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BENCHMARKING CONNECTIVITY IN AFRICA: TOWARDS EFFECTIVE INDICATORS FOR MEASURING PROGRESS IN THE USE OF ICTS IN DEVELOPING COUNTRIES

Keynote paper*

Mr. Mike Jensen, Independent Consultant & IDRC Knowledge Analyst, South Africa

* Due to the late submission, this paper could not be translated.

I. INTRODUCTION

1. The size of the national ICT infrastructure is a good indication of a country's progress towards an information-based economy. The largest barrier to increased use of ICTs in Africa and other developing countries is said to be the high usage costs and low perfusion of the communications infrastructure caused by the lack of competition and openness in the ICT market sector. In consonance with other development indicators, Africa's Internet infrastructure is the least developed in the world, with on average less than 1 in 100 people having access. Similarly, the average cost of Internet access is up to 100 times higher than in developed countries, and most markets are dominated by state operated or recently semi-privatised monopolies.

2. However, there is great variation in the diffusion of ICT services, their cost and market structures in different countries. Thus, decision makers in both national and international organisations need better understanding of the factors affecting uptake and diffusion, where regulatory barriers and costs are most extreme, how they are affected by policy or market change, and how improved connectivity could help accelerate other development changes.

3. By combining information on ICT penetration with market-openness assessments and the cost of connectivity, a clearer picture of the dynamics of supply and demand can be achieved. Correlating these indexes with other measures of development can provide further insights, and comparison between countries can highlight the impact of various national and regional strategies. In the lead up to WSIS and its finale in Tunis in 2005, this information will be particularly important in helping to assess national or regional progress and to determine policies and strategies that help meet universal access objectives.

4. This report describes on-going work by the International Development Research Centre of Canada (IDRC), and the Open Society Institute (OSI) to better develop useful measures of the digital divide in Africa. Because of the difficulties in obtaining reliable and timely data in developing countries it is important to take a pragmatic approach in adopting indicators which

II. MEASURING ICT USAGE

5. The use of the Internet is a good indicator of the extent of ICT adoption, as it requires the integration of most of the individual components - telecommunications infrastructure, electricity, computers, and the skills to use these technologies. Traditionally, the number of Internet users has been employed as a measure of Internet penetration, however measuring the numbers of users is not easy in developing countries because many people share accounts, use corporate and academic networks, or visit the rapidly growing number of cyber cafés, telecentres and business services.

6. Furthermore, simply measuring the number of users does not take into account the extent of use, from those who just write a couple of emails a week, to people who spend many

hours a day on the net browsing, learning, transacting, streaming, or downloading. As a result, new measures of Internet activity are needed to take these factors into account.

7. One indicator that is becoming increasingly popular is to measure the amount of international Internet bandwidth used by a country - the 'size of the pipe', most often measured in Kilobits per second (Kbps), or Megabits per second (Mbps). The data is relatively easily obtainable as there are much fewer international Internet operators (about 100 in Africa), and most of the Internet traffic in a developing country is international (75-95%), so the size of its international traffic compared to population size provides a ready indication of the extent of Internet activity in a country.

8. The use of outgoing bandwidth is usually a better indicator because it is more reliably obtained - there are fewer, more well-known outgoing gateways and the speed or size of these circuits is more consistent - service providers often augment their outgoing international bandwidth (which often has to be purchased at high-prices from monopoly telecom operators) with grey-market incoming satellite circuits at un-committed information rates.

9. In 2002 IDRC commissioned a survey of international Internet gateways in Africa to determine the size of their international bandwidth and to map this against current total population levels[1]. ISPs and telecommunication operators were contacted in almost every African country, as well as many of the international providers in Europe and North America who provide links to Africa. The ITU and Telegeography also provided figures to help cross-check the statistics. Corporate and private networks such as those operated by the World Bank and many multinationals and diplomatic organisations were not included in the survey - only international bandwidth used for public access facilities - ISPs, cybercafes etc.

10. The study found that in some countries the international links are only as large as the local circuit of a small or medium sized business in a developed country - about 128Kbps, or about 3-4 times standard modem dialup speeds. In most cases these are confined to very small and poor African countries.

11. But in order to make useful comparisons the population size of the country must be taken into account. As shown in the map produced for the project shown at the end of this document, the coloured circle in each country on the map shows to exact scale the international bandwidth available in bits per capita (BPC) in mid 2002 on publicly accessible IP networks. It was derived by dividing the country's total projected population for mid 2002 by the country's total amount of outgoing international bandwidth in bits per second for that period. The countries are shaded according to their wealth as measured by World Bank GDP/capita figures for 1999.

12. As is evident from the map, there is an extremely large variation in the BPC index, ranging from 0.02 to over 40 - a factor of over 1000. These figures reflect the wide range of wealth in different countries, however GDP per capita only varies by a factor of about 30, which indicates that there are other influences also at work. In particular, bandwidth price varies considerably on the continent and this impacts heavily on demand. Price is in turn influenced by the regulatory environment - the presence of competition, availability of

wireless and VSAT licences, as well as access to international and regional fibre-optic bandwidth.

13. Clearly shown by the map is that there is almost no intra-African Internet connectivity and the vast majority of international bandwidth lands in the G8 countries - principally North America followed by Europe (Belgium, France, Germany, Italy, Netherlands, Norway, Portugal, and the UK). Lack of infrastructure and high intra-regional telecom prices have limited the establishment of links between neighboring countries to just 5 - Gambia-Senegal, and South Africa's links to Namibia, Lesotho, Swaziland and Botswana. As a result increasing amounts of intra-African traffic must be transited through high cost inter-continental links.

14. However the recent establishment of the West African marine fibre cable (WASC) has already resulted in activity by operators in Gabon, Cote d'Ivoire, Namibia, Nigeria and Senegal to establish large international Internet links and this may substantially increase the available Internet bandwidth. Senegal has since proceeded furthest this direction with its 310Mbps Internet circuit to France via the recently installed Atlantis-2 cable, which it is now sharing with neighbouring Mali and Gambia and is planning to connect to Mauritania as well. Similarly, the availability of low-cost VSAT licenses is expected to have a major impact on the Internet infrastructure in countries that allow it, now that consumer and small-business oriented services have become available over the whole continent via Ku-band satellite footprints from operators such as Panamsat, Intelsat and News Skies. Satellite hubs can even be built at the new marine cable landing points to more economically provide onward satellite connectivity to regions without terrestrial telecommunication infrastructure. In addition, associations of Internet service providers in Africa are planning to interlink their national Internet exchange points via fibre and satellite to reduce the amount of internal traffic that must flow off-continent.

15. To maintain the value of the BPC indicator, it will in future be necessary separate out Voice-over-IP (VoIP) traffic from other Internet traffic because increasing numbers of telecom operators are switching over to this protocol for their international voice traffic. In addition, to be fully consistent in comparisons between countries, it is also necessary to measure the level of utilisation of the outgoing bandwidth available. The eJournals Delivery Service (EJDS) of the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy (ICTP), is collaborating with the Stanford University Linear Accelerator Centre (SLAC) in the US in a pilot project to monitor utilisation of Internet circuits in developing countries[2], but a larger project with more resources is required to make the data more comprehensive.

III. MARKET OPENNESS AND ACCESS COSTS

16. In order to meet the need for better information in this area OSI and IDRC are currently carrying out a preliminary survey and analysis of costs, policy and regulatory frameworks and the resultant market structures in relation to Internet connectivity in 20 selected African countries. The preliminary results of the survey will be available at WSIS.

17. The surveys are essentially pragmatic rather than exhaustive, asking the minimum number of questions necessary to derive simple yet reliable indexes of market structure and

cost which allow countries to be compared and ranked. It is expected that this will result in the development of readily available measures which allow comparison of market structure and costs of connectivity in different countries and with world benchmarks. It will also allow for comparisons to be made of various strategies to reduce the cost of access and to better understand the relationship between these measures and other development indicators.

18. The learning and experience from the project will be used to refine the methodology and experience with local researchers to conduct a larger and more comprehensive survey in 2004. This will include updating and expanding measurement of the two other factors mentioned above that necessary to flesh out the connectivity picture, namely usage (numbers of users and available bandwidth), and quality of service (link utilisation measurement).

IV. ICT MARKET STRUCTURE AND REGULATORY FRAMEWORK

19. The ICT market structure survey assumes that a sufficient degree of accuracy can be obtained by assigning points on a scale from 1 to 5 for a series of 8 variables as outlined below. To some extent there are likely to be some subjective variations in the assignment of points caused by the differing perspectives of the researcher in each country. This can be partly addressed by cross-checking with the existing knowledge base in the area.

20. The variables in the market structure survey are:

a) Degree of fixed line competition
1 = Fixed Line Monopoly in International, National and Local loop (e.g most countries)
5 = Open competition in International and Local Loop (i.e at least one competitor in both areas, operating for 1 year - e.g Nigeria soon, DRC now)

b) Extent of state ownership of fixed line operators
1 = State Owned Monopoly (e.g most countries)
3 = Partially privatised, effective Monopoly (some countries, e.g SA, Ghana - i.e small/ineffective SNOs and a few rural licenses don't count)
4 = Majority share in privatee hands - e.g CI Telecom
5 = Fully privatised national telco (none known)

c) Regulatory strength
1 = No separate regulator (PTO or ministry regulates, a few countries)
2 = Partially independent or newly established regulator (e.g Cameroon, most countries) or ineffective regulator.
3 = Benign regulator
4 = Effective & fully independent regulator (e.g- Botswana)
5 = 4 + plus progressive policies

d) Technology Openness

VoIP
1 = VOIP prohibited except by monopoly operator

2 = VOIP prohibited except by several identified operators
3 = VOIP licensed but to anyone who applies
4 = Technology Neutrality (no restrictions on VOIP)
5 = VoIP technologies promoted by government, regulators and private operators

VSAT
1 = VSAT prohibited except by monopoly
2 = VSAT prohibited except by restricted number of operators
3 = Licensed to whoever applies but restrictive licence fee
4 = Low or not fees for licensees
5 = No license or fee for VSAT

WiFi/Unlicensed spectrum

1 = Significant Restrictions on use of Wifi/Unlicensed Spectrum
2 = Only for non-commercial use
3 = ISM bands are Licensed Frequencies
5 = No restrictions on WiFi

e) Interconnectivity
1 = No interconnection, and/or no requirements (many countries?)
2 = PSTN Interconnection required
3 = Interconnection of all operators required and tariffs set by regulator (SA ?)
4 = Internet exchange required by regulator.
5 = Facilities access and presence of Internet exchange point.

V. CONNECTIVITY COSTING

21. 'Connectivity' is moving toward a unified packet-based system with two cost components – a) access to the underlying physical telecom infrastructure between the Internet supplier and the user, and b) access to the upstream Internet supplier's bandwidth. Thus connectivity costs integrate both the costs of telecom infrastructure and Internet service provision, which in turn takes into account its own underlying connectivity costs.

22. Technically, once you have access to the Internet you're free to recover the costs or make a profit by providing access to 'downstream' users. While some ISPs may limit the volume of data that can be moved, these days anyone with a PC or $75 Wifi access point can resell access, even if they only have a dialup connection to the Internet. Thus the provision of Internet access follows a very simple recipe – 1) estimate the costs of purchasing upstream Internet bandwidth, 2) estimate the needs and costs of distributing the bandwidth amongst yourself and your downstream users, 3) decide how you're going to charge/share or otherwise recover the costs.

23. There are a wide range of pricing mechanisms ISPs use to charge for Internet access, which partly reflects the wide range in incomes and levels of usage. For pragmatic reasons, the study will assume that they can be divided into three groups – a) dialup users spending an average of 20 hours a month online b) cybercafe users spending 10 hours a month online and c) organisational users with permanent leased lines (not including cybercafes).

24. Relative to bandwidth charges, equipment costs are far more uniform across the continent and therefore, for pragmatic reasons are not included in the cost accounting process.

25. To further simplify the information gathering, for dialup users, the cost estimate includes the monthly phone line rental fee (people are increasingly using mobile for voice calls anyway), and the closest subscription package that fits 20hrs a month of peak-time usage (most access occurs during the day anyway).

26. For leased line users a 128Kbps leased line link with at least 64Kbps guaranteed international bandwidth would be used as the benchmark. In many cases telecom leased line and Internet access charges are bundled together so there is only one cost line for leased line users. This is also true for cybercafe users where 10 hours per month per user is assumed.

27. For comparative purposes the figures can be annualised and scaled for the index in a 1-100 range in the ratio 1:10:100 leased-lines:dialups:cybercafe-users. This is somewhat arbitrary but does reflect the rough order of magnitudes of each of the end-user bases. A more accurate ratio or even a per-country ratio will be achieved in subsequent research by including the numbers of each of the types of users in surveys. Using user-base figures in each country could allow the derivation of a total 'Internet-spend' per country. The impact of changing the assumed ratios is in any case be assessed as part of the sensitivity analysis for the other variables and assumptions such as business vs residential lines, off-peak vs on-peak charges, etc.

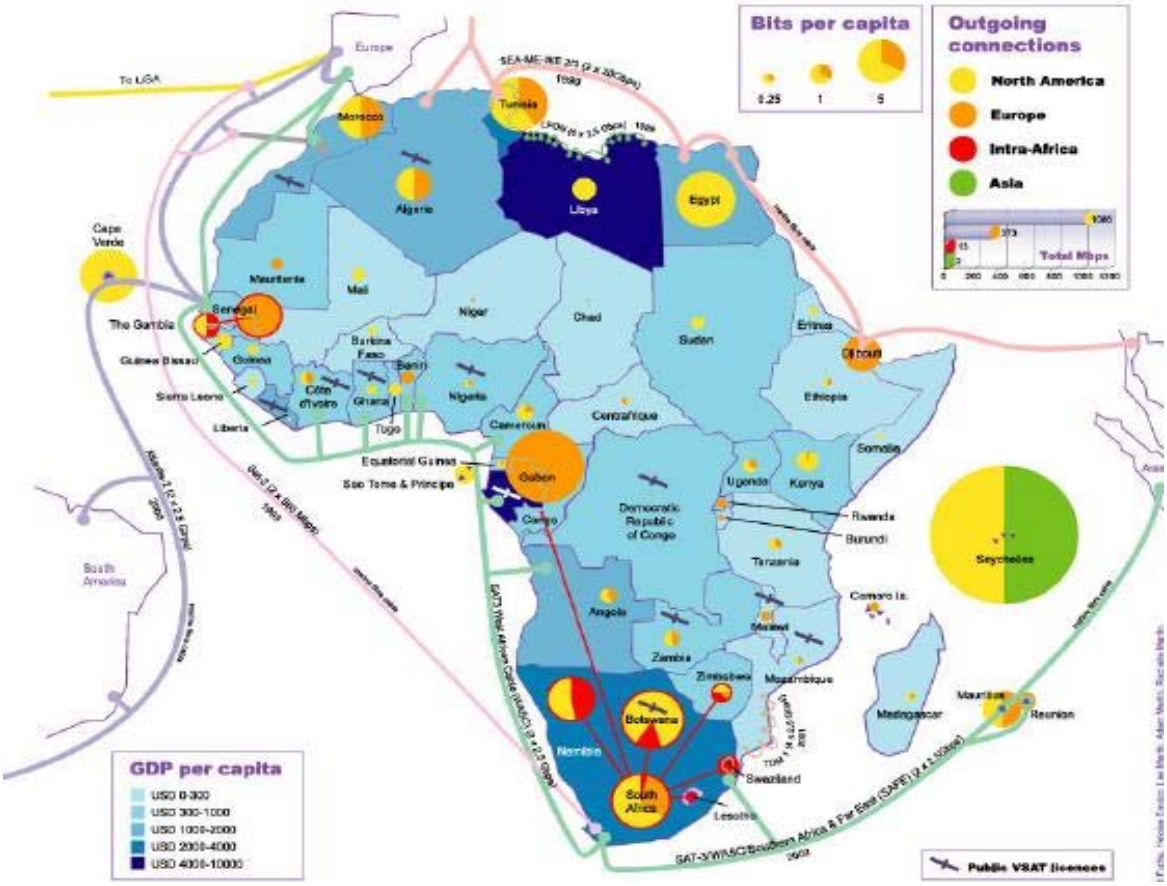
28. Where choices between different providers are available, the lowest cost provider is chosen, assuming this provider has been in operation for at least a year. If the link is provided by VSAT, VSAT licensing fees need to be included in the annual cost.

29. Figures also need to be converted to the Euro and the US$ at current exchange rates and also converted to PPP for analytical purposes. The information gathered should also include sales tax if applicable, and if the accounts must be paid in hard currency.

30. The table below shows an example assessment for a country with 20,000 dialup users, 200,000 cybercafe users and 2,000 leased lines, which, using average figures for the continent works out at an estimated US$88.5million annual Internet spend.

		Variable Costs		Fixed Costs				
User Groups	**Users**	**Cost / Unit**	**Units /month**	**Month**	**Annual**	**Spend per User**	**Total Annual Spend**	**Note**
Dialup Telecom	20000	1.5	20	20		600	12000000	1
Dialup ISP charge	20000			30		360	7200000	2
Dialup Total	20000					960	19200000	
Cybercafe	200000	1	10			120	24000000	3
128/64Kbps Leased Line	2000			750	4000	13000	26000000	4
Total Annual Spend USD							**$88,400,000**	

1.$1.5/hr peak rate dialup charge, $20/month business line rental
2.$30/month subscription fee for 20/hrs per month
3.$1/hr usage fee to cybercafe owner
4.$750/month to combined Internet/telecom provider, $4000/yr to VSAT regulator, other variable costs or annual charges may also apply.



NOTES

1See http://www.idrc.ca/acacia/divide.

2See http://www.ejds.org