

Cyberspace Across Sub-Saharan Africa

Moving from technological desert toward emergent sustainable growth.

Over the past three decades much of the continent of Africa, and especially the sub-Saharan region, has been viewed as technological desert [8]. Spanning over 24 million square kilometers from the Sahara in the north to the Cape Verde in South Africa, sub-Saharan Africa (SSA) comprises 49 countries and is home to 659 million people [12].

With its many problems of hunger, epidemics, war, and other related socioeconomic problems, the diffusion of the Internet might be the last thing to be associated with SSA. While much research has been published on the status and impact of Internet diffusion in other regions of the world [1–4], little is found in mainstream journals on the diffusion of the Internet in Africa [5], particularly in SSA. An update of the status of the Internet is thus in order, along with a discussion of some inhibitors and contributors that appear to shape the diffusion of the Internet in this region.

Current Internet Status in Sub-Saharan Africa

SSA may be a late starter on the Internet, but it is currently under-

going a rapid transformation. The countries in this region are experiencing growth in Internet connectivity, the use of computers, and in

the diffusion of wireless communications [6, 11, 12]. Current statistics show that:

- No longer is the telephone density (the ratio of fixed telephone lines to population) of SSA trapped below the 1% threshold, which is considered essential to economic growth and development. For example, in the millennium year fixed telephone density grew from 0.9% to 1.2% [6];
- By 2001, the number of mobile

subscribers had outpaced fixed-line subscribers with a recorded ratio of approximately 17 mobile phone subscribers per 1,000 compared to 14 per 1,000 for land-line phones [6]; and

- No longer is the region as stifled by a lack of fair regulation and free competition. In the last two years, 36 new operators launched mobile services and well over half of the countries across the region established independent organizations to regulate their information and telecommunications sectors [7].

These changes have largely taken place since the mid-1990s, before which most of SSA was a technological desert [5, 8]. Statistics obtained in 1995 (see Figure 1) show a continent with sparse Internet presence and low connectivity. Much of this has changed (see Figure 2). In November 2000, the country, Eritrea, obtained a local Internet connection, finally bringing all 54 of Africa's countries and territories online. Currently, the number of dialup Internet subscribers exceeds the one-million mark and the total outgoing international Internet bandwidth is above the 1Gbps

International Perspectives

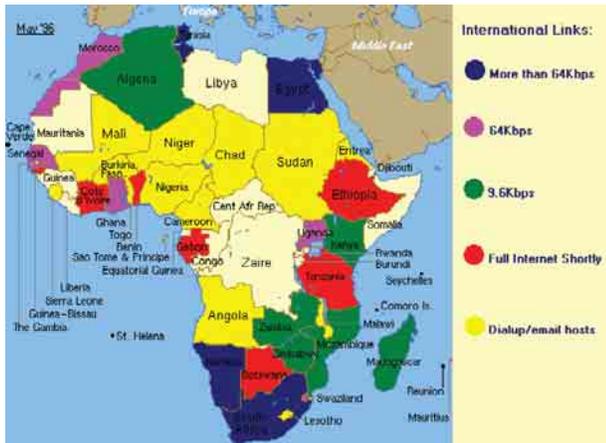


Figure 1. Africa's Internet access and international bandwidth in 1996. *Source: United Nations Economic Commission for Africa [10].*

mark. This represents substantial growth compared to the figures in 1995.

Internet diffusion has been largely confined to the major cities, where a minority of the population lives, although a growing number of countries have points of presence (POPs) in some of the secondary cities. There are now about 250 POPs across the region, with 100 in South Africa.

Sixteen countries now have local-call charges for all calls over the Internet (see the table). Seychelles has gone a step further and made charges for Internet calls 50% lower than normal voice calls to further encourage Internet use. With this plan offering reduced costs for those in remote areas, it is surprising that more countries have not adopted this strategy.

End-User Connectivity and Subscriber Population

The total number of computers permanently connected to the Internet (excluding South Africa)

was about 35,000 in 2001 as measured by Network Wizards (www.nw.com). However, these figures are becoming increasingly meaningless because of the widespread use of .com and .net domains, and more importantly, the frequent use of Network Address Translation (NAT). NAT allows the reuse of the same address across many computers in different networks. As a result many of the countries show zero or only a handful of hosts in the surveys when in actuality there might be hundreds if not thousands of machines connected to the Internet.

It is also difficult to measure the total numbers of Internet users. The World Bank currently estimates about 3.7 million users. This works out to about one Internet user for every 200 people compared to a world average of about 1 in 30; a North American and European average of about 1 in 3; 1 in 125 for Latin America and the Caribbean; 1 in 200 for South East Asia and the Pacific; 1 in 250 for East Asia; and 1 in 500 for the Arab States [11, 12].



Figure 2. Africa's Internet access and international bandwidth in 2001. *Source: United Nations Economic Commission for Africa [10].*

Presently, 24 countries have 1,000 or more dialup subscribers, 19 have more than 5,000 and 6 have over 20,000 subscribers (see the table). Although exact data on the number of rural vs. urban users has proved difficult to obtain, the clustering of ISPs and POPs within major cities suggests that users in the cities and towns greatly outnumber rural users. There are now local Internet Society chapters in all the regions of SSA and in most of the countries with large Internet user populations.

Internet Access Cost

Currently, the average total cost of using a local dialup account for 20 hours is about U.S.\$68/month. These costs include usage fees and local-call telephone time, but not telephone line rental. ISP subscription charges range from U.S.\$10 to \$100 a month. Cost of subscription is typically paid in local currency. The huge variance in subscription charges is a reflection of the different maturity levels of

the markets, the varying tariff policies of the telecom operators, and the different regulations on private wireless data services and on access to international telecommunications bandwidth across the region's countries.

ISPs

The capital cities of most countries in SSA now have more than one ISP. There are about 575 public ISPs across the region (excluding South Africa, where the market has consolidated into three major players with 90% of the market and 75 small players with the remainder). Five countries have 10 or more active ISPs. Fifteen countries have five or more ISPs, and 20 countries have only one ISP. Although Ethiopia and Mauritius are the only countries where a monopoly ISP is still national policy (where private companies are barred from reselling Internet services), there are other countries in which this practice still continues, predominantly in the Sahel sub-region where markets are small.

In response to the high cost of Internet services and the slow speed of the Web, and also because of the overriding importance of email, lower-cost, email-only services have been launched by many ISPs. A large proportion of users also access the free Web-based services such as Hotmail, Yahoo!, and Excite. These services can be more costly and cumbersome than using standard email software because extra online time is needed to maintain the connection to the remote site. However, they provide the added advantages of anonymity and per-

Country	Dialup Internet Subscribers	International Bandwidth Kbps Outgoing	Internet Hubs Number	Number ISPs	Population Millions 2000	GDP/Capita USD 1999	Cities with POPs	Dialup Access Cost USD
Africa	1351075	723038	6	644	768.66	1185.55	147	67.94
South Africa	750000	300000	5	80	44.31	2979	100	40
Angola	4000	192	1	4	12.09	1684	5	
Benin	4000	1024	1	2	5.78	374	2	
Botswana	25000	14000	1	6	1.57	3252	4	
Burkina Faso	3000	256	1	3	11.31	199	1	42
Burundi	150	64	1	2	6.46	159	1	
Cameroon	2500	256	1	7	14.31	617	2	40
Cape Verde	1800	1024	1	1	0.41	876	1	
Central Africa Republic	200	64	1	1	3.48	276	1	
Chad	300	64	1	1	7.27	149	1	
Comoros	200	64	1	1	0.66	382	1	
Congo	200	128	1	1	2.79	833	2	
Cote D'Ivoire	10000	5120	2	5	16.2	767	2	
D.R. Congo	4500	2048	3	5	49.3	400	4	
Djibouti	300	64	1	1	0.62	846	1	
Equatorial Guinea	200	64	1	1	0.43	668	1	
Eritrea	1000	128	1	4	3.58	161	5	70
Ethiopia	2500	512	1	1	59.65	103	1	75
Gabon	2500	512	1	2	1.17	5121	2	
Gambia	3000	128	1	1	1.23	284	1	
Ghana	15000	4096	3	8	19.16	372	7	
Guinea	4000	128	3	2	7.71	677	3	
Guinea-Bissau	250	64	1	1	1.13	245	1	
Kenya	35000	6144	1	34	29.01	347	6	123
Lesotho	250	512	2	2	2.06	547	1	
Liberia	75	128	1		2.67	1000	1	
Madagascar	8000	2556	2	7	16.36	224	4	
Malawi	2400	1024	3	2	10.75	242	2	
Mali	3000	128	1	5	10.69	230	1	130
Mauritania	550	384	1	5	2.53	455	2	
Mauritius	35000	4096	1	1	1.15	3661	1	
Mozambique	6000	2048	3	5	18.88	86	4	31
Namibia	15000	3072	2	3	1.66	2051	13	40
Niger	350	192	1	1	10.08	161	1	
Nigeria	50000	9216	5	15	113.5	551	5	40
Reunion	500	576	1	2	0.68	9270	1	
Rwanda	1000	128	3	1	6.6	317	1	
Sao Tome & Principe	200	64	1	1	0.14	358	1	
Senegal	15000	48000	1	8	9	518	1	51
Seychelles	3000	4098	2	2	0.08	6995	1	
Sierra Leone	500	128	1	1	4.57	209	1	
Somalia	250	64	1	1	10.63	169	1	160
Sudan	2000	256	1	1	28.29	364	1	
Swaziland	1200	256	2	2	0.95	1388	2	
Tanzania	20000	4096	3	14	32.1	244	2	
Togo	1700	1536	2	12	4.4	324	1	
Uganda	10000	2048	4	8	20.55	317	1	109
Zambia	6500	3072	3	3	8.78	463	3	
Zimbabwe	20000	5120	1	8	12.68	712	4	46

Dialup Internet access costs calculated for 20 hours a month of local call time plus Internet subscription fee
 "Call costs" is converted to U.S. \$/hour
 Source of Data: Direct contact with Internet Service Providers, regulators and hub operators in African countries

haps greater perceived stability than a local ISP, which may not be in business next year.

Internet kiosks, cyber cafés and other forms of public Internet access are growing rapidly. Emerging Internet-access practices

African country Internet status summary (June 2002).

include adding PCs to community phone-shops, schools, police stations, and clinics that can share the cost of equipment and access

Unfortunately there remains dismal direct cross-border Internet and telecommunications traffic across other countries that share common borders.

among a larger number of users. This is happening even in remote towns where a long-distance call provides the linkage to the nearest dialup access point. In addition, a growing number of hotels and business centers provide PCs with Internet access, and some ISPs are rolling out a new generation of branded cyber cafés in major cities.

Public Telecommunications Operators

In the last few years PTOs have established Internet services in 33 countries. This follows trends in the more developed countries where almost all of the PTOs have established Internet services. In many francophone countries, the PTOs operate as the major value-added service providers in joint ventures with France Cable and Radio, called Telecom-Plus in many countries and DTS in Madagascar.

The PTO has usually been the sole international link provider in most of the countries within this region. However, in a growing number of countries, the PTOs now compete with the private sector's international VSAT links. Elsewhere, the PTOs operate the international gateway and access to the national backbone, and leave the resale of end-user Internet access to the private sector. In Botswana, Cameroon, South

Africa, Zambia, and in most of the francophone countries, the PTOs also compete with the private sector in the provision of end-user dialup accounts.

International Bandwidth

Due to high international tariffs and lack of circuit capacity, obtaining sufficient international bandwidth for delivering Web pages over the Internet is still a major problem. Until recently few of the countries outside of South Africa had international Internet links exceeding 64Kbps, but today 23 countries have links carrying 5Mbps or more, and 13 countries have outgoing links of 10Mbps or more (see Figure 2). Excluding South Africa, the total international outgoing Internet bandwidth installed in SSA is about 400Mbps.

Two-way, satellite-based Internet services using very small aperture terminals (VSAT) to connect directly to the U.S. or Europe have been quickly adopted wherever regulations allow. More consumer-oriented VSAT services similar to services now available in the U.S. and Europe are being launched by satellite operators.

With the exception of some ISPs in Southern Africa, almost all of the international Internet circuits in SSA connect to the U.S. A few connect to the U.K., Italy,

France, and Singapore. However, ISPs in countries bordering South Africa benefit from the low tariff policies instituted by South African Telecom for international links to neighboring countries. As a result, South Africa acts as a hub for some of its neighboring countries. Unfortunately there remains dismal direct cross-border Internet and telecommunications traffic across other countries that share common borders in this region.

Regional Inhibitors of IT (Internet) Assimilation:

Various technological, environmental, operational, and financial bottlenecks exist and continue to constrain the growth of Internet connectivity. They are:

- In most countries, Internet services are still limited to the urban centers. Very few ISPs have POPs outside major cities. This, it has been argued, is mainly due to the poor telephone connections in rural regions.
- Local telephone infrastructure problems, including low levels of teledensity, low-speed and narrow-bandwidth lines, poor-quality connections, and high land-line telephone installation charges and usage fees, continue to constrain the reach of the Internet.
- The high cost of available international long-haul (terrestrial or

satellite) links to the high-speed Internet backbones may be a key obstacle to Internet growth. These links usually translate into high subscription and connection charges for end users.

- The acute shortage of technical staff to design, install, operate, and maintain the networks and requisite Internet technologies remains a major impediment to growth. Lack of technical support for end users is another serious limitation. Numerous Internet initiatives and projects have been delayed or even postponed due to the shortage of properly skilled people.

Regional Stimulants of Internet Assimilation

These factors have continued to foster Internet growth in SSA:

- Public Internet access through cyber cafés, and rapidly falling service charges provide an opportunity for many more people to use the Internet regularly.
- Rapid growth in mobile communications is freeing up land-lines that are then dedicated to Internet connectivity.
- The role of governments has been a major impetus to Internet growth on the continent. Many governments have allowed for the commercialization of the Internet sector, and are also actively participating by launching government-owned Web sites and Internet services. The concurrent deregulation and liberalization of the telecommunications sector in most of these countries has added impetus in accelerating the diffusion of Internet services in this region.

- Many governments now allow computers to be imported to their countries duty free or at reduced rates. This has resulted in higher diffusion rates for computers among the sub-Saharan population and, in turn, higher Internet connectivity and usage.

Conclusion

Although SSA still has a long way to go before catching up with the rest of the world, the region is experiencing rapid growth in Internet diffusion. This is in part because of the liberalization of policies toward Internet connectivity, the telecommunications sector, and PC purchase and import policies. The rapid diffusion of wireless technologies and the falling prices of telecommunications and Internet services also contribute to this high level of Internet diffusion.

Internet diffusion in SSA is substantially helping Africa solve some of its critical problems. For example, many Africans are obtaining college education through Internet-based, distance-learning initiatives such as the African Virtual University. Another example is that of telemedicine. Through several HEALTHNET (a telemedicine provider) initiatives, many doctors in Africa are being educated on recent developments in the medical field, such as steps to combat HIV/AIDS, a major epidemic in SSA.

While it is difficult to project what the future holds for Africa's Internet penetration, we contend that within the next decade, the Internet will no longer be a mystery and a luxury, but a necessity for the day-to-day activities of inhabitants within the region. **C**

REFERENCES

1. Agarwal, P.K. Building India's national Internet backbone. *Commun. ACM* 42, 6 (Jun. 1999), 53–58.
2. Danowitz A. Nassef, Y., Goodman, S. Cyberspace across the Sahara: Computing in North Africa. *Commun. ACM* 38, 12 (Dec. 1995), 23–29.
3. Ein-Dor, P., Goodman, S., Wolcott, P. From Via Maris to Electronic Highway: The Internet in Canaan. *Commun. ACM* 43, 7 (Jul. 2000), 19–24.
4. Goodman, S., Gottstein, J., Goodman, D. Wiring the wilderness in Alaska and the Yukon. *Commun. ACM* 44, 6 (Jun. 2001), 21–26.
5. Goodman, S. Computing in South Africa: An end to 'apartness'? *Commun. ACM* 37, 2 (Feb. 1994), 19–24.
6. International Telecommunication Union. *African Telecommunication Indicators*; ITU, Geneva (2001).
7. Jensen, M. *Continental Connectivity Indicators*. The Association for Progressive Communications, South Africa, 1999.
8. Odedra, M., Lawrie, M., Bennett, M., Goodman, S. Sub-Saharan Africa: A technological desert. *Commun. ACM* 36, 2 (Feb. 1993), 25–30.
9. Tan, Z., Foster, W., Goodman, S. China's state-coordinated Internet infrastructure. *Commun. ACM* 42, 6 (Jun. 1999), 44–52.
10. United Nations Economic Commission for Africa. UN-ECA; The African connection rally country fact sheets. United Nations, New York, 2001.
11. World Bank. *World Development Report 2002: Building Institutions for Markets*. World Bank, Oxford University Press, 2002.
12. World Bank. World Development Indicators Database (Apr. 2002); www.worldbank.org/data/dataquery.html.

VICTOR MBARIKA (victor@mbarika.com) is an assistant professor of Information Systems and Decision Sciences at Louisiana State University's E.J. Ourso College of Business Administration in Baton Rouge, LA.

MIKE JENSEN (mikej@sn.apc.org) is a South African independent consultant with experience in over 35 countries in Africa, assisting in the establishment of information and communications systems.

PETER MESO (pmeso@cis.gsu.edu) is an assistant professor at Georgia State University's J. Mack Robinson College of Business in Atlanta, GA.