in 2015. The 6.7 per cent of households with Internet access at home in 2013 increased to 13.6 per cent in 2015, which is also a key indicator in terms of guaranteeing inclusive access. In terms of the number of SIM cards in circulation, the accounts of the African mobile market are even higher. Many African users often have several cards and had

Figure IV: Status of ICT access and useage in Africa, 2005 -2015 (Per 100 inhabitants/households)



Source: International Telecommunication Union (2017).

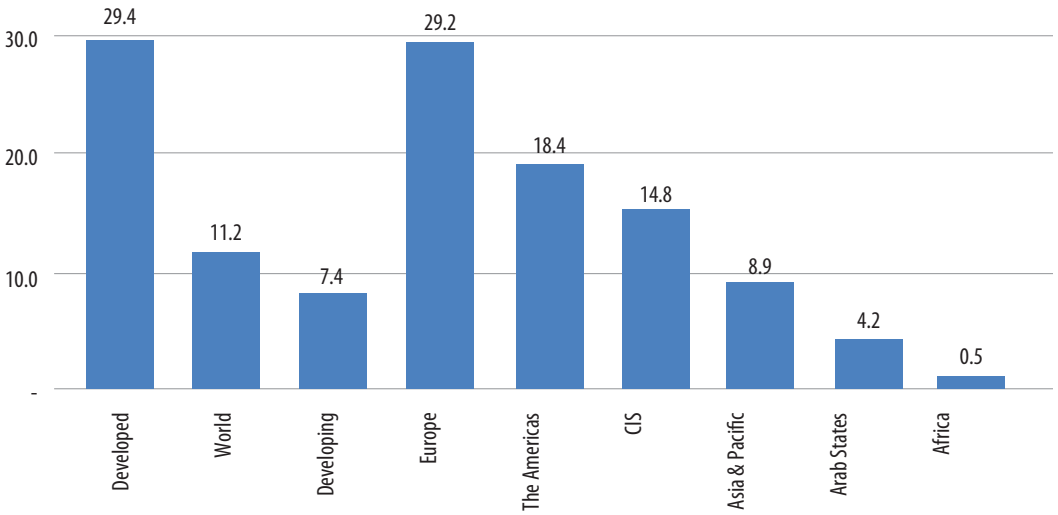
[3] See Statistica. "Number of social network users worldwide from 2010 to 2012 (in billions)". Available from www.statista.com/statistics/278414/number-of-worldwide-social-network-users/.

accumulated 965 million SIM cards by the end of 2015. This number is projected to reach 1.3 billion by end of 2020, given the rapid rates of increase in access and usage (International Telecommunication Union, 2016).

Average fixed broadband penetration in Africa is below 1 per cent and is the lowest in the world. This is far below the developing country average of 7.4 per cent and the world average of 11.2 per cent, as shown in figure V.

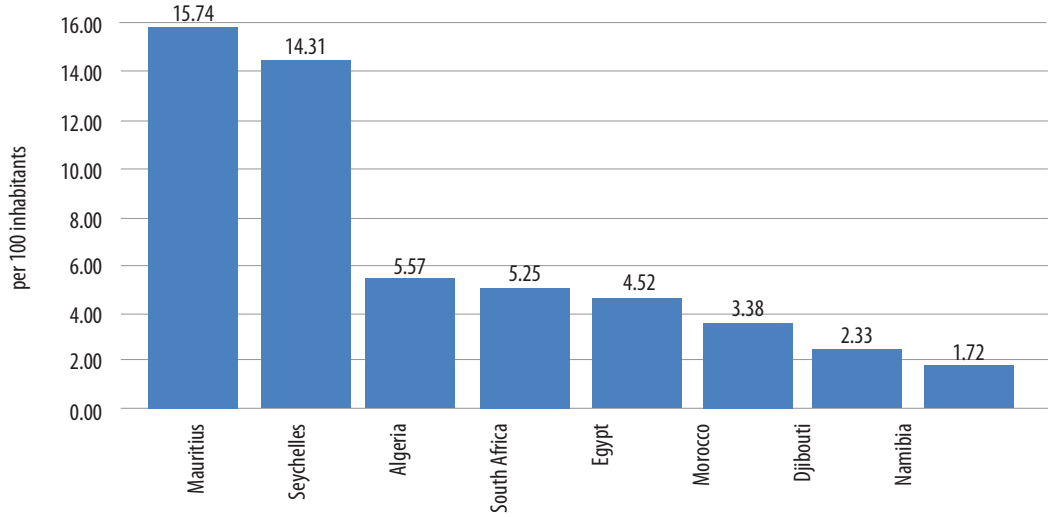
While 12 countries have attained more than 1 per cent penetration in fixed broadband subscriptions, 2 countries have more than 10 per cent penetration: Seychelles (15.7 per cent) and Mauritius (14.3 per cent). They are the leading countries in fixed broadband penetration on the continent (see figure VI).

Figure V: Fixed broadband subscriptions by region, 2015 (Per 100 inhabitants)



Source: International Telecommunication Union (2017).

Figure VI: Fixed broadband subscriptions in selected African countries, 2015 (Per 100 inhabitants)



Source: International Telecommunication Union (2017).

Other countries achieved penetration rates of between 1 and 6 per cent: Algeria (5.6), followed by South Africa (5.3), Egypt (4.5), Morocco (3.4), Djibouti (2.3) and Namibia (1.7). This largely reflects limited access and the high price of fixed broadband access.

As shown in figure VII, mobile broadband penetration is highest in the Americas (75 per cent), followed by Europe (73 per cent), the Commonwealth of Independent States (51 per cent), the Arab States (43 per cent), Asia and the Pacific (38 per cent) and Africa (19 per cent). During the period 2013-2016, all regions showed double-digit growth in mobile broadband penetration. However, in this case, Africa led with a phenomenal growth rate of more than 40 per cent, twice as high as the global average. By end of 2015, mobile broadband penetration in Africa reached almost 20 per cent, which is a 10-fold growth from less than 2 per cent in 2010.

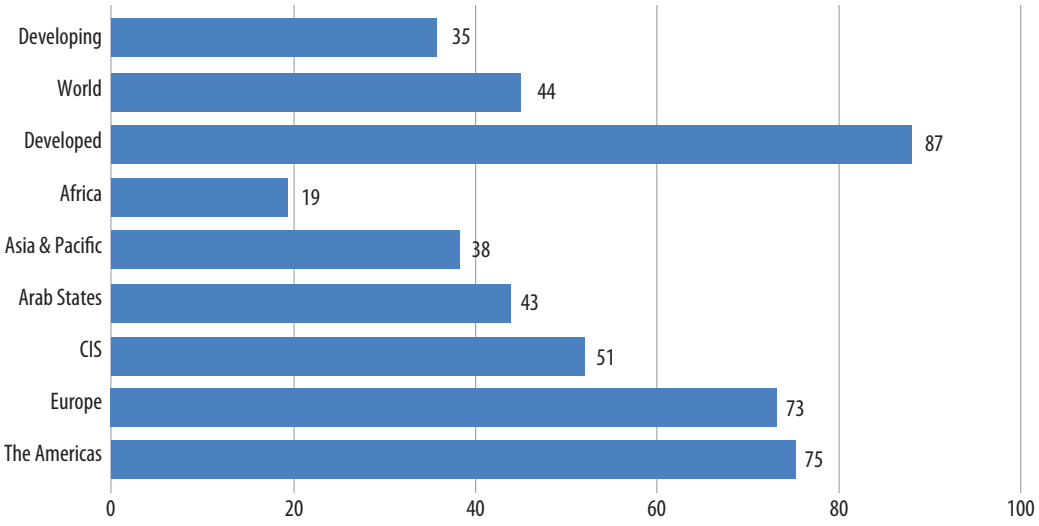
2.3 Backbone infrastructure and bandwidth

The numbers indicated show only the overall growth of broadband access on the continent, but effective use can be assessed by looking at such aspects as speed and the quality of broadband connections and services. In this regard, two aspects of broadband infrastructure could be taken as indicators to assess the quality and speed of broadband: backbone infrastructure and the amount of international bandwidth available in the region and in the countries of that region.

2.3.1 International connectivity

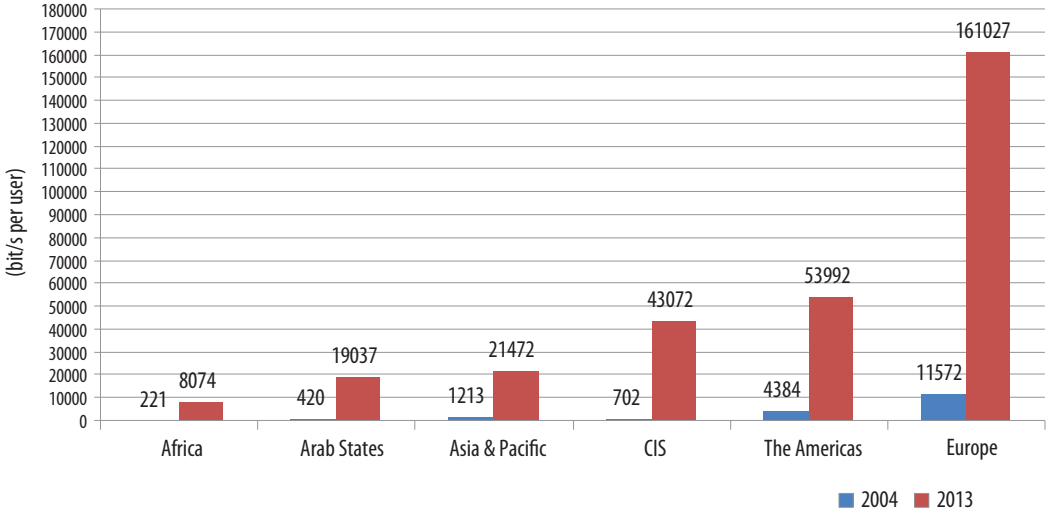
One of the key indicators that highlights the quality and speed of networks is the amount of international internet bandwidth available in the region as a whole and in each country. This bandwidth is a key requirement for delivering data-intensive applications and services using high-speed networks in the current digital society.

Figure VII: Active mobile broadband subscriptions by region, 2015 (Per 100 inhabitants)



Source: International Telecommunication Union (2017).

Figure VIII: International bandwidth per Internet user by region, 2004 and 2013 (Bits per second)



Source: International Telecommuniocation Union (2014).

The data in figure VIII indicate that Africa's international Internet bandwidth had increased more than 36 times between 2004 and 2013.

This clearly shows the impact of available international bandwidth on Internet usage. Availability differs widely between countries and regions, with Africa being the lowest, six times lower than the world average of 52,000 bit/s per user. Europe is a global leader, with 161,000 bit/s per user, which was almost 20 times that of Africa in 2013.

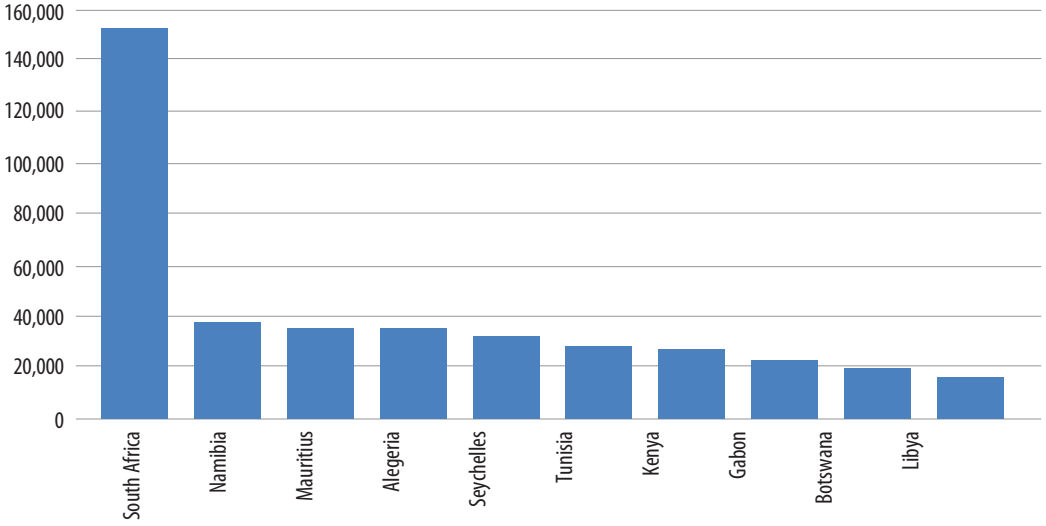
Nevertheless, with the placement of several submarine fibre optic cables on the east and west coasts of the continent since 2012, Africa has been the fastest-growing region n the world, with international bandwidth demand increasing 69 per cent, compounded annually between 2009 and 2013.

Such growing traffic has direct implications in terms of the capacity requirements for the underlying broadband infrastructure. To this end, all three network components of this broadband infrastructure, namely, international (and regional) connectivity, national backbone and access networks, have to be in place and optimally used to meet the increasing demand in the most cost-effective way.

The first component of the broadband network is the international and regional infrastructure that provides connection to the rest of the world. Until 2010, sub-Saharan Africa had been the most underserved region in the world in terms of international fibre capacity, in particular East Africa, which was reliant exclusively on costly and less-reliable satellite connections.

Since the mid-2000s, the situation dramatically changed, due to the mobile phone revolution on the continent, driving growth in both bandwidth demand and operator revenue, on the one hand, and, on the other, the increased support from international financial institutions and private financiers in providing lending for telecom infrastructure projects, including the focus by submarine cable suppliers on potential

Figure IX: Top 10 countries in Africa in terms of international Internet bandwidth per Internet user, 2014



Source: World Bank world development indicators: the information society. Available from http://wdi.worldbank.org/table/5.12.

market opportunities in Africa. As a result, Internet bandwidth per Internet user increased significantly in several countries (see figure IX).

Kenya is the bandwidth-richest country in Africa. Its international Internet bandwidth per Internet user increased from 4,500 Mbit/s in 2011 to 24,000 Mbit/s in 2012, followed, respectively, by Tunisia, South Africa, Côte d'Ivoire and Seychelles as the top five countries. In a number of other African countries, including Botswana, Djibouti and Ethiopia, international bandwidth per Internet user has actually decreased. This is not because there was a reduction in the international bandwidth, but because the number of Internet users increased faster than the amount of bandwidth available.

All of Africa's international bandwidth is supplied by submarine cables, terrestrial networks connected to submarine cables or satellite. Currently, of the total bandwidth supplied to sub-Saharan Africa, 94 per cent (1.070 Tbps) was supplied directly by submarine cable. There is great scope for future growth, given that the total bandwidth available is still less than 5 per cent of the total design capacity of at least 28.841 Tbps that can be made available by the more than 18 submarine cable landing stations serving the continent as of December, 2013 (Hamilton Research, 2015). International bandwidth was expected to exceed 50 Tbps by the end of 2014, which was the capacity estimated to meet the needs of Governments, households and business users for the medium term (African Development Bank, 2013).

2.3.2. Backbone network infrastructure

The second component is the domestic backbone network (including backhaul) infrastructure that carries traffic from the international landing point or from the nearest point of the border in a landlocked country to the various parts of the country. While microwave and satellite transmissions account for a steadily decreasing amount, an increasing and majority share of data traffic is transferred nationally through

terrestrial fibre. As a result, there has been an increase in backbone infrastructure, with the regional network (terrestrial transmission networks across Africa) increasing to 958,901 route km by June 2014, compared with 465,659 km in 2009. There was also a plan to deploy a further 92,402 km of fibre optic network under construction, with a further 86,045 km planned and 70,573 km proposed.

Currently, approxiamtely 44 per cent of the African population is within reach of fibre networks, of which 22 per cent live within a range of 10 km. Once the planned and proposed networks enter into service, the reach will increase to 52.3 per cent of the population (African Development Bank, 2013).

Given the dynamic growth of mobile broadband in Africa, the key requirement in servicing the growing demand is to supply sufficient national fibre capacity for the backbone, including backhaul connectivity to base stations, which are currently mostly using microwave radio links on networks designed for the second generation of mobile telecommunications technology (2G). This is important for accommodating and handling the growing amount of traffic on the backbone level of the network. Otherwise, operators will not be able to expand their retail offerings and increase the speed of broadband connections in the access network infrastructure serving end users.

Apart from connecting more cities, these terrestrial backhaul networks are also delivering much greater bandwidth to those countries that do not have their own submarine cable landing points. A landlocked country, Zimbabwe, increased its international bandwidth to 9.060 through connection to submarine cables for its supply, facilitated by Botswana, Mozambique, Namibia and South Africa. Ethiopia reached 8.686 Gbps in 2013 and is connected to submarine cables through Djibouti, Kenya and the Sudan. Rwanda reached 4.997 Gbps, backhauled through Kenya, Uganda and the United Republic of Tanzania, while Botswana reached 3 Gbps, backhauled through Namibia and South Africa (African Development Bank, 2013). Therefore, there is great scope and opportunity for countries to expand their user base.

2.3.3 Access network infrastructure

The third network component, the access network infrastructure, is the one that links the backbone network to the end user. At this point, two main groups of “last mile” broadband access technologies are available: fixed broadband technologies and mobile broadband technologies (see annex I).

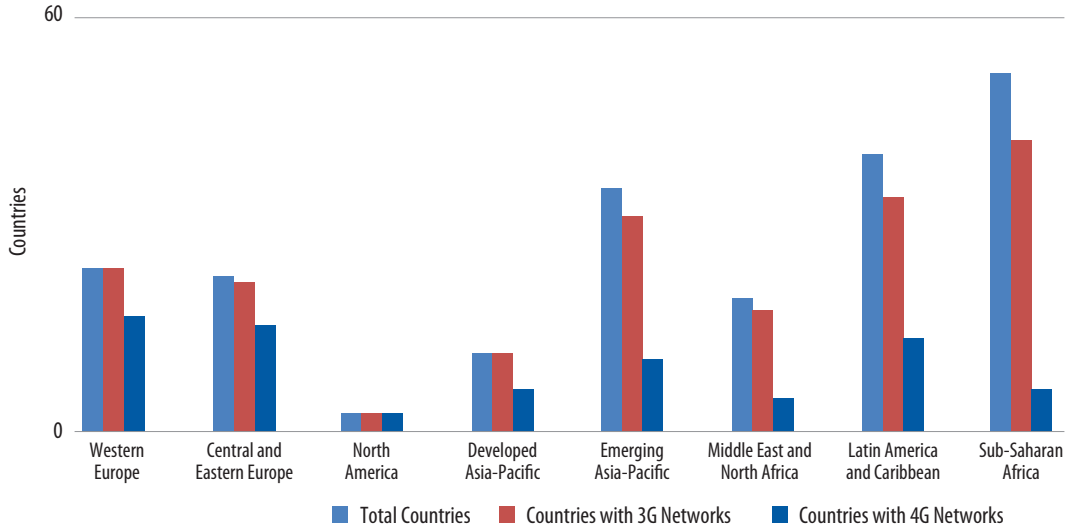
While it is important to note that broadband access network technologies are strongly determined by network deployment and technical and financial constraints, the deployment of specific technologies tends to follow commercial viability, in that fixed broadband technologies are more prevalent in highly populated areas (in conjunction with the rapid development of complementary mobile broadband access), while mobile broadband solutions are more prevalent in less densely populated areas.

The quality and speed of broadband connections also differ between mobile and fixed technologies. With technological evolution, mobile technologies are improving high-speed broadband access. While 3G networks are continuing to be built and

expanded throughout the continent, several countries have made significant increases in penetration. Botswana is leading, with 74 per cent, followed by Cabo Verde, which attained the second-highest penetration in the region, at 43 per cent. Burkina Faso, having launched 3G in 2013, reached a penetration of 9 per cent by end of the same year. Globally, 2012 was considered to be the year of rapid 4G adoption, with 49 countries procuring at least one commercial 4G LTE network.

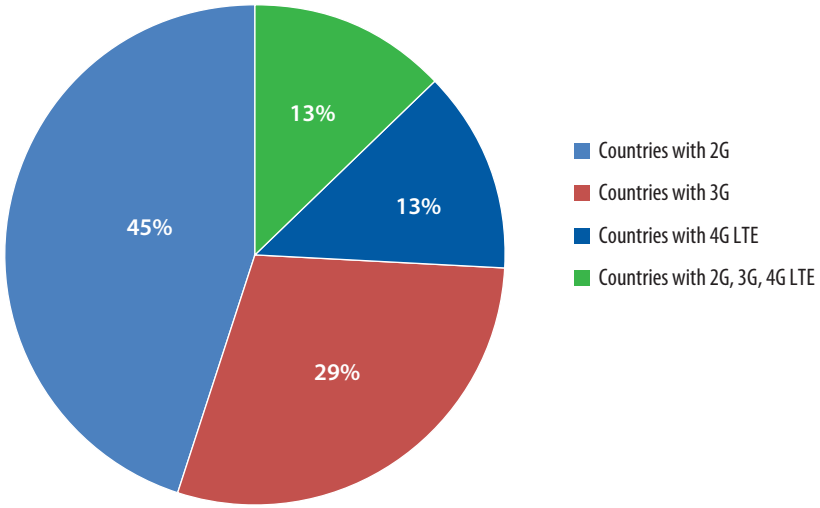
Mobile devices, either 3G or 2.5G EDGE networks, are already the main platform for Internet access in Africa, allowing people to bypass the limited reach of fixed broadband networks. By the end of 2014 (oAfrica, 2012), 24 African countries had 4G service.

Figure X: 3G and 4G networks by deployment by region, 2012



Source: Internet Society, 2014.

Figure XI: Deployment of mobile networks in 53 African countries, 2014 (Per cent)



Source: International Telecommunications Union (2014).

In mid-2016, there were 72 4G LTE services in 32 countries in Africa. In 2017, 102 mobile operators have launched 4G LTE services in 43 countries.[4]

In practice, there are concerns over 4G LTE services. On one hand, there is the issue of whether the potential speed and affordability of 4G can be realized in the years to come. On the other hand, the speed offered in most markets is well below what is possible with broadband coverage. Lastly, most devices in Africa are still only capable of 2G or 3G, and users need a 4G-enabled device to utilize the high transfer speeds.

2.4 Facilitating universal access: the role of public ICT access points

As indicated above, Africa hosts only 11 per cent of households with Internet access. Ultimately, as can be seen in the various goals of the broadband plans presented in chapter three, the policy for universal access to broadband Internet is to ensure that every household has access. Household access is mostly a shared access whereby all family members can use the service and share the subscription fees. The challenge is both availability and affordability. In view of these issues and the low level of household Internet access, public access points to the Internet, in particular, play a great role in Africa.

Public access to ICT can be provided by commercial facilities, such as privately operated Internet cafes, and community-type facilities, which typically provide Internet access free of charge. Schools, post offices and public libraries also play an important role in providing access to broadband. For example, globally, only 10 per cent of post offices provide public access to the Internet, even though 31 per cent of them had a broadband Internet connection in 2012.

According to the Universal Postal Union, increasing the proportion of post offices offering public Internet access to more than 45 per cent would ensure that up to a third of all rural areas and small towns have access to the Internet, while, with 60 per cent coverage, half of all rural areas could be connected (International Telecommunication Union, 2014a).

To this end, African countries need to encourage the development of public ICT access points both in urban and rural areas to ensure widespread adoption and use of broadband.

2.5 Investment expenditure on broadband infrastructure in Africa

Backbone networks have a major impact on the delivery of ICT services in a country. In a typical mobile voice network, the backbone network accounts for approximately 10-15 per cent of total network cost. GSMA (2013), reported that mobile operators throughout the region had invested an estimated $44 billion between 2007 and

[4] See Balancing Act, "4G/LTE in Africa: number of subscribers, launches, trends and projects (May 2017)" (July 2017). Available from www.balancingact-africa.com/reports/telecoms-internet/4glte-network-projects-and-launches-in-africa-july-2017.

Table 2: Investing in different network infrastructure layers

Network	Proportion of costs	Payback period	Examples
Passive layer	70 to 80 per cent of network costs	15 years	Trenches, ducts, dark fibre
Active infrastructure layer	20 to 30 per cent of network costs	5-7-year rate of return	Electronics equipment, OSS, BSS
Service layer	N/A	A few months to 3 years	Content, services and applications

Source: Commonwealth Business Council (2013).

2013 (excluding investment in fibre and international cables). For network operators providing broadband connectivity, however, the cost of backbone networks is more significant.

In this context, a network for broadband infrastructure consists of several different layers, each with a level of costs, payback period and time horizon (see table 2).

With respect to their cost and return on investment, the first layer, namely, the passive layer (civil works and dark fibre), can account for 70 to 80 per cent of the overall investment and has a payback period of approximately 15 years. The second layer is the active infrastructure layer, in which the intelligence of the network concentrates, with a 5-to-7-year rate of return on investment. The service layer has a very different cost structure and a much shorter rate of return. For example, investment in new sub-Saharan African systems grew from $953 million during the period 1988-2008 to $2.927 billion during the period 2009-2012 (TERABIT Consulting, 2013).

Investment in infrastructure could be made by either of the three types of entities, namely, the incumbent operator's infrastructure (which is that deployed by fixed operators and eventually by their mobile branches owing to historical monopoly); private operators (mobile operators, carrier to carrier, Internet service providers, etc., for their own needs); and alternative infrastructures (those deployed by other sectors, such as energy and transport, including railways and roads, for the owners' own needs, but which may also make extra capacity available for use by the ICT sector).

Data is lacking on the specific amount of investment made in the past few years on broadband alone. Most of the data available are either for the entire telecom sector or the mobile communication subsector. However, the investing countries, in particular those with national broadband plans in place and targets set for broadband, can foresee and give a better picture of the level of investment needed. Boxes 2, 3 and 4 give some examples of countries that have national broadband plans in place and that have allocated the corresponding levels of investment needed to achieve some of the targets set out in the plans.

Similarly, Kenya has also clearly identified its investment needs for meeting the goals stated in its national broadband strategy (see table 7). In the medium term, it is estimated that the broadband strategy will need more than $3 billion to implement its goals, which include infrastructure, capacity-building, creating content, applications and innovations and expanding the adoption and use of broadband in the country (see box 3).

Box 2: Egypt's eMisr national broadband plan of 2011, with a short-term target to 2015 and a long-term target to 2021

According to the eMisr national broadband plan, the projected short-term subscriber numbers for broadband services would surpass 12.5 million subscribers in 2012. Annual revenue from broadband services in Egypt was projected to amount to $2.88 billion in 2015. The estimated investment required during the four-year forecast period to achieve the set availability, penetration and social targets are projected to be in the range of $2.4 billion to3.95 billion.

To encourage investment in such areas, it is assumed that government stimulation of up to 20 per cent of the total investment needed would be required. On the other hand, and in order to stimulate the demand needed for successful broadband diffusion, an investment in the range of $350 million will be needed, in accordance with the Ministry of Communications and Information Technology, over four years.

Source: Government of Egypt (2011).

Box 3: Kenya's national broadband strategy, 2013 – 2017

The Government of Kenya currently spends 0.5 per cent of the national budget on ICT. The broadband strategy will ensure that the Government spends at least 5 per cent of its overall budget on ICT and broadband during 2013-2017.

The total expenditure forecasted in implementing the national broadband strategy totals more than $3 billion, with the infrastructure cost (such as for LTE, FTTX and backbone), amounting to more $ 2.1 billion; capacity-building and awareness, $217 million; content, applications and innovations, $434 million; and a contingency of 10 per cent of the infrastructure cost.

Source: Government of Kenya (2013).

Table 7 shows the funding requirements of the Nigerian national broadband plan for the period 2013-2018 for the implementation of fibre networks throughout the country. Given that long-distance fibre is already in place and that states need rings to connect to this fibre, two assumptions have been made, as described in box 4.

One of the challenges of investing in broadband is the evolution of the telecom market that moves from a period of high growth to a period of intensified competition, market consolidation and maturity (Broadband Commission for Digital Development, 2014). Planning the deployments of network infrastructure is also becoming more complex, given the fast-changing technologies and rapid shifts in consumer demand and expectations, as well as the change in business models as revenue is increasingly displaced from operators to content players.

Another challenge is the deployment of broadband networks in remote and rural areas where there is low population density, challenging geography and lower incomes. Thus, costly deployment in rural areas lowers operating margins, making it difficult for networks to remain commercially viable.

Box 4: Nigerian national broadband plan for the period 2013-2018: funding estimates for deployment

The cost of building fibre within cities is estimated at $60,000 per km, while the cost of building fibre around states is estimated at $20,000 per km. This difference can be attributed to the higher number of civil works, road crossings and restoration that will be required for metro fibre networks. The funding requirements for the state to zonal rings are described below.

The average number of states per geopolitical zones is six and the number of geopolitical zones is six. In calculating the funding required for state-ringed fibre optic infrastructure, the relevant states have been broken down by land mass into large, medium and small, requiring an approximate fibre network of 750 km, 500 km and 250 km, respectively. Accordingly, the total cost of all state rings for 8 large states, 16 medium and 12 small states is estimated to amount to $340 million.

In calculating the funding required for the metro-ringed fibre optic infrastructure, the average cost of laying fibre (including electronics, but excluding right-of-way charges) in Nigeria is estimated at $60,000 per km. An average state capital (excluding Abuja, Lagos and Port Harcourt) will require 250 km of fibre for a metro-ringed design. The cost estimate for 33 state capitals is therefore $495 million.

Source: Government of Nigeria (2013).

2.6 Conclusion

Broadband infrastructure is improving but still widely unavailable and unaffordable. While it is currently accepted that broadband is becoming a necessary infrastructure in accelerating socioeconomic development, especially in high-growth sectors, there is less effort being made to formulate the plans necessary and implement them with strategic investment. Africa is in a good position to adopt the evolving technology and invest in a sustainable manner.

It is not only necessary to open up the market, but also to build a more harmonized regional approach to investment in scaling up use. To this end, it is of paramount importance that both national and regional broadband plans and strategies have clear targets and time frames. The next chapter will address national broadband plans and strategies, with specific reference to selected country cases. The chapter after that will examine regional aspects in the context of regional integration.

Africa has certainly made remarkable achievements recently with regard to international connectivity through the various submarine fibre optic cable projects. However, the limited competition in international (and regional) connectivity has resulted in high prices for international high-speed connectivity in the region. This will be examined in more detail in chapter four. A lack of competition and limited open-access regulations are significant barriers to the effective use of international and regional connectivity infrastructure in most of the subregions. This has adverse consequences on the affordability of broadband services to end users.

CHAPTER 3: Status of development of national broadband policy, strategy and plans in Africa

3.1 Introduction

Since ICT is considered an integral tool for socioeconomic and political development, it is essential to maximize the benefits. It is imperative that ICT networks and services be established and made accessible to all. Most African countries have developed some form of national broadband policy and strategy since 2009 (International Telecommunication Union, 2017) (see annex II), although with varying degrees of explicit implementation plans. In objectives 1 and 2 of the Connect Africa summit, held in Kigali in October 2007, African countries were encouraged to connect all African capitals to broadband by 2012 and the villages by 2015.

This target has considerably accelerated the deployment of optical fibre backbones on the continent. Indeed, the majority of the countries with national broadband policies in place are expected to have identified infrastructure as one of the key priority areas and drive investment in the required infrastructure.

Countries have been setting various goals for extending access to broadband through innovative policies and regulatory frameworks. The fundamental goal is to enhance widespread and universal broadband access and use. In this report, selected countries with national broadband plans have been identified to showcase their strategies for expanding access and for extending reach and use in underserved areas and communities. The different models in financing broadband deployment are also reviewed. Specific country strategies with their relevant goals are presented in tables to aid comparison.

3.2 Status of broadband policies and regulatory frameworks in Africa

The introduction of broadband plans in a number of African countries is relatively recent, with most of them dating from 2009 (International Telecommunication Union, 2017; Broadband Commission for Digital Development, 2014) (see annex I). Prior to 2009, most plans focused on information society issues, with broadband coming to the fore from 2009 onwards. Increasingly, broadband connectivity is gaining popularity and recognition in terms of its economic and social impact. By 2015, 39 African countries had already adopted national broadband plans. Of those countries, more than 50 per cent had goals for ensuring national infrastructural coverage and promoting services (Broadband Commission for Digital Development, 2014). In addition, six countries (Burkina Faso, Ghana, Namibia, Nigeria, Rwanda and Uganda) had not only adopted national broadband plans, but also had included them in their definitions of universal service and access. The main features of these policies focus on building the supply of and demand for broadband. They usually establish the strategic framework under

which the policy will be implemented and the associated institutional arrangements. Moreover, these policies have the tendency to adjust and evolve with market trends.

The importance of national policy leadership is increasingly understood by ICT stakeholders on the continent. Policy leadership provides a clear vision to identify opportunities, constraints and actions regarding broadband supply and demand. Although, in many countries, broadband deployment has been realized through the efforts of the private sector, Governments play an essential role in ensuring a stable regulatory and legal framework to foster investment, create a level playing field among the various actors present in the market, establish adequate spectrum policy and reasonable spectrum allocation, and ensure long-term, sustainable competition. Governments are also seeking to extend outreach by implementing programmes such as e-government, digital literacy initiatives and connected public institutions and locations.

Moreover, recent research (International Telecommunication Union and United Nations, Educational, Scientific and Cultural Organization, 2013) suggested an opportunity cost associated with the absence of a broadband plan. Factoring out the impact of average income per capita, market concentration and urbanization, the research suggested that countries with plans were associated with fixed broadband penetration some 2.5 per cent higher on average than countries without plans, constituting a significant advantage.

In mobile telephony, the impact of a plan may even be greater – countries with plans are associated with mobile broadband penetration some 7.4 per cent higher on average than countries without plans. This suggests that national policy leadership can help to establish a positive incentive and vision for the development of broadband within national and subregional markets.

3.3 Goals of broadband policies and strategies

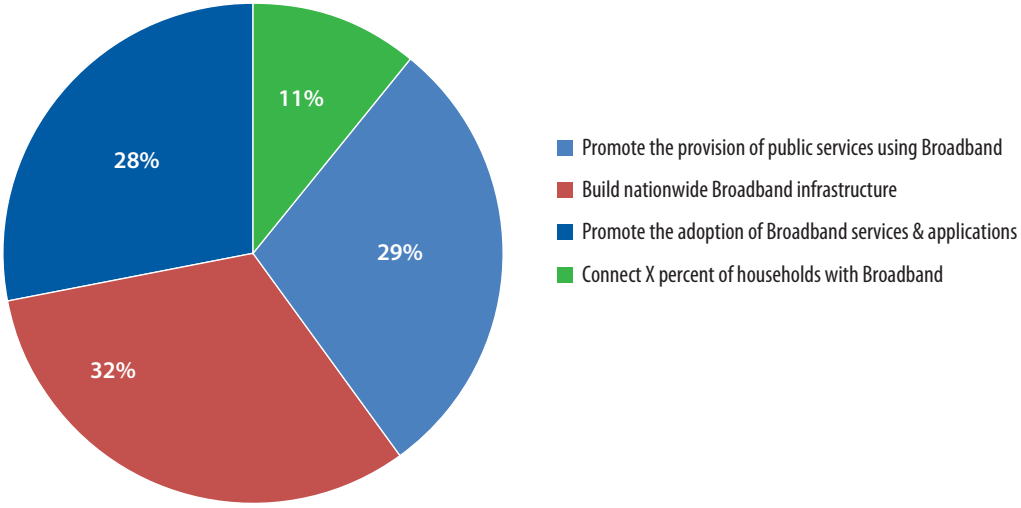
It is also important to note that broadband is now widely accepted as not only a consequence of economic growth, but also as one of its drivers. For broadband use to cause growth, there should be clear targets set with identified economic benefits, coverage and quality or speeds to be met (see annex III).

In contrast with other ICT services, such as fixed-line voice telephony, broadband, including mobile broadband, behaves as an ecosystem in which the supply and demand sides interact and mutually reinforce each other. Both aspects of the ecosystem therefore need to be addressed by policy initiatives (Kelly and Rossotto, 2012).

Figure XII presents the various goals of national broadband plans in Africa.

As shown in figure XII, most of the policy initiatives focus on the demand side to promote the adoption of broadband services so that 29 per cent of broadband plans are aimed at promoting the provision of public services using broadband and 28 per cent are aimed at promoting the adoption of broadband services and applications. On the other hand, 40 per cent of the goals represent the supply-side policies so that 32

Figure XII: Goals of national broadband plans in Africa, 2012 (Per cent)



Source: Broadband Commission for Digital Development, 2012c.

per cent are aimed at building nationwide broadband infrastructure and 11 per cent are aimed at connecting a specific percentage of households with broadband.

This can be further elaborated from the national broadband plans of selected countries in Africa in terms of the goals found in their respective broadband plans/ strategies (see table 3).

Table 3: Examples of goals found in national broadband plans/strategies

Country	Goal			
	Broadband coverage	**Broadband speeds**	**Economic impact (including employment)**	**Other goals (including sector-specific targets)**
Egypt	Fixed - 9 million (~40 per cent) households subscribed to broadband services by 2021 Mobile - 15 million (~15 per cent) citizens subscribed to mobile broadband services by 2021	Fixed – 90 per cent of households have access to broadband (25 Mbps) by 2021 Mobile – 90 per cent of the population with 4G/ LTE coverage by 2012	Short term targets broadband to create 6,650 to 17,500 direct jobs on average annually, with an incremental cumulative contribution to GDP of $ 4.17 billion	100 per cent of Egyptian communities connected to 25 Mbps by 2021 Each 3rd level Egyptian administrative locality (sheyakha and village) served with a least one public access point with 25 Mbps
Kenya	35 per cent penetration of households by 2017	Minimum broadband speed for rural areas at 5 Mbps by 2017 Minimum broadband speed for urban areas at 40 Mbps by 2017	Cost per Mbps in relation to average income, which currently stands at 30 per cent of average national income, to reduce to 10 per cent by 2017	100 per cent penetration by schools and by health facilities by 2017

Morocco	N/A	N/A	By 2013, establish 58,000 jobs in IT (up from 32,000 in 2008); direct additional GDP: 7 billion Moroccan dirham; indirect additional GDP: 20 billion dirham	N/A
Nigeria	N/A	By 2018, 80 per cent of the total population to access broadband Internet at a minimum speed of 1.5Mbit/s		
South Africa	By 2020, achieve target of 90 per cent per cent broadband penetration	By 2020, 90 per cent at 5 Mbps; 50 per cent at 100 Mbps		By 2020: Percentage of schools and health facilities – 100 per cent at 10 Mbps and 80 per cent at 100 Mbps Percentage of government offices – 100 per cent at 10 Mbps

Source: Country reports on national broadband strategy.

The pace of broadband uptake around the world is accelerating, and Africa is at risk of being left behind. Countries therefore urgently need to reconsider their sector policy strategies if they are to see broadband take off in Africa with affordable access as it has in other parts of the world. Some of the recommendations provided by the Broadband Commission for Digital Development in this regard have been presented.

3.4 Regulatory issues

It is evident from several studies that 57 per cent of countries in Africa liberalized in part of in full their telecom markets and have promoted infrastructure competition. Competition among backbone networks has begun to emerge. This competition has proven both viable and valuable. Where it has been established, the quantity and quality of available backbone capacity have significantly expanded. Some countries, including, Ghana, Kenya, Mauritius, Morocco, Senegal and South Africa, have introduced incentives in their regulation to promote broadband access and uptake. These measures are intended to build demand by removing major constraints to uptake, such as import taxes and lack of energy.

In 2012, Morocco had a combined capacity exceeding 10 terabits per second (Tbps) from three different international submarine cables and landing stations. All three telecom operators have access to international connectivity, with full competition, resulting in a favourable price for international bandwidth. Maroc Telecom controls three submarine stations in which it is a shareholder (Sea-Me-WE4, Atlas Off Shore and Estepona-Tetouan). Méditel has redundant connectivity, with more than two different physical submarine stations and submarine cables. Wana-INWI has only the cable leased from the national electricity grid and a more fragile and insecure international

connectivity, but the situation improved as of December 2012. In 2013, two other independent cables landed in Morocco: Glo1 and Main One.

In specific countries, such as Eritrea and Ethiopia, the legislation does not attract the participation of the private sector in the deployment of broadband infrastructure owing to the regulatory restrictions, such as limits on the number of licences, constraints on the type of infrastructure that licensces are allowed to build and restraints on the services that licensees are allowed to offer. In other countries where the private sector, such as utility companies, electricity transmission operators and railway companies, helps to deploy the broadband infrastructure through alternative transport and energy infrastructure, the cost of public investment in backbone infrastructure has been reduced.

In most African countries, lack of competition and limited open-access regulations pose significant constraints on the effective use of the available international and regional connectivity infrastructurenent (see box 5).

Backbone network competition, where it has been established, has significantly expanded the quantity and quality of available backbone capacity. In some countries, the administrative and regulatory procedures are also challenginge. For example, Nigeria's operators face multiple taxes and fees at local, state and federal levels, with service disruptions relating to tax claims costing the sector millions of dollars annually.

Box 5: Open access to international submarine or terrestrial cables

The concept of "open access" refers to access to terrestrial or submarine fibre optic systems by operators or service providers (holders of a telecommunications operating licence or permit to engage in the provision of telecommunications infrastructure or services) on nondiscriminatory and transparent terms (for pricing and non-pricing aspects) and cost-based pricing.

Previous experience with fibre cables in East and South Africa shows that supporting the development of infrastructure and improving the policies and regulatory framework have an impact on the market. There is a rapid increase in demand when the price of bandwidth decreases.

The Africa Coast to Europe submarine cable connects Europe with 13 countries along the West African coast: Benin, Côte d'Ivoire, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Liberia, Mauritania, Nigeria, Sao Tomé and Principe, Senegal and Sierra Leone. The World Bank is providing financing, under its regional projects, namely, the West Africa Regional Communications Infrastructure Programme and the Central African Backbone, to several African countries to join Africa Coast to Europe, which is committed to public-private partnerships and open-access principles.

The open-access, non-discriminatory treatment of all entities fosters transparency, facilitates market entry and promotes reasonable tariffs, maximizing the developmental contribution of the financing. Access to new submarine capacity on an open-access basis via Africa Coast to Europe is expected to feed directly into lower retail prices and higher bandwidth availablity in these countries. A significant increase in penetration will be set in motion, both for fixed (through asymmetric digital subscriber line or metropolitan fibre) and mobile broadband (through third-generation mobile telecommunications technology dongles or smart phones).

Source: Kelly and Rossotto (2012).

With the growing penetration of mobile broadband and the corresponding market expansion, spectrum allocation is becoming a key regulatory issue. Two approaches are practised in large part around the world. A growing number of regulators are introducing market-based mechanisms, such as in-band migration, spectrum sharing and spectrum trading, to distribute spectrum in an effort to quickly and efficiently meet the demand for fresh spectrum both for 3G and 4G services. A substantial number of regulators, however, still rely heavily on administrative assignment and "beauty contests" to award spectrum licences. In Africa, this second approach is the most common.

Uganda, for example, has made several bands available for mobile services using a first-come,first-served approach without conducting auctions, although they are allowed in the regulations. The Independent Communications Authority of South Africa created a hybrid assignment system involving a first-stage "beauty contest" to pre-qualify bidders. The regulator had some difficulty designing an auction system and finding a qualified auctioneer to run it. Cameroon, Ghana, Nigeria and Senegal are looking to develop 4G service provision through turn-key arrangements with operators.

Lastly, one of the key regulatory issues is the high prices and lack of effective competition in interconnection charges, in particular in mobile services. In this regard, African mobile operators have been leaders in reducing and eliminating international mobile roaming charges. This has happened in cases in which a number of African operators offer cheaper Internet Marketing Services to neighbouring countries or to countries where they already had footprints.

3.5 Challenges

Notwithstanding the progress in establishing a conducive environment for broadband network deployment, African countries face several challenges to strengthen the enabling environment for broadband infrastructure and network development. Barriers include limited fixed infrastructure, high cost and insufficient backbone networks. Broadband connections and services are not available in many localities and unaffordable to the majority of the citizens where available

The challenge remains to prioritize the limited resource in investing on the broadband infrastructure and backbone networks necessary. The private sector alone cannot ensure the provision of broadband services until the last kilometre. Therefore, regulators have a decisive role to play in ensuring that the provision of these services should be extended to the areas concerned by means of a universal service fund.

Access to the submarine cables is a necessary condition, but not sufficient to boost the market for telecoms/ICT, or even broadband, to Africa. This is shown by the fact that African countries that have had access to the submarine cable SAT3 at the same time are at varying levels in terms of the development of broadband.

3.6 Conclusion

Many countries are now having broadband policies put in place. Some countries have made additional efforts to specify strategies focused on key goals and targets, whether

in ensuring universal access or deriving economic benefits and transforming the economy. Decisions on broadband development, including policy adoption, regulation and legislation, are essentially political in nature, requiring the effective participation of political players in relevant Africa countries. In additio, countries need to harmonize policies and regulatory frameworks with neighbouring countries through the existing regional economic community initiatives in order to accelerate broadband uptake on the continent.

CHAPTER 4: Broadband in the context of African regional integration

4.1 Introduction

At the regional level, ICT is recognized as one of the key infrastructure requirements for the continent, along with energy and transport, to advance socioeconomic development and regional integration in Africa. The African Union Commission and regional economic communities have recognized ICT as a critical infrastructure for regional economic integration and have been active since 2002 in exploring the deployment of broadband infrastructure in the region. Broadband offers new opportunities by facilitating trade and social exchange between African countries, as evidenced elsewhere in the world (African Union and the New Partnership for Africa's Development, 2009). In this context several regional ICT initiatives have been undertaken to achieve a broader integration of member countries through broadband infrastructure in order to attain greater economic integration in their relevent subregions.

As a result, owing to the regional nature of broadband network initiatives, it requires significant efforts for countries to cooperate with one other and synchronize/coordinate policies and regulatory frameworks. On the one hand, a much more developed regional integration will help to advance the regional initiatives in this area. On the other hand, an advanced ICT sector in Africa, in particular broadband backbone infrastructure and networks, will likely lead to faster integration of the region by facilitating trade and social exchanges between African countries, as shown elsewhere in the world (African Union and the New Partnership for Africa's Development, 2009).

In recent years, African countries have vigorously pursued an integration agenda as a collective development and transformation strategy. Notwithstanding the strong economic growth recorded, the continent remains marginalized in global economic terms, with its share of world trade standing at only 3.2 per cent. The reasons include constraints that inhibit trade within Africa and trade with developed markets, such as physical transport and communications infrastructure, customs procedures and border administration, weak financial and capital markets, and the lack of a diversified production base and of adequate regional policy coordination (Economic Commission for Africa and others, 2012).

This chapter will review how regional integration and cooperation enhance improved access to broadband on the continent through improving the regional backbone infrastructure, making broadband affordable, expanding access to remote and rural areas and enhancing the policy, regulatory and legal environment at the regional level.

4.2 Impact of broadband on regional trade and integration

Just as railroads and highways have facilitated trade and commerce in the past, broadband is the information superhighway of the twenty-first century that is accelerating global commerce at a rate never imagined before. Remarkably, there has been a growing trend in online consumer purchasing throughout the world's major economies. Sectors that have grown most in online commerce include advertising, software sales, books, entertainment, travel, event tickets, clothes and consumer electronics.

African countries have recognized the importance of intra-Africa trade. To this end, efforts have been under way to realize an African continental free trade area, while some of the regional economic comunity have already ebgun to implement free trade agreements in the various subregions. As shown in tables 4 and 5, both the sources of African regional economic community imports and the destination of their exports show that African countries trade with one other less while they are striving to ensure trade integration.

As shown in table 4, some of the regional economic communities perform better than others in terms of intra-African exports. For example, the Arab Maghreb Union,

Table 4: Destination of African regional economic community exports, on average, 2000-2015 (Percentage of world total)

Regional economic community	United States of America	Japan	Brazil	China	European Union	Africa	Rest of the world
Arab Maghreb Union	2.8	3.1	0.7	10.6	4.6	64.5	13.7
Central African Economic and Monetary Community	25.8	4.8	1.4	17.9	27.2	4.5	18.4
Community of Sahelo-Saharan States	14.1	1.8	3.4	4.7	43.0	11.3	21.7
Common Market for Eastern and Southern Africa	5.2	1.8	0.6	10.5	45.6	13.1	23.1
East African Community	4.4	2.3	0.0	4.4	25.4	36.7	26.8
Economic Community of Central African States	23.0	2.2	1.3	30.1	20.5	4.8	18.1
Economic Community of the Great Lakes Countries	6.5	0.2	1.0	31.7	27.4	20.6	12.6
Economic Community of West African States	21.9	2.0	5.8	2.3	30.0	14.8	23.1
Indian Ocean Commission	11.8	2.3	0.0	1.7	56.2	10.1	17.9
Intergovernmental Authority on Development	3.2	6.0	0.0	26.2	16.7	21.7	26.2
Mano River Union	8.4	0.2	0.5	3.3	40.9	26.7	20.0
Southern African Development Community	12.3	4.2	0.7	17.6	24.7	18.2	22.3
West African Economic and Monetary Union	5.5	0.4	0.5	3.8	30.5	33.6	25.6

Source: Compiled from United Nations Conference on Trade and Development database.

the East African Community, the West African Economic and Monetary Union, the Intergovernmental Authority on Development and the Southern African Development Community (SADC) perform better, with 64.5, 36.7, 33.6, 21.7 and 18.2 of their exports, respectively, destined within Africa. Similarly, the European Union and the United States remain the major source of imports for most African countries (see table 5).

As shown in table 5, some regional economic communities perform better than others with regard to intra-Africa imports. SADC, Economic Community of Central African States, East African Community, Common Market for Eastern and Southern Africa (COMESA) and Economic Community of West African States (ECOWAS) imports from within Africa represent, respectively, 22.4 per cent, 19.5 per cent, 17.3 per cent, 15.8 per cent and 14.7 per cent of their import volume.

Major regions, such as the European Union, Asia and countries of the North American Free Trade Agreement and of South America trade more among themselves than with the rest of the world. By contrast, the main trading partners of the African regional economic communities are located outside the continent. This is therefore the main challenge for Africa in creating a continental free trade area that will help to build African markets and intra-African trade (from the current low average of 10 per cent

Table 5: Sources of Africa regional economic community imports, on average, 2000–2015 (percentage of world total)

Regional economic community	United States of America	Japan	Brazil	India	China	European Union	Africa	Rest of the world
Arab Maghreb Union	4.9	1.8	2.0	1.3	8.0	53.2	5.6	23.2
Central African Economic and Monetary Community	8.7	1.0	1.8	2.2	10.3	41.2	21.3	13.4
Community of Sahelo-Saharan States	6.9	2.0	2.1	3.5	11.5	37.6	9.5	26.9
Common Market for Eastern and Southern Africa	6.0	2.7	1.7	5.3	11.6	25.9	15.8	31.0
East African Community	4.2	4.5	0.6	13.3	12.9	16.8	17.3	30.4
Economic Community of Central African States	7.9	1.1	3.6	2.2	11.9	37.8	19.5	16.0
Economic Community of the Great Lakes Countries	2.9	1.2	0.7	2.5	9.6	24.9	47.2	10.9
Economic Community of West African States	7.8	1.8	2.2	4.2	15.9	33.0	14.7	20.3
Indian Ocean Commission	2.5	2.4	0.6	11.8	13.1	25.7	12.7	31.3
Intergovernmental Authority on Development	5.1	3.9	0.9	9.6	16.4	17.6	11.9	34.6
Manu River Union	3.1	2.9	1.1	3.0	9.3	30.7	26.4	23.5
Southern African Development Community	6.0	3.6	1.8	4.3	11.5	26.8	22.4	23.6
West African Economic and Monetary Union	3.5	1.4	1.3	3.5	11.1	35.4	26.8	17.2

Source: Compiled from United Nations Conference on Trade and Development database.

during the past decade). The continental free trade area is also expected to help Africa to regain its lost share of global trade of 5 per cent in the mid-1960s, compared with 3.2 per cent in recent years. In this respect, broadband, with its potential to facilitate trade through online trade and e-commerce, will have a great role in enhancing implementation of the continental free trade area agenda.

Most regional economic communities have introduced plans for one-stop/joint border posts. COMESA, SADC, the East African Community and ECOWAS have committed themselves to trade facilitation by developing continental and regional information and communication infrastructures and by simplifying and harmonizing cross-border procedures. In this regard, the regional economic communities, ECA and the African Union Commission have developed e-strategies that address regional communications policy and financing and regulatory issues to promote and develop the trade in goods and services through e-commerce. To this end, the regional broadband infrastructure initiatives of the regional economic communities and other international organizations discussed below would facilitate the regional trade integration efforts.

4.3 Regional broadband initiatives

The regional economic communities have played a major role in promoting greater regional integration through broadband to accelerate broadband uptake and use in the region. The regional initiatives focus not only on building a seamless interregional broadband infrastructure network, but also on the harmonization of policy and regulatory frameworks governing ICT infrastructure development. For example, the key initiatives include COMTEL for COMESA ICT infrastructure; RICTSP, funded by the European Union to enhance the policy and regulatory framework for economic integration in COMESA; the Southern African Regional Information Infrastructure for SADC; and the East African Backhaul System for the East African Community.

Both the Intergovernmental Authority on Development and the East African Community have a RICTSP component. These initiatives, specifically COMTEL, the Southern African Regional Information Infrastructure and the East African Backhaul System, were incorporated under the New Partnership for Africa's Development (NEPAD) broadband infrastructure project by a decision of the Conference of Ministers in charge of ICTs in 2004. The activities were consolidated and put under the NEPAD high-level broadband infrastructure, commonly known as the Kigali Protocol, in 2006.

Box 6: Regional backbone initiatives

The absence of regional connectivity between States with access to the submarine cable and landlocked countries and, more generally, the scarcity of cross-border backhaul links is one of the key broadband access gaps in Africa.

Central African backbone: The project is aimed at implementing a telecommunications network comprising onward terrestrial fiber connections linked to undersea optical fibre cable systems in the African west coast (SAT3) that would link several Central African countries and provide the region with a digital broadband access to the global fibre network. The planned broadband backbone would leverage the fiber optic infrastructure laid along the oil pipeline between Kribi, Cameroon, and Doba, Chad, and will interconnect in its phase 1 three countries: Cameroon, the Central African Republic and Chad.

East Africa broadband network: The project is aimed at implementing an integrated East African broadband ICT infrastructure network that would provide cross-border connectivity between five East African Community partner States (Burundi, Kenya, Rwanda, Uganda and the United Repulic of Tanzania) and link to global gateways through submarine fibre cable systems.

Maritime communications for safety on Lake Victoria: The project is aimed at establishing maritime communications for Lake Victoria with the following components: (a) a wireless communications system based on GSM technology, allowing two-way contact between boats in distress and rescue centres; (b) a regional maritime communications centre, with capacity to process distress radio traffic from the public in the region; and (c) a maritime communications system that would facilitate search and rescue operations. Lake Victoria is shared by three countries: Kenya, Uganda and the United Republic of Tanzania.

Southern Africa region backbone (SATA backhaul): The project is aimed at improving cross-border links that would interconnect the Southern African Development Community member States. The objective is to improve cross-border connectivity of the SATA participating members member countries through optical fibre networks and link them to submarine cable systems, including the Eastern african submarine cable system.

West Africa network: The project is aimed at improving the connectivity between Economic Community of West African States (ECOWAS) offices and affiliated organizations, therefore contributing to the integration of the ECOWAS region by providing a robust platform for regional information systems. The network is an Intranet linking all member Sstate capitals and enhanced with broadband communications. It will serve as the enterprise information system for ECOWAS and will be connected to the global internet. It is ECOWASowned and operated, and accessed only by ECOWAS officials and affiliated organizations.

ECOWAS power pool-based fibre network: The objective of the West Africa Project Pool project is to expand broadband access in the ECOWAS region by first leveraging the Power Pool's communications infrastructure network and linking its network to national and regional infrastructure to bridge connectivity gaps in the ECOWAS region.

Source: African Development Bank, ICT initiatives. Available from www.afdb.org/en/topics-and-sectors/sectors/information-communication-technology/ict-initiatives/.

Table 6: Status of broadband development in the East African Community

Description	Burundi	Kenya	Rwanda	United Republic of Tanzania	Uganda
Backbone submarine	N/A	(a) Two landing stations: TKL and Seacom (b) Three networks: EASSy, Seacom and TEAMS	N/A	(a) Two landing stations: Zantel and Seacom (b) Two networks: EASSy and Seacom	N/A
Backbone terrestrial optical fibre backbone infrastructure	Jointly owned optical fibre backbone infrastructure	Three private optical fibre backbone infrastructure operators and one public operator (Government of Kenya)	Three optical fibre backbone infrastructure operators and one public	One public optical fibre backbone infrastructure operator	Three private optical fibre backbone infrastructure operators and one public operator
Backbone cross-border optical fibre backbone infrastructure	Optical fibre backbone infrastructure interconnects: Burundi/ United Republic of Tanzania: 2 Burundi/ Rwanda: 1	Optical fibre backbone infrastructure interconnects: Kenya/United Republic of Tanzania: 2 Kenya/ Uganda: 1	Optical fibre backbone infrastructure interconnects: Rwanda/ Burundi: 1 Rwanda/ United Republic of Tanzania: 2 Rwanda/ Uganda: 2	Optical fibre backbone infrastructure interconnects: United Republic of Tanzania/ Burundi: 2 United Republic of Tanzania / Kenya: 2 United Republic of Tanzania / Rwanda: 2 United Republic of Tanzania / Uganda: 1	Optical fibre backbone infrastructure interconnects Uganda/Kenya: 1 Uganda/ Rwanda: 2 Uganda/ United Republic of Tanzania: 1
Access	(a) Liberalized (b) Limited coverage	(a) Liberalized (b) Limited coverage	(a) Liberalized (b) Limited coverage	(a) Liberalized (b) Limited coverage	(a) Liberalized (b) Limited coverage

Source: East African Community reports, regulator websites and operator reports.

As shown in table 6, the backbone cross-border interconnections between two or more countries show the regional collaboration and cooperation that will result in improved access to broadband in countries, whether they have coastal links to international connectivity or are landlocked countries that do not have direct international connectivity access.

4.3.1 Regional policy, regulatory and legal frameworks

The existence of an enabling policy and regulatory environment is a key factor for the growth and widespread adoption of broadband. Such regional policy and regulatory frameworks are important in harmonizing the policy and regulatory frameworks at the national level. In this regard, ECOWAS provides a good example. A binding mechanism, such as a regional law, that helps to ensure national adoption of policies and regulations promulgated at the regional level would help in this respect. ECOWAS and the European Union have benefited from this type of mechanism to encourage rapid regional harmonization and policy development, in which penalties can be applied to member

States that fail to comply with ECOWAS directives. The decisions of the regional telecommunication regulatory association, the West African Telecommunications Regulators Assembly, that are endorsed by ECOWAS therefore become mandatory for transposition to the national level.

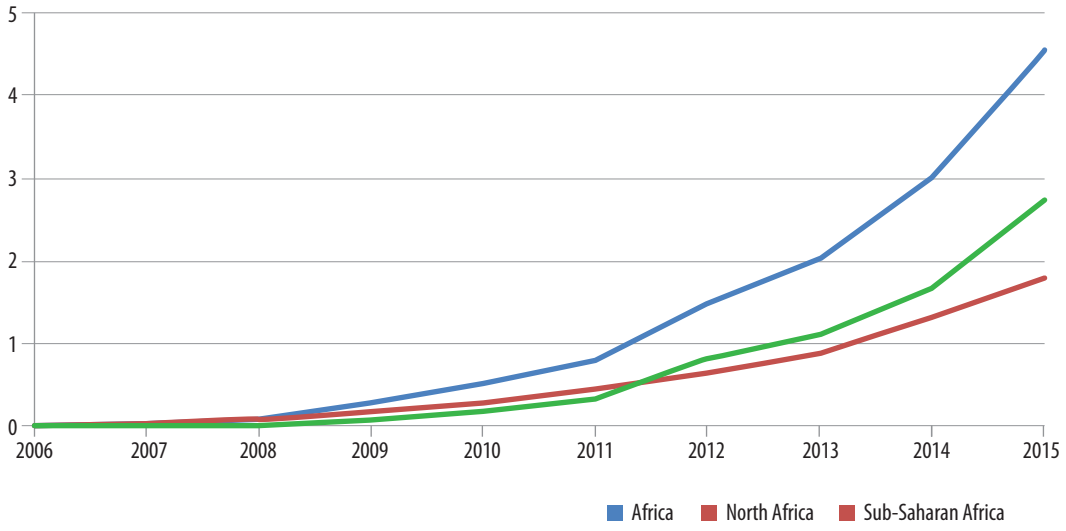
The East African Community broadband infrastructure network agreement of 2009 is aimed at contributing to the harmonious, balanced, equitable and sustainable development of member States' territories and the region by facilitating the speedy establishment of the regional ICT broadband infrastructure network or networks on open-access principles and the harmonization of policies and regulatory frameworks of the member States (East African Community, 2009).

In 2007, African leaders and development partners, including the private sector, convened at the Connect Africa Summit, held in Kigali, and agreed on a set of goals to interconnect the continent and ensure high-capacity and high-speed connection in the region, which also resulted in commitments amounting to more than $55 billion, with the ICT industry taking the lead.[5]

As result, investment in the landing of submarine optical fibre cables in East and West Africa and the expansion of national backbone networks had increased considerably since 2007. Overall Africa's international bandwidth was 96.3 Gbps in 2008, increasing from 26.1Gbps in 2007. It increased twenty-fold during the period 2007-2013 and passed the 2 Tbps mark by December 2013.

On the other hand, a significant milestone in the development of broadband in Africa was the adoption by the African Union Summit in January 2014 of the "Smart Africa

Figure XIII: Africa international Internet bandwidth, 2006-2015



Source: Africabandwidthmaps.com.

[5] See International Telecommunication Union, "USD 55 billion committed to connect Africa", 31 October 2007. Available from www.itu.int/newsroom/press_releases/2007/34.html.

manifesto" which is a unique regional framework to enhance connectivity on the continent, among other objectives. As a result, African's internatonal bandwidth reached 4.6 Tbps in 2015.

4.3.2 Regional backbone infrastructure for integration

A major first step to achieving economic integration in Africa is infrastructural development. Accordingly, there are several initiatives in Africa aimed at creating a communications infrastructure conducive to achieving the continental goals of increased integration and cooperation. To this end, at the regional level, the importance of regional cooperation in enhancing regional backbone infrastructure can be viewed from three levels: the system of submarine cables and landing stations that provide the continent with access to the international communications infrastructure the terrestrial infrastructure comprising optical fibre for both cross-border links and infrastructure within countries and the Internet exchange points and data centres that play key roles in routing Internet protocol traffic transmitted through regional infrastructure.

4.3.2.1Submarine cables and landing stations

In 2007, Africa's telecommunication links to the rest of the world were very limited, with only one intercontinental submarine cable in operation, namely, the SAT-3 cable along the west coast of the continent, with none along the east coast. As a result, Africa had to depend heavily on scarce and expensive satellite capacity for international connectivity. After the mid-2000s, the situation changed dramatically, drivenprimarily by three factors: (a) the widespread adoption of mobile phones throughout the continent, bringing growth in both bandwidth demand and telecom revenue; (b) lending from international financiers such as the World Bank, the African Development Bank and private financiers became available, with increased infrastructure projects in the region, mainly fibre optic networks; and (c) the submarine cable suppliers began to focus on potential opportunities in Africa by proposing attractive prices for potential new African projects in an attempt to stimulate demand (TERABIT Consulting, 2013) (see table 7 and figure XIV for African submarine cable profiles and the African submarine cables map).

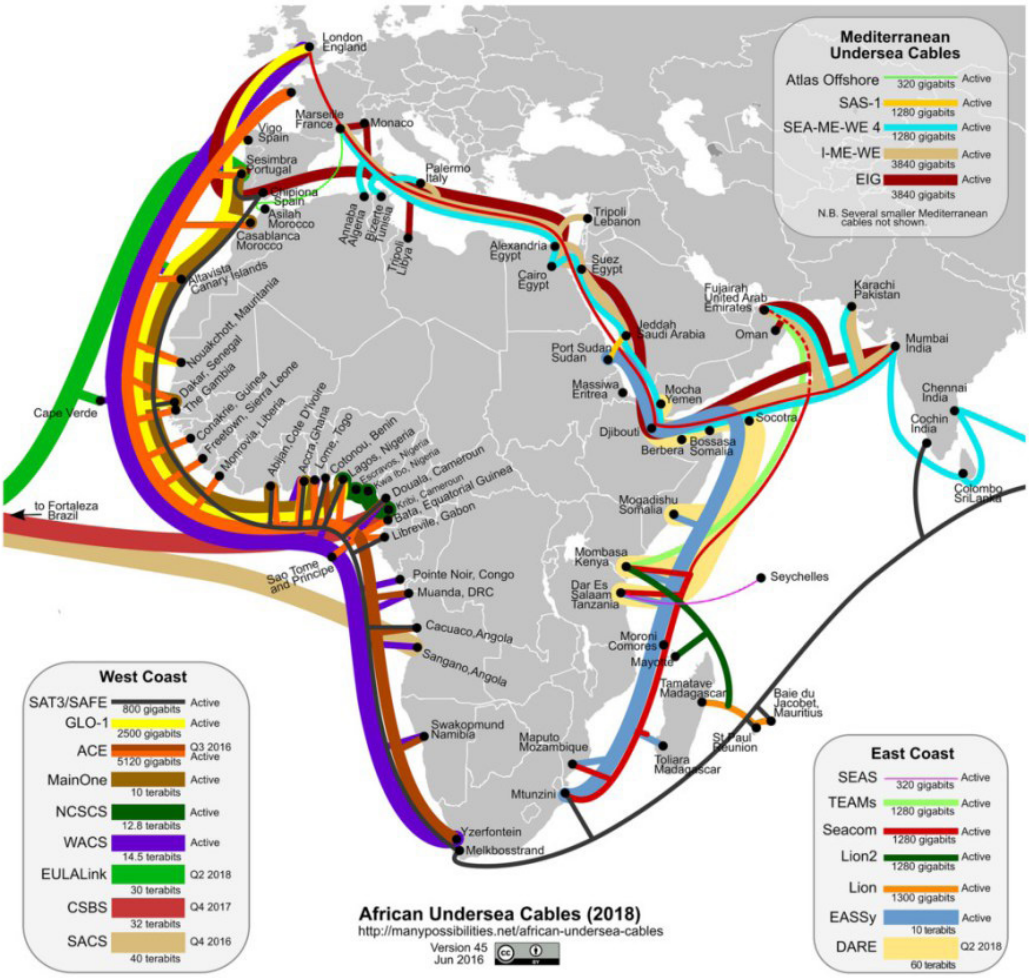
Table 7: African submarine cable profiles

African Submarine Cable Profiles

Name	RFS	Cost (USD Millions)	Lit Capacity (Gbps)	Max Capacity (Gbps)
East Africa				
Eastern African Submarine Cable System (EASSy)	Jul-10	$248	190	4,720
Lion2	Q2 2012	$75	–	1,280
SEACOM/Tata TGN-Eurasia	Jul-09	$700	110	1,280
Seychelles to East Africa Systems (SEAS)	2012	$38	–	640
The East African Marine System (TEAMS)	Oct-09	$100	120	1,280
North Africa				
Algeria-Spain	Jun-11	$14	–	–
Europe India Gateway (EIG)	Feb-11	$700	660	3,840
FLAG Europe-Asia (FEA)	Nov-07	$1,600	440	4,680
FLAG Hawk	2011	–	100	2,720
IMEWE	Dec-10	–	730	3,840
Middle East North Africa (MENA) Cable Systems	2012	$400	180	5,760
SeaMeWe-3	Sep-99	$1,173	400	–
SeaMeWe-4	Dec-05	$500	1,620	4,800
Silphium	Sep-11	$10	70	1,200
TE North	Jul-11	$140	520	20,480
Sub-Saharan Africa				
Atlantic Cable System-Africa (ACSeaAFR)/South Atlantic Cable System (SACS)	Q2 2014	–	2 Tbps	32 Tbps
South Atlantic Express (SAEx)	Q2 2014	$260	400 Gbps	24 Tbps
WASACE Africa	Q4 2014	–	–	–
West Africa				
Africa Coast To Europe (ACE)	2012	$700	–	5,120
GLO-1	2010	$600	–	2,560
Main One	Jul-10	$240	90	1,920
SAFE	Apr-02	$290	440	440
SAT-3	Apr-02	$507	340	340
West African Cable System (WACS)	Q1 2012	$600	500	5,120

Source: TeleGeography (2012).

Figure XIV: Map ofAfrican submarine cables

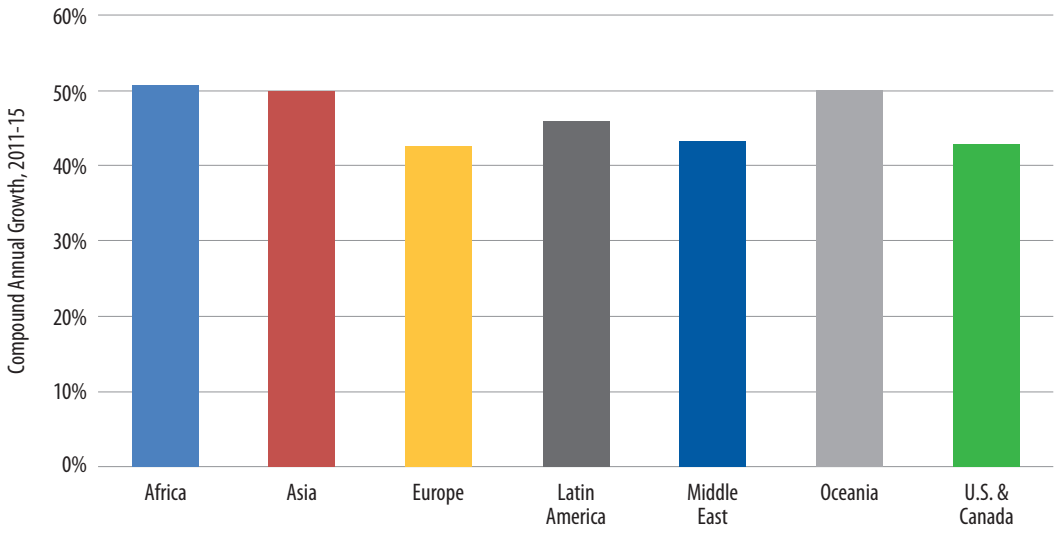


Source: Many Possibilities. Available from https://manypossibilities.net/african-undersea-cables/.

The deployment of these submarine systems has had a dramatic impact on the continent's international bandwidth, with annual growth in demand exceeding 100 per cent in many countries. The total lit capacity in sub-Saharan African submarine cable systems increased by 71 per cent annually during the period 2010-2015, with the availability of more than 25 Tbps bandwitdth capacity. As shown in figure XV, Africa has been the fastest-growing region, with international bandwidth demand increasing 69 per cent, compounded annually, between 2011 and 2015.

Consequently, African operators need to expand their networks to meet the growing bandwidth demand.

Figure XV: Used international bandwidth growth by region, 2011-2015 (Per cent)



Source: Adapted from TeleGeography, Global bandwidth research service, executive summary, figure 2 (2016). Available from www.telegeography.com/page_attachments/products/website/research-services/global-bandwidth-research-service/0006/7209/gb16-exec-sum.pdf.

4.3.2.2 Terrestrial optical fibre infrastructure

The landing stations, which play an essential role in connecting Africa to the rest of the world, have a privileged position in the regional and continental infrastructure. Nevertheless, countries, mainly landlocked African countries that do not have access to landing stations of their own, will have to rely on the terrestrial infrastructure and transborder connection with countries with a landing station on international submarine cables.

While there is extensive coverage of backbone networks in the region, it is found predominantly within and between major urban areas and on intercountry routes. There is therefore a concentration of backbone network development in specific countries resulting from the effect of infrastructure competition. In countries where the backbone market is liberalized, however, new entrants have focused backbone network construction in the same areas in which the incumbent operator already has its network. However, a good regional integration indicator in terms of the geographical development of fibre optic cable networks is that they often connect to borders.

For example, in Kenya, the two major fibre networks both extend from Nairobi to the Ugandan border, even though there are few major population centres in this area. The main reason for choosing this route was that it would be able to carry traffic between Uganda and the coastal landing stations of the submarine cables. This trend is being seen throughout the region, unless political or regulatory issues constrain the networks extending to key border crossing points. The question is how landlocked countries are being served, which is another key regional integration issue.

Looking at some of the regional initiatives in this area, for example, in East African Community, there are two initiatives for interconnecting national networks in the subregion, namely, the East African Community broadband ICT infrastructure network, which is a public sector initiative, and the East Africa backhaul system, which is a private sector initiative.

There are national operational fibre cable networks in all five countries of the East African Community, except Burundi. National coverage varies from country to country, but, overall, major transport corridors and urban centres are covered.

Another example is the ECOWAS wide area network, which is a public sector e-governance network. It has put in place a fibre optic network within member States ("middle mile" connectivity), enhanced cross-border penetration and "last mile" (end user) connectivity. The coastal corridor leg of the network will connect cities along the coast and develop internal connections for the Gambia, Guinea, Guinea-Bissau, Liberia and Sierra Leone (Commonwealth Business Council, 2013).

This initiative is intended to ensure that each member State has at least two broadband infrastructure connections and to provide access to submarine cables for all landlocked countries. The project will secure access to landing stations in ECOWAS. Implementation will include feasibility studies and business plans on links, including Mali–Niger–Nigeria and Burkina Faso–Benin, and broadband links between Mano River countries (Côte d'Ivoire, Guinea, Liberia and Sierra Leone) and neighbouring countries (Guinea-Bissau, Mali and Senegal).

Through a number of such initiatives, the expenditure on cross-border terrestrial fibre in Africa in 2010 was $12 billion. As a result, the total capacity of terrestrial cross-border routes in sub-Saharan Africa grew from 33 Mbit/s in 2005 to 30,960 Mbit/s in 2011, as shown in figure XVI.

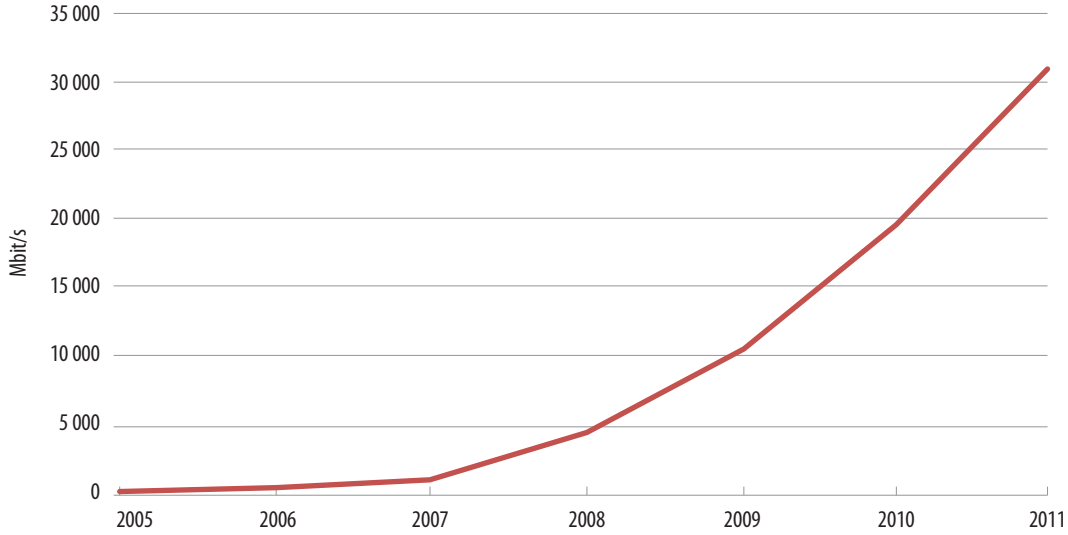
These facilities are important not only to allow landlocked countries to reach the landing points for undersea cables, but also to handle regional traffic without tromboning and to allow the development of Internet exchange points as regional hubs (International Telecommunication Union, 2013).

Table 8: East African Community national optical fibre cable deployment

Country	Infrastructure deployed by:
Burundi	National optical fibre cable under deployment
Kenya	Government of Kenya, TKL, Kenya Data Networks, Jamli Telecom and Kenya Power
Rwanda	Government of Rwanda and MTN
Uganda	Government of Uganda, UTL, MTN, UETCL (i.e., power utility)
United Republic of Tanzania	The Government has consolidated optical fibre deployment by all operators into one network, namely, the National ICT Broadband Infrastructure

Source: National broadband strategy of the countries listed in table.

Figure XVI: International Internet bandwidth in sub-Saharan Africa supplied by terrestrial cross-border networks



Source: Africabandwidthmaps.com

4.3.2.3 Regional exchanges

Independent analysis has shown that Africa pays more than $600 million annually to countries with more developed infrastructure for intracountry and inter-African traffic exchange that is routed outside the continent.

The effect of the lack of local exchange points is shown by tracing the path followed by an internet data packet from Kigali to Nairobi. The data packet from Kigali will go through the terrestrial fibre optic cables that traverse Nairobi and use one of the three submarine cables landing at the port city of Mombasa, Kenya, to go to Europe. From there, it returns to Nairobi using the same cables. This is an indication of the challenge of insufficient Internet exchange points on the continent.

Where there is direct interconnection between major cities, it is also clearly indicated that the former satellite routing policies remain predominant in a submarine cable and terrestrial fibre infrastructure setting. This is therefore one of the major obstacles to development of the Internet in Africa that regional policymakers and regulators need to address (Commonwealth Business Council, 2013).

Table 9: Internet exchange points and data capacity, 2012-2013

	Internet exchange points				Domestic bandwidth production			
	Feb 2012	Feb 2013	Net change	Change (per cent)	Feb 2012	Feb 2013	Net change	Change (per cent)
Africa	23	24	+1	+4	5.63G	11.9G	+6.24G	+111
Asia and thePacific	74	76	+2	+3	1.32T	1.52T	+202G	+15
Europe	144	149	+5	+3	9.74T	10.6T	+1.87T	+21
Latin America and the Caribbean	40	46	+6	+15	115G	193G	+77.8G	+68
North America	86	88	+2	+2	1.26T	1.47T	+210G	+17
Total	367	383	+16	+4	11.4T	13.8T	+2.36T	+17

Source: African Internet Governance Forum (2014).

Internet exchange points provide a mechanism for their members, including Internet service providers, backbone providers and content providers, to interconnect their networks and exchange traffic directly. The exchanges encourage the local routing of domestic or regional Internet traffic by facilitating the interconnection between all the players in order to reduce costs and maximize performance (Analysys Mason, 2012).

Figure XVII: Map of African Internet exchange points

Source: TeleGeography (2012).

This picture will also change in the near future once the current African Union Commission-led African Internet Exchange System project is completed. The initiative will establish Internet access points in 30 African Union member States, with the aim of keeping African Internet traffic within the region.

SADC is ahead of other regions in Africa, with the majority of member States hosting at least one Internet access point. There are more than 13 Internet access points in the subregion, with only Madagascar, Seychelles and Swaziland lacking one. Nevertheless, local traffic is not always exchanged through the Internet access points, given that it is cheaper to use external exchanges than local ones. As a result of the lack of regional exchanges (although their emergence is natural owing to the vibrancy of local traffic exchanges) and the absence of national exchanges in some SADC member States, along with many poorly functioning existing Internet access points, millions of dollars annually are paid as indicated above to off-continent Internet transit providers for traffic that could stay local or regional (Southern African Development Community, 2012).

4.4 Challenges to and constraints on regional integration

Regional integration faces multiple challenges, which underline the need to strengthen coordination among regional economic communities. While the continent has succeeded in rapidly increasing access to basic voice communications, broadband penetration has been slow on the continent, owing primarily to high prices, limited availability and low market maturity. Among the key challenges are energy access, harmonized policies and regulations and the development of and access to regional broadband infrastructure to drive market integration

terms of harmonization policies and regulation, notwithstanding the several initiatives by regional economic communities, the level of transposition or implementation of these policies and regulation at the member State level is relatively slow and inconsistent. Other communities could adopt the best practice of the ECOWAS subregion in mainstreaming the regional policies and regulation decision at the national level.

infrastructure is developing well in the region, the regulatory environment to enhance affordable broadband access remains challenging. African countries need to have an infrastructure of ICT broadband that is modern and reliable in order to attract new infrastructure investment, thereby creating jobs and the full social and economic integration of the region. This is evident, for example, in the effect of competition on national backbone pricing, which can be observed when comparing prices for capacity between, for example, South Africa (which has at least four competing backbone providers) and Namibia, where Telecom Namibia is the only provider. In South Africa, the cost of capacity is currently at least 45 per cent less than the same capacity on the Namibian side.

The majority of next-generation sub-Saharan African submarine cable projects are either majority or wholly funded by telecommunications operators, sometimes in the form of consortium projects, such as the Eastern Africa Submarine Cable System and the West Africa Cable System. Given that the carrier-funded projects are based on

the operator's own estimated bandwidth needs, they are, in general, perceived to be less risky than the investor-led models predicated on the sale of wholesale capacity to operators.

The role of the private sector in backbone infrastructure development has not been utilized. The wholesale markets in backbone capacity are poorly developed. There are few examples of joint ventures on the construction and operation of terrestrial backbone networks and there is little sharing of backbone network facilities. In addition to deploying infrastructure that attains the lowest unit cost, network operators should be able to optimize their network topology and peering relationships.

4.5 Conclusion

As observed from this analysis, broadband plays an important role in enhancing regional integration and trade facilitation, apart from its role in connecting people. Without affordable regional backbones providing multiple routes to each member State in the region, African countries will not be able to fulfil all their objectives for supporting regional socioeconomic integration. Nevertheless, the key regional integration question is how to make the market work for Africa, given that the current African submarine cable market is based on the wholesale capacity business model.

Studies show that, owing to the historical resistance to consolidation among operators and to transborder market integration, and notwithstanding the persistently high bandwidth prices – some sub-Saharan African countries still spend hundreds of dollars per Mbps for Internet transit bandwidth through Europe – Africa's wholesale bandwidth market continue to benefit multiple submarine cable projects. In fact, the challenge for African countries is broadband readiness, which is an important step for infrastructure development.

The uptake and use of broadband helps to stimulate broadband infrastructure deployment and enhances affordable access. In this regard, for broadband to have a substantial impact on regional cooperation and integration, regional economic communities need to play a leading role in regional consultations and in the development of e-strategies that address regional communications policy, financing and regulatory issues in a way that promotes harmonization. This can be realized through activities ranging from joint venture infrastructure deployment to promoting open access and instituting effective regulation.

CHAPTER 5: Regulation and pricing of broadband services

5.1 Introduction

One of the key determinants of the widespread uptake and use of ICT services has been price. Affordability remains a barrier to Internet access in many African countries. In this regard, it would be appropriate to examine the effects of competition in driving down prices, for example, through innovative mechanisms in the cellular mobile market whereby low prepaid prices can become a key enabler for the mass uptake of mobile cellular services observed in Africa and other parts of the developing world. Regulations are key instruments that policymakers and regulators have been using to influence competition. Consequently, the roles of regulation and competition are both of paramount importance in enhancing the affordability of ICT prices.

Innovative regulatory models and competition helped to reduce prices. For example, the pro-competitive measures in developed countries, such as mobile number portability, reductions in mobile termination rates and the licensing of new entrants, including mobile virtual network operators, have been implemented to drive the prices down. Similarly, in many developing countries, operators have developed innovative prepaid offers at reduced prices to reach the huge customer base that was previously untapped. Doing so has helped to make the market grow organically and benefit from economies of scale.

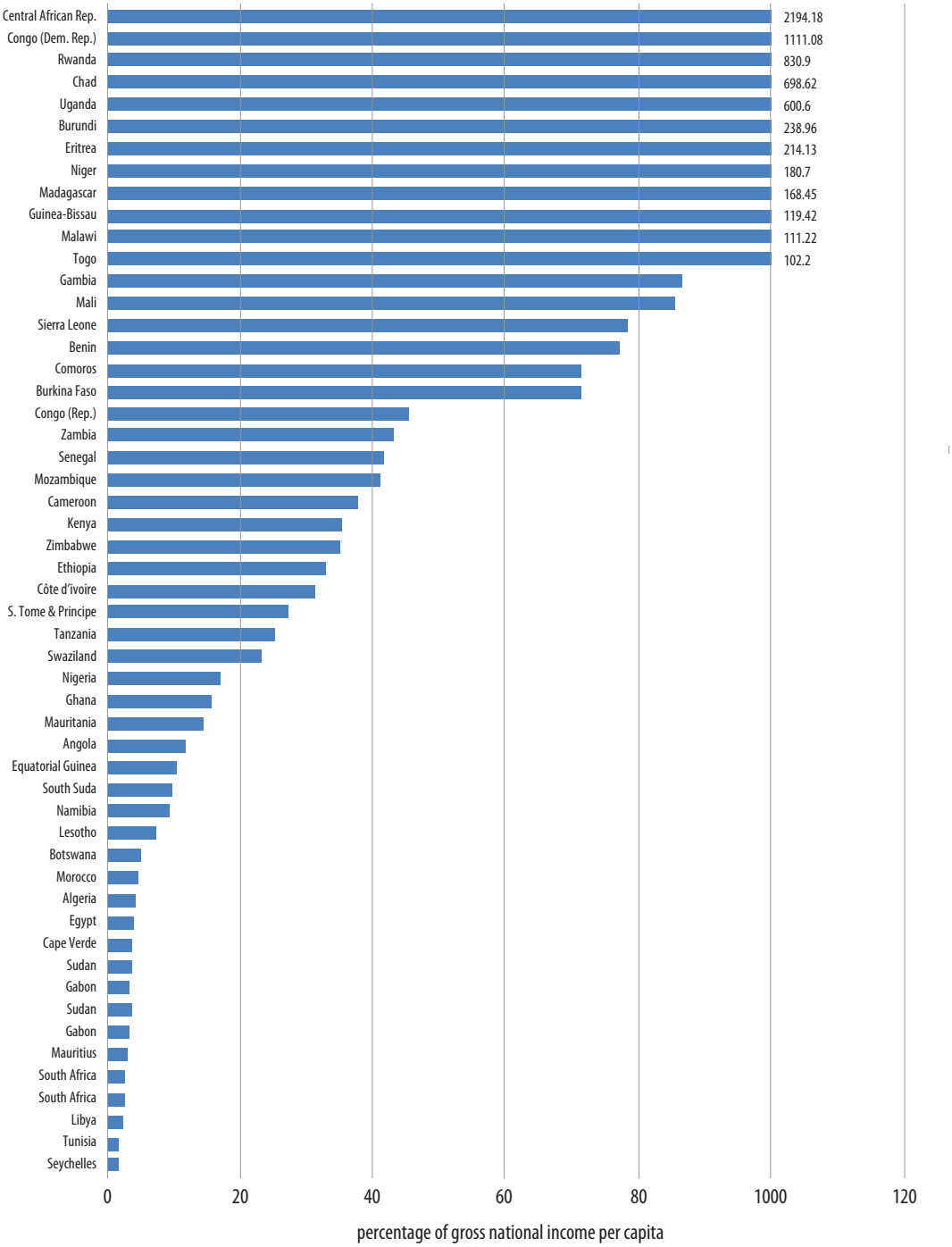
This chapter examines prices in the broadband market, highlighting some pricing trends, including in the most prevalent broadband segment, namely, mobile broadband. This is also analysed in the context of income inequality and how low-income segments of the population might be excluded from the digital economy by price barriers. There is therefore a need to assess the impact of competition and regulation on ICT prices.

5.2 Fixed-broadband prices in Africa

Fixed broadband continues to be a critical service for accessing high-speed, high-capacity and reliable Internet services. Given the limited deployment of advanced mobile broadband technologies, fixed broadband remains the main option for accessing high-volume Internet applications and services. Since 2010, there has been a shift in the entry-level fixed broadband speeds in developing countries, from 256kbit/s in 2012 to 1 Mbit/s becoming the most common entry-level speed in 2013.

As shown in figure XVIII, only 6countries have entry-level fixed broadband prices below the 5 per cent gross national income per capita affordability threshold, including Seychelles (1.44 per cent), South Africa (2.46 per cent), Mauritius (2.87 per cent), Gabon (3.42 per cent) and Cabo Verde (3.55 per cent). On the other hand, Mauritius and Seychelles are the African countries with the highest fixed broadband penetration, with a nearly 13 per cent penetration rate.

Figure XVIII: Fixed broadband prices as a proportion of gross national income per capita in Africa, 2014 (Per cent)



Source: International Telecommunication Union (2015).

These could be due to their low fixed broadband prices and their relatively strong economies with high levels of gross national income. Nevertheless, this conclusion might not always be true, given the comparison between penetration in Cabo Verde and South Africa, the two countries with a relatively lower and higher gross national income per capita. Cabo Verde and South Africa rank third and fourth among African countries with the highest fixed broadband penetration, at 4 and 3 per cent, respectively. However, notwithstanding having a lower gross national income per capita than other

African countries, they stand out for their inexpensive entry-level fixed broadband prices ($10.7), three times lower than in Gabon ($30.4).

This suggests that Gabon could progress in terms of fixed broadband adoption (0.5 per cent penetration by the end of 2013) if cheaper prices were available. Other countries with higher incomes than Cabo Verde, such as Angola, Botswana, Equatorial Guinea and Namibia, could meet the Broadband Commission for Digital Development's target of offering broadband services at prices below 5 per cent of gross national income per capita by 2015.

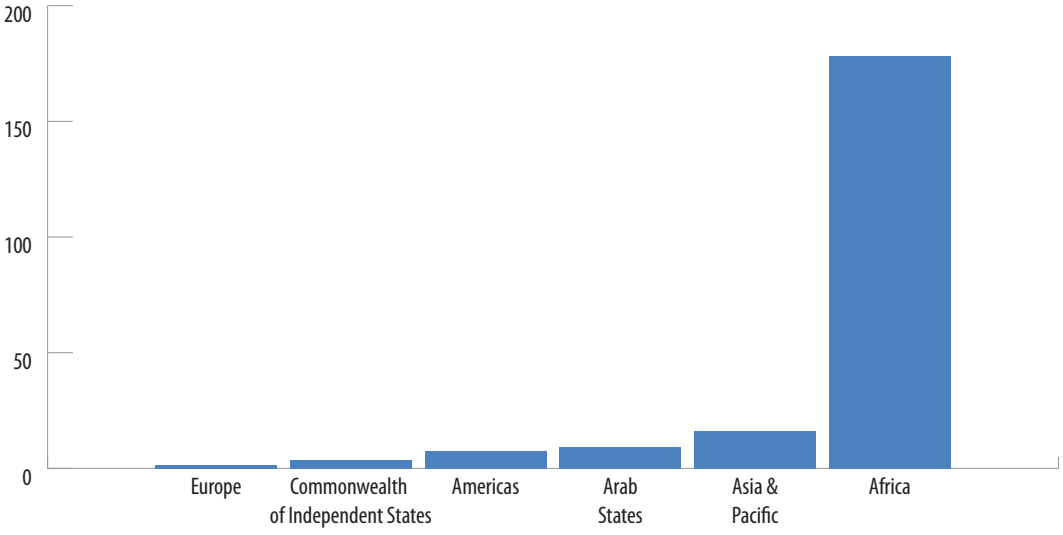
Clearly, the continent has the least affordable fixed broadband prices in the world, with an average price of more than 100 per cent of gross national income per capita. In seven African countries, namely, Burundi, Central African Republic, Madagascar, Malawi, Niger, Rwanda and Togo, fixed broadband plans cost more than 100 per cent of gross national income, which is an issue that coincides with the low level of fixed broadband penetration. Globally, it is evident that Africa is where broadband is the most expensive and unaffordable to ordinary citizens.

Although global fixed broadband prices are falling, the situation in Africa is, in general, one of stagnation. Indeed, the service has become even more expensive in a number of developing countries, especially those in Africa (see figure XIX).

5.3 Mobile broadband prices in Africa

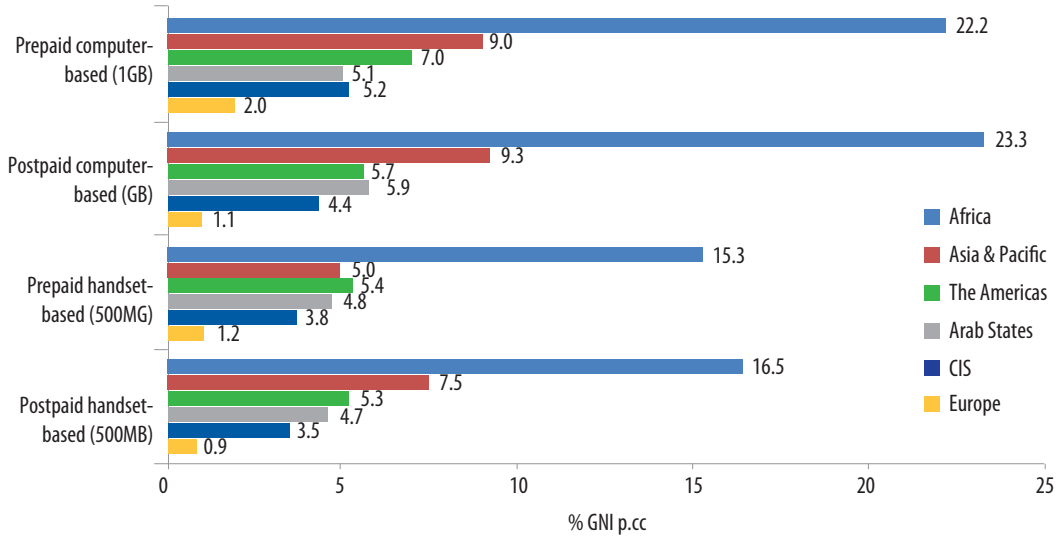
Similarly, mobile broadband is also the least affordable in Africa, compared with other regions of the world (see figure XX), although mobile broadband prices tend to be cheaper than those for fixed broadband. Nevertheless, mobile Internet is the most dynamic, with prices continuing to fall and usage and penetration continuing to rise.

Figure XIX: Fixed broadband prices as a proportion of gross national income per capita, by region, 2014 (Per cent)



Source: International Telecommunication Union (2015).

Figure XX: Mobile broadband prices as a proportion of gross national income per capita by region, 2013 (Per cent)

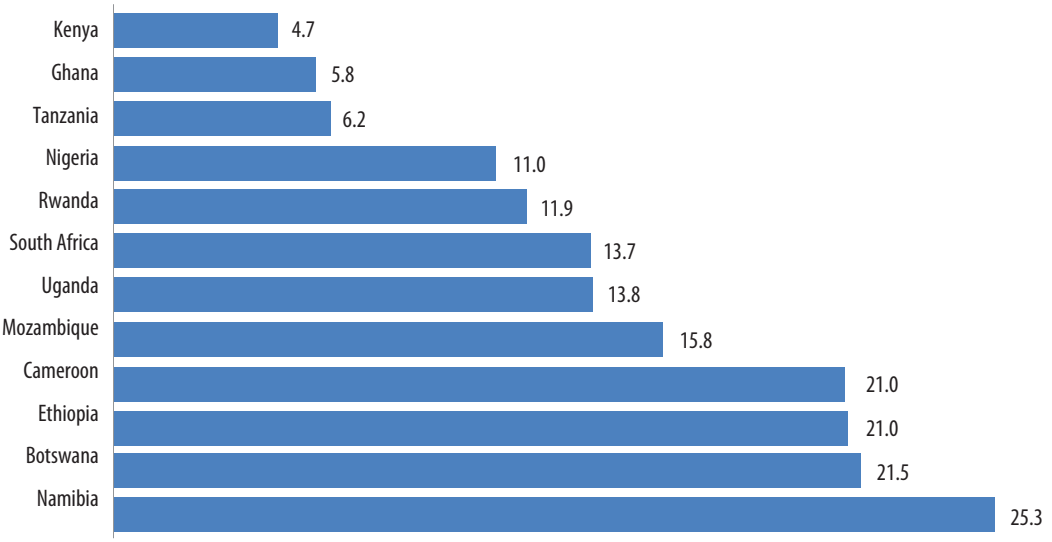


Source: International Telecommunication Union (2014).

Although Africa is the least affordable region in the world in both the prepaid and postpaid computer-based (1GB) and prepaid and postpaid handset-based (500MB) mobile broadband services, new innovative pricing schemes are emerging. Mobile broadband is providing a viable solution for low-income populations. In recent years, with the decrease in mobile broadband prices worldwide, the service has, on average, become 20 to 30 per cent more affordable.

Some studies comparing prices to find out which countries have the cheapest mobile broadband service reveal the same picture at the regional level (see figure XXI).

Figure XXI: Cheapest prepaid 1GB basket for quarter 1 of 2014 (United States dollars)



Source: Research ICT Africa (2014).

The cheapest 1GB mobile prepaid baskets are found in Kenya, Ghana and the United Republic of Tanzania at $4.7, $5.8 and $6.2, respectively. Cameroon, which is dominated by two companies, MTN and Orange, is at the same level as the monopolistic Ethiopian and Botswana markets. The Botswana Telecom Corporation is a state-owned, fixed-line and mobile operator. Namibia rates as the most expensive African country in terms of the 1GB mobile data basket.

One of the challenges in this regard is the spectrum issue. In order to make sufficient bandwidth available and avoid operators having to raise prices to lower demand and usage, policymakers need to ensure that adequate spectrum becomes available for mobile Internet access at the international and national levels.

5.4 Price and pricing trends

Since 2010, Africa has been a centre of new network construction, with a number of projects improving access in the region to submarine cables and terrestrial connectivity. This has stimulated competition, facilitated price reductions and encouraged regional demand growth. Neverthless, Africa remains one of the most expensive destinations in the world. International circuits to cities along both coasts and sub-Saharan Africa experienced price declines of up to 89 per cent between 2011 and 2012. Prices vary substantially by route, however, and are far from uniform. Median monthly leave prices for a STM-1 circuit between Africa and Europe ranged from $7,650 in Cairo to$ 120,000 in Lusaka in quarter 3 of 2012 (TeleGeography, 2012).

While connectivity and competition in coastal country markets have increased, bringing bandwidth inland remains a challenge. A lack of competing terrestrial networks in the region has kept last mile prices extremely high. In Kenya, a terrestrial link can cost an extra $100 to $200 per Mbps, in addition to the cost of submarine capacity. These high prices fuel concerns over whether end users will benefit from reductions in submarine capacity costs until greater investment in national infrastructure are complete.

Governments and private companies are responding by developing network links to landlocked countries from submarine cable landings. Terrestrial network construction connecting Kenya, Rwanda, Uganda and the United Republic of Tazania is currently under way by Kenya Data Networks and Six Telecoms. The Burundi backbone system is scheduled to come on line in 2013. The Central Africa backbone project, completed in 2016, should further bolster national infrastructure and begin to lead to price declines in landlocked areas.

Prices reflect a combination of route length and available infrastructure within each country and the number of competitors operating in the market. In Kenya, which hosts four cables in Mombasa alone, median monthly lease prices for a STM-1 connection to Europe fell to some of the lowest levels on the continent. In quarter 4 of 2012, the median monthly lease price for a STM-1 circuit between London and Nairobi was approximately $20,000 per month, half of what it had been in 2011.

5.5 Regulation is key to enhancing broadband access and making it affordable

According to ITU (2014), regulatory action is needed in Africa to open the international gateways to competition and to facilitate backhaul (e.g., by setting a reference offer for the leased lines of the incumbent that provide connectivity to the landing station), which could lower barriers to entry in the market and stimulate competition in the broadband service sector. Doing so would contribute to opening up fixed broadband markets to competition in Africa and alter the status quo in several African countries, where the market is monopolized by a single operator. With the exception of micro States and small island States, fixed broadband markets have been opening up to a much larger degree of competition in other regions, to the benefit of customers.

The key features of innovative regulatory approaches as provided by ITU are presented in box 7.

Box 7: Fourth generation regulation

Innovative and smart regulatory approaches can foster equal treatment of market players without placing an extra burden on operators and service providers. Some of these guidelines include the following:

- Adopt a "light-touch" regulatory approach, intervening only when necessary, while ensuring that market forces work without constraints and in favour of innovation
- Ensure principles of fair, equal and non-discriminatory treatment of all market players for a level playing field among regulated and unregulated players
- Streamline procedures to facilitate market entry and stimulate competition and innovation
- Conduct market analysis to assess the market situation in a converged environment
- Adopt a regulatory framework that eliminates barriers to new entrants
- Include competitive provisions that guarantee a healthy relationship between all authorized players in the relevant market (operators, Internet providers, over-the-top providers, etc.)
- Empower consumers to make informed decisions through the development of online tools to check download speeds, quality of service and prices for access and data plans
- Monitor the use of traffic management techniques to ensure they do not unfairly discriminate between market players
- Encourage network and facility sharing through "soft" measures (e.g., cross-sector mapping of infrastructure that enables the coordination of civil works)
- Ensure transparency and openness (e.g., by making market data and regulations available)
- Encourage multi-stakeholder consultation on policy and regulatory matters
- Continue to ensure regulatory predictability and foster co-regulation wherever possible
- Work with all stakeholders to reduce or remove practical barriers to broadband deployment

Source: International Telecommunication Union (2014b).

African countries need to give strong policy and regulatory attention to broadband markets at the national and regional levels to ensure improved and affordable access to broadband.

Some of the actions that help to increase the availability of broadband will also have an impact on lowering costs, even in areas in which mobile Internet services are being offered. Consequently, policies to increase competition at the international gateway over local connectivity and in the last mile will also contribute to lowering prices.

5.6 Introducing innovative pricing models

Given the unaffordable cost of access to broadband for both fixed and mobile broadband services, low fixed-line and fixed broadband penetration on the continent and the growing data consumption and bandwidth demand, there is a need for telecom operators to introduce new pricing models to ensure improved access to and use of broadband. In this regard, as the experience in other parts of the world demonstrates, telecom operators and service providers need to introduce innovative pricing models that are tailored to specific consumer segments and designed on the basis of consumer-context information, such as the device used, location, time of use and service being consumed rather than only the volume of consumption (Stork and others, 2013).

This is important for the continent, in particular in the mobile broadband service segment, given that it is a dynamically growing area of service. Designing these innovative pricing models requires a clear understanding of the components of a mobile broadband pricing model and of the operational and market prerequisites that allow their rapid roll-out.

5.7 Conclusion

Africa needs to intensify efforts to fill the wide gap in broadband development and access. This challenging gap can be turned into an opportunity if African countries can work together to adopt the best approaches and models from cost-effective, emerging broadband access technologies. This will be possible only if the enabling government, private sector and civil society environment is effective for ICT broadband development and its facilitating role in the envisioned transformation agenda.

CHAPTER 6: Conclusion and policy recommendations

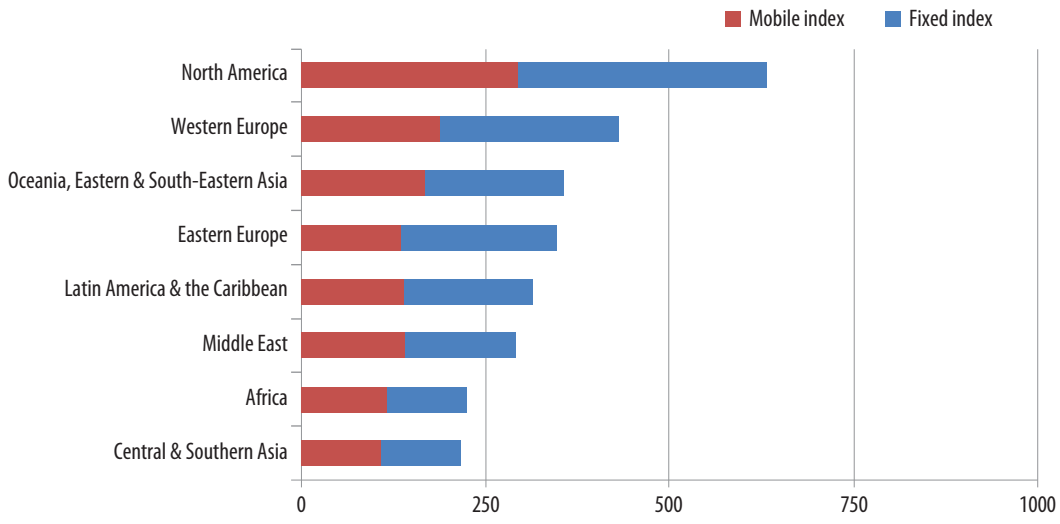
6.1 Conclusion

The report has addressed the complex broadband issues that range from both demand-side and supply-side factors in broadband growth to key policy and regulatory issues determining uptake and use at the national, subregional and regional levels.

Mobile data connections and services are growing strongly in Africa, but the continent continues to lag behind most of the rest of the world in terms of high-speed, fixed-speed broadband penetration. Notwithstanding double-digit growth in fixed broadband since 2011, penetration in Africa remained low, at 0.4 per cent, by the end of 2014. According to Ovum's broadband development index[6], Africa is ranked second-to-last among world regions in terms of its broadband development, with a Broadband Development Index score of 226 of 1,000 for 2014, just ahead of Central and Southern Asia (219), and a long way behind the leading regions, North America (633) and Western Europe (433).

This underdevelopment, together with the insufficiency of broadband infrastructure on the continent, are the major barriers to broadband uptake and, in turn, to its low level of contribution to socioeconomic development and regional integration on the continent The submarines cables that serve Africa connect the region mainly through the United States, Europe and Asia, while the "middle mile" and "last mile" solutions have not developed well in many countries.

Figure XXII: Broadband development index, ranking of regions, 2014



Source: Ovum.

[6] "Informa's Ovum: mobile data services on rise in Africa", *Informa*, 13 November 2014.Available from https://informa.com/media/press-releases-news/latest-news/informas-ovum-mobile-data-services-on-rise-in-africa/.

Where available, the cost of broadband access remains prohibitive for most Africans. Nevertheless, one of the main factors is undoubtedly the absence of specific broadband policies and strategies in most African countries. As a result, 80 per cent of the population in sub-Saharan Africa was not connected by late 2014, depriving them of access to the world's pool of knowledge and to participation in the many opportunities of the digital age.

It is well recognized that broadband is an essential element of the digital economy. Broadband infrastructure therefore makes major contributions to people-friendly sustainable development. Strengthening access to such infrastructure and services must therefore be one of the major priorities for African countries. Indeed, the organization GSMA expected 240 million mobile broadband connections in sub-Saharan Africa alone by 2015, compared with just 4 million fixed broadband connections. The major trends in consumption will include increased use of social networks (especially the data), largely but not solely among young people; consumers becoming content creators; the expansion of the broadband footprint of cities to rural areas; and access to services through mobile phones anytime and anywhere.

Many African Governments consider broadband access to be key to realizing a knowledge-based economy. The status is that, although broadband policies are in place, they are often not equally matched with the implementation requirements on the ground. Solutions now include high-speed broadband availability to all at an affordable cost and the deployment of wide band; creating a regulatory environment streamlined and conducive to broadband; the removal of the barriers to broadband market entry by private operators; and appropriate solutions to maximize resource mobilization, innovation and investment in broadband within both developed and developing regions.

6.2 Policy recommendations

In order to improve access to broadband on the continent, the following key policy recommendations are offered for consideration by African ICT policymakers and decision makers.

6.2.1 Broadband policies and strategies

Many African countries need to update their national ICT and broadband policies. This absence of policy guidelines and regulations is a major obstacle to the development of broadband infrastructure and networks. Incentive regulation is essential to facilitating the universalization of affordable access to ICT, in particular to fixed and mobile broadband. For this purpose, Governments should develop a legal and regulatory environment conducive to improved broadband access, ensure the allocation of adequate resources for its implementation and encourage private sector participation. They have to review or develop a comprehensive policy framework for enhancing broadband access in collaboration with all relevant stakeholders, including civil society and the private sector. Various mechanisms for supporting accelerated growth, technological transformation, trade and development, skills development, and job creation include the following:

- Ensuring affordable broadband service offers
- Allocation of frequencies for technical Wi-Max and mobile
- Affordable access to international bandwidth
- Competition: new licence or no licence for fixed wireless access
- Removal of taxes on access equipment
- Achieving the total interconnection of national and regional broadband infrastructure.

6.2.2 Universal access to broadband

African Governments have already established consensus that everyone should have broadband access and benefits. To achieve this objective, effective implementation of the concept of universal service is vital. The universal deployment of broadband can be a powerful accelerator of development and economic growth. Policymakers and regulators are encouraged to review their policies on access and universal service in order to expand funding to support investment in broadband networks and services that guarantee access by all to the digital world.

It is important to have such incentives as preferential terms of licences and authorizations of uses of the spectrum to attract investors to the deployment of broadband services in high–cost areas. This approach would ensure the resource development necessary for Internet infrastructure and services.

6.2.3 Harmonization of policy and regulatory frameworks

At the regional level, although several regional frameworks for harmonizing broadband policies have been developed by the regional economic communities and other regional organizations to increase connectivity to networks and services, with specific emphasis on cross-border networks, the level of implementation and regulation at the member State level is relatively slow and inconsistent. To encourage harmonization of broadband policy and regulatory frameworks at the subregional and regional levels, member States need to introduce serious measures and actions at the national level to implement regional economic community decisions to realize regional interconnectivity and universal access. They should also take all legislative and regulatory measures necessary for the adoption of the Protocol for policy and regulatory framework for AU-NEPAD ICT broadband infrastructure network for Africa.[7]

[7] Available from www.nepad.org/fr/resource/protocol-policy-and-regulatory-framework-nepad-ict-broadband-infrastructure-network-africa.

6.2.4 Regional backbone infrastructure and exchanges

Therefore, special attention should be paid to the development of a broadband infrastructure and to the achievement of regional interconnectivity and universal access. In many countries, national backbone and cross-border infrastructure remains relatively limited. As a result, most Internet traffic between African countries is exchanged in Europe, North America or Asia. There are enormous needs for investment to fill the missing links. According to ITU, approximately 92,000 km of optical fibre links, including 25,000 km of international submarine cable routes, are needed to bridge regional and international broadband gaps. This means an investment of $1.6 billion for regional links.

The role of the private sector is crucial to ensure national coverage and achieve regional connectivity in order to meet the supply and demand for broadband. Consequently, the legal and regulatory framework should be adapted for public-private partnerships and collaboration to facilitate the establishment of broadband networks and the sharing of experiences and knowledge. Therefore, Governments need to design appropriate financing mechanisms to open up the market and look for a more harmonized regional approach to investment and scale-up use. To this end, national and regional broadband plans and strategies should have been in place by 2015, with clear targets in accordance with the recommendations of the Broadband Commission for Digital Development.

6.2.5 Broadband for regional integration

In terms of regional integration, African landlocked countries are facing a serious problem of high-speed Internet access, given that they do not have direct access to any submarine cable. Physical integration is an essential element and, accordingly, broadband infrastructure is a key component. The future competitiveness of the continent is directly dependent on its ability to strengthen subregional and regional broadband infrastructure.

Consequently, to attain better socioeconomic integration on the continent through broadband infrastructure, there is need to plan the development of integrated regional infrastructure very well. Member States have other obligations to fulfil, such as completing missing broadband links attributable to cross-border physical networks, thereby enhancing policy and regulatory frameworks for integration.

Broadband technologies continue to have a growing influence on development trends in most African countries. Therefore, Governments, the private sector and academia need to cooperate in identifying the main knowledge gaps in research in broadband infrastructure and developing a set of applications and services. It is also necessary to define priorities for action with regard to the allocation of the radio frequency spectrum for broadband services; universal service obligations; the establishment of innovative financing mechanisms; and the search for leading technology solutions, in particular with regard to the deployment of broadband access to rural areas.

6.2.6 Pricing and regulation

A small number of countries could meet the Broadband Commission for Digital Development's 5 per cent of gross national income per capita affordability target, including Angola, Botswana, Equatorial Guinea and Namibia. The entry-level fixed

broadband price in more than half the countries in Africa represents more than 40 per cent of the gross national income per capita. This is due to not only the lack of availability of broadband through the well-developed backbone networks and access networks, but also the lack of competition through appropriate regulatory mechanisms.

Nevertheless, experience from elsewhere indicates that fixed broadband markets have been opened up to a much larger degree of competition, to the benefit of customers. To this end, African Governments and regional economic communities should promote the "open access" principle to the existing infrastructure of incumbents, utilities, etc. This includes enhancing interconnection at the national and regional levels through the development of Internet access points to improve the localization of traffic that can contribute to more affordable broadband services.

Today, it is recognized by African leaders in all sectors that digital development is a catalyst for sustainable development. For Africa to realize its Agenda 2063 vision of the African Union, which is a shared framework for inclusive and sustainable development, priority attention to broadband connectivity and services needs to be given to ensure the efficient use of ICT in the service of health, education, governance and trade to achieve sustainable socioeconomic growth. In order to fully realize the benefits, it is imperative that the deployment of broadband networks be encouraged and be made accessible to all, at affordable prices.

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Annex I: List of African countries with national broadband policies

	Economy/Country	Policy available?	Year in which policy was adopted	Title/Details
1	Algeria	yes	2008	E-Algérie 2013
2	Angola	yes	2010	Livro branco das Tecnologias da Informação e Comunicação
3	Benin	yes	2014	Projet de développement des infrastructures et des TIC
4	Botswana	yes	2014	National broadband strategy
5	Burkina Faso	yes	2013	Le backbone national en fibre optique
6	Burundi	yes	2011	National projects for broadband connectivity, Burundi Community Telecentre Network
7	Cameroon	no		
8	Cabo Verde	yes	2005	Programme stratégique pour la société de l'information accompagné du plan d'action pour la société de l'information
9	Central African Republic	yes	2006	Politique, stratégies et plan d'actions de l'édification de la société de l'information en République Centrafricaine
10	Chad	yes	2007	Plan de développement des technologies de l'information et de la communication au Tchad
11	Comoros	yes	2014	Loi N°14-031/AU du 17 mars 2014, relative aux communications électroniques et Décret N°08-019/PR
12	Côte d'Ivoire	yes	2010	Objectifs stratégiques du Government de Côte d'Ivoire en matière de télécommunications et de TIC
13	Democratic Republic of the Congo	no		
14	Djibouti	yes	2004	Plan d'action national pour l'exploitation des TIC
15	Egypt	yes	2012	eMisr national broadband plan
16	Equatorial Guinea	yes	2012	Nuevas tecnologías: national project aimed at the popularization of information and communications technologies
17	Eritrea	no		
18	Ethiopia	yes	2013	National broadband master plan
19	Gabon	yes	2011	Digital Gabon - Gabon Industriel, Gabon vert et Gabon des Services
20	Gambia	yes	2008	The Gambian ICT4D-2012 plan
21	Ghana	yes	2010	Broadband wireless access

	Economy/Country	Policy available?	Year in which policy was adopted	Title/Details
22	Guinea	yes	2009	Plan national de fréquences/Plan de développement de l'infrastructure nationale d'information et de communication de la République de Guinée 2001–2004
23	Guinea-Bissau	no		
24	Kenya	Yes	2013	National broadband strategy - Vision 2030
25	Lesotho	yes	2014	National broadband policy 2014-2018
26	Liberia	yes	2010	Policy for the telecommunications and information communications technology 2010-2015
27	Libya	no		
28	Madagascar	yes	2014	Loi n° 2005-023 du 17 octobre 2005
29	Malawi	yes	2013	National ICT policy
30	Mali	no		
31	Mauritania	no		
32	Mauritius	yes	2012	National broadband policy 2012-2020
33	Morocco	yes	2012	Plan national pour le développement du haut et très haut débit au Maroc
34	Mozambique	yes	2006	National ICT policy implementation strategy 2002 and 2006 - Digital inclusion in Mozambique
35	Namibia	yes	2009	Telecommunications policy for the Republic of Namibia
36	Niger	yes	2005	Plan de développement des technologies de l'information et de la communication au Niger/ Plan NICI du Niger
37	Nigeria	yes	2013	National broadband plan 2013-2018
38	Republic of the Congo	yes	2011	Projet de couverture nationale, Projet West Africa Cable System, Projet back bone national en fibre optique
39	Rwanda	yes	2006	Regional connectivity infrastructure programme
40	Sao Tomé and Principe	no		
41	Senegal	no		
42	Seychelles	no		
43	Sierra Leone	no data		
44	Somalia	no		
45	South Africa	yes	2013	National broadband policy
46	South Sudan	no		
47	Sudan	yes	2012	National strategic development plan 2012-2016
48	Swaziland	no		
49	United Republic of Tanzania	yes	2004	National information communication and technology broadband backbone
50	Togo	planning		
51	Tunisia	yes	2015	Tunisie digitale 2018

	Economy/Country	Policy available?	Year in which policy was adopted	Title/Details
52	Uganda	yes	2009	Uganda broadband infrastructure strategy national position paper
53	Zambia	yes	2006	National information and communication technology policy
54	Zimbabwe	yes	2005	National ICT policy

Source: Adapted from International Telecommunication Union and United Nations, Educational, Scientific and Cultural Organization (2013), annex 1.

Note: countries with national broadband plans: 40; countries planning to introduce national broadband plans: 1; countries without national broadband plans (and no data): 14; national broadband policies include national broadband plans and national policies with broadband targets adopted (development, ICT, etc.).

Annex II: Broadband concepts and terminologies

The term broadband in telecommunications refers to a wide bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types. The medium of transmission could be through coaxial cable, optical fibre, twister pair or wireless broadband (wireless broadband includes mobile broadband). Broadband is the catalyst to transformation when it is properly integrated with strategic economic and social development policies. The transformative benefits of having broadband available to all are clear and include improved learning, increased job creation, better community and civic engagement, improved trade and commerce, and a positive impact on GDP.

The definition of broadband has also evolved since its initial access speeds, defined as 256 Kbps, then 1 Mbps, followed by 2 Mbps, to the point at whichmore than 100 Mbps is understood. In the United States, the Federal Communication Commission, in looking at advances in technology, market offerings by broadband providers and consumer demand, updated its broadband benchmark speeds to 25 Mbps for downloads and 3 Mbps for uploads, up from from the 4 Mbps download and 1 Mbps for uploads standard that had been established in 2010.

Understanding broadband speeds

1 kbit/s = 1,000 bits per second

1 Mbit/s = 1,000,000 bits per second (1,000 kbit/s)

1 Gbit/s = 1,000,000,000 bits per second (1,000 Mbit/s

A broadband signaling method is therefore one that handles a wide band of frequencies. Broadband is a relative term, understood according to its context. The wider (or broader) the bandwidth of a channel, the greater the information-carrying capacity, given the same channel quality.

In this context, definitions of several terms of the various broadband technologies and concepts used in the report are provided below for easy reference.

Dial-up: A technology that uses copper telephone lines to establish a low bit-rate connection to an Internet service provider. The typical dial-up modems have a maximum theoretical transfer speed of 56 Kbps. While dial-up technology can be used to access the Internet, it is a basic technology and not considered to be a broadband technology. Accordingly, dial-up was not assessed in this study. Limitation of the technology and the modem capability is the factor impacting data speeds.

ADSL (Asymmetric Digital Subscriber Line): A technology designed to give basic broadband performance over copper telephone lines, allowing more data to be sent

than with dial-up internet. Downstream data speeds for ADSL are up to 9 Mbps and up to 1.3 Mbps upstream.

ADSL2+ (Asymmetric Digital Subscriber Line 2+): An enhancement to ADSL that uses a wider frequency range to achieve substantially faster speeds over relatively short distances. ADSL2+ speeds reach up to 24 Mbps downstream and up to 3.3 Mbps upstream.

3G and 4G Mobile broadband: 3G mobile networks typically offer speeds between 1 and 20 Mbps downstream and 550 Kbps to 3 Mbps upstream. 4G mobile networks typically offer speeds between 2 and 50 Mbps downstream and 1 and 10 Mbps upstream. However, mobile networks are shared networks, such that, when multiple users are using the network at the same time, the speed performance will be reduced.

FTTP (Fibre to the Premises): This describes the installation of optical fibre from a point of interconnect to the network all the way to a premise (residential or business). A common FTTP technology that is employed in residential scenarios is GPON: gigabit passive optical network. GPON delivers 2.5 Gbps downstream and 1.2 Gbps upstream shared between a maximum of 32 premises. Typically, retail products over FTTP networks offer speeds of up to 100 Mbps downstream and 40 Mbps upstream, although higher speeds services, such as 1 gigabit service downstream and 400 Mbps upstream services, are available.

FTTN (Fibre to the Node): Fibre to the node describes the installation of optical fibre from a point of interconnect (or exchange) to a distribution point (a node or street cabinet) in a neighbourhood that serves a few hundred customers within a radius of about 1 km. The connections from the node to the customer premises use the copper connection and one of the Digital Subscriber Line (xDSL) standards to deliver broadband. This network offers downstream speeds of up to 60 Mbps and upstream speeds of 5 Mbps and more. Depending on the technical standards utilized FTTN networks are capable of up to 100 Mbps downstream and 50 Mbps upstream. There is an upgrade path for FTTN networks to G.fast, which is capable of achieving access speeds of hundreds of Mbps over existing copper wire within 250 m range of a distribution point.

Gb (or gigabit): Gb is short for gigabit, which is a unit used to describe the speed at which data travel across an Internet connection (also sometimes written as Gbps or gigabits per second). Current broadband connections are measured in Mb (megabits per second). There are 1024Mb in 1Gb.

GB (or gigabyte): GB is short for gigabyte, which is often used to describe the size of computer files and memory storage capacity. There are 1024 bytes in a kilobyte (KB), 1024 kilobytes in a megabyte (MB) and 1024 megabytes in a gigabyte. To give a better idea of usage, a small text file could be measured in bytes, a basic Word document in kilobytes, a music file in megabytes and a DVD-quality film in gigabytes.

HSDPA: High Speed Downlink Packet Access is a super-powered 3G mobile data standard supporting much faster mobile broadband speeds, currently rated up to 42Mb

with further upgrades to the standard planned. In some countries, some networks have begun rolling out HSDPA, giving a faster connection to compatible smartphones, tablets and dongles at no extra charge, sometimes coming close to rivalling the new 4G mobile broadband services in performance.

Kb (or kilobit): Kb is an abbreviation of kilobit. When it comes to Internet speeds, one may also see it written as Kbps or kilobits per second. This was commonly used to measure dial-up Internet speeds and still crops up with slower mobile broadband connection and slow uploads and downloads of Internet files. See also Mb (Mbps).

KB (or kilobyte): KB is short for kilobyte, which is a term used to describe the size of computer files and storage capacity. See GB for more details.

LTE: A next-generation 4G mobile data standard. While there has been some confusion over whether LTE counts as 4G or is simply a faster type of 3G, it has been widely adopted and marketed as such by networks across the world, where is used for their 4G service.

Satellite: Retail satellite broadband products over existing Ku-band satellite networks for home users and small businesses offer speeds up to 6 Mbps downstream and up to 1 Mbps upstream. Next-generation satellite solutions will offer the home user and small business satellite customer speeds of up to 25 Mbps downstream and up to 5 Mbps upstream.

WiMAX: This term is short for Worldwide Interoperability for Microwave Access - a 4G broadband technology offering a wireless broadband alternative without the need for cables. WiMAX lost out to LTE in the race to be the next generation of mobile broadband, largely because the latter fit the established network model mobile companies already use. That is, they simply had to upgrade their technology, rather than starting afresh.

Distinction between fixed and mobile broadband technologies

	Fixed broadband technologies	Mobile broadband technologies
Location	End user at the same location to use the broadband service, given that access is associated with a specific physical location	End user can use the broadband service while on the move and from anywhere, subject to coverage by its mobile broadband provider (directly or via roaming)
Technologies used to deliver broadband	Wireline connection. Three types: traditional copper line telephone network equipped with digital subscriber line (of any type) (xDSL) technology; traditional cable television network upgraded to provide broadband Internet; or a newly built fibre optic network	Third generation of mobile telecommunications technology (3G), such as Universal Mobile Telecommunications System High Speed Packet Access (UMTS HSPA) (14.4 Mbps downstream; 5.8 Mbps upstream)
	By a wireless connection: based in general on Worldwide Interoperability for Microwave Access (WiMax) technologies. Current technology provides data rates up to 1 gigabit per second (Gbps) within a signal radius of some 50 km from the base station serving the area	Fourth generation of mobile telecommunication technology (4G), such as long-term evolution (LTE) (100-300 Mbps downstream; 50-70 Mbps upstream)
	By a satellite connection, used in general in remote or rural areas when wireline or wireless connection cannot be made available. Data rates range from 2 Mbps to 1 Gbps downstream and from 2 Mbps to 10 Mbps upstream.	Second generation of mobile telecommunication technology (2G) mainly for voice services and slow data transmission, which also has evolved in to 2.5G (GPRS) and 2.75G (EDGE) for improved data transmission With GPRS (General Packet Radio Service), theoretical transfer speed of max. 50 kbit/s (40 kbit/s in practice) With EDGE (Enhanced Data Rates for GSM Evolution), theoretical transfer speed of max. 1 mbit/s (500 kbit/s in practice)

Source: Compiled by the author.

Annex III: Common traits/features of broadband policies and strategies

African countries are looking to increase access to, and the use of, broadband, which is, in general, seen as a technology that stimulates growth and creates new business opportunities. Nevertheless, the broadband policies and plans in these countries cannot be universal, and it varies from country to country. Given varying political and economic circumstances, however, it is impossible to provide universal solutions.

In a number of countries, national broadband policies are developed under the framework of national ICT strategies, with specific solutions tailored to the situation in each country. MOst of these policies, however, have some common traits or features with almost similar building blocks because they focus on improving incentives and the climate for private investment, a policy that even highly resource-constrained countries should be able to follow.

In a report by the Broadband Commission for Digital Development (2013), three building blocks that countries may wish to consider as they attempt to develop their broadband markets were proposed. These building blocks are not the only tools available for growth, nor are they applicable to all countries. Instead, they represent emerging good practices that countries can study and adapt to their own goals, circumstances, and resources.

Be visionary yet flexible. Most of the countries surveyed, early in the growth of their broadband markets, developed national broadband strategies that laid out their visions and service goals. These served as frameworks in which policies and regulations were developed to implement the strategies though public-private partnerships. Nevertheless, such strategies were not static: they adapted to evolving markets and accommodated newer technologies. By 2009, all the countries surveyed had, or were developing, a national broadband strategy.

Use competition to promote market growth. The more successful countries in the survey used collaborative approaches between the public and private sectors to promote and later universalize broadband services. In some cases, public investment was aimed at specific gaps or triggered larger private investments. In addition, every country surveyed relied on competition to expand the broadband market. Some focused on facility competition, while others focused on service competition. The more successful countries also benefited, in general, from inter-modal competition, notably between digital subscriber line (DSL), cable modem and third-generation (3G) wireless technologies. Each country tried to create level playing fields and competitive markets to ensure fast private sector–led growth of broadband services.

Facilitate demand. The successful countries in the survey developed and implemented demand facilitation policies in the initial stages of market development to raise broadband awareness among users, make services more affordable and expand networks and services to the widest population in the shortest time possible. Other

countries have used public funds for more than network roll-out and have supported research, manufacturing promotion, content development, user awareness, ICT skill development and digital literacy programmes.

African countries could also use the experiences of some countries, such as the Republic of Korea, which is not only one of the most successful broadband markets, but also has deployed a wide range of polices and regulations. The country can demonstrate the nature and features of broadband policy. Policies and programmes for broadband market development can be split into three components that overlap but also follow a logical sequence: promotion when the market was incipient, oversight as competition begins to drive growth and universalization as the market matures.

A toolkit might be required for African policy makers to help them to convert the broad strategic and policy ideas to practical instruments used in policymaking, regulation and implementation of broadband network development.

Source: Broadband Commission for Digital Development (2013).