ATICS

African Tertiary Institution Connectivity Survey

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Commissioned by Robert Hawkins of the World Bank Institute

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Executive Summary

Connectivity in African Tertiary Institutions

The state of Internet connectivity in tertiary institutions in Africa can be summarized by three characteristics – too little, too expensive and poorly managed. The average African university has bandwidth capacity equivalent to a broadband residential connection available in Europe, pays 50 times more for their bandwidth than their educational counterparts in the rest of the world, and fails to monitor, let alone manage, the existing bandwidth, when improving bandwidth management is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes. As a result, what little bandwidth that is available becomes even less useful for research and education purposes.

However, initiatives within the continent point the way to a different future. North Africa is the most advanced of all regions in Africa because universities in these countries have just recently become members of the EU MED Connect project, which links them to high speed undersea fibre networks. The potential for these types of arrangements hold out the possibility to dramatically alter the bandwidth landscape in tertiary institutions in the near future. But, due to limited national and international fibre backbones, satellite bandwidth will continue to be an important means of obtaining connectivity for many tertiary institutions. Even so, there are significant barriers for these organizations in obtaining authorization to use satellite connectivity, as indicated by only 14 out 52 countries having clearly defined competitive satellite regimes (see Table 4 on page 28).

The African Tertiary Institutions Connectivity survey collected information from 83 institutions, representing 40 countries in Africa (full results can be found at www.atics.info). This resource will hopefully continue to be used in the coming years as African education institutions form their own consortiums and support systems. Most of Africa is still to be networked by terrestrial Internet infrastructure, and those bandwidth networks which do exist are not independently owned or managed.

In order for most academic institutions to improve their connectivity the formation of a VSAT based bandwidth consortium is the most effective strategy in the near term and would lower their bandwidth costs by an estimated 50%. As has been seen elsewhere in the world the formation of consortia to purchase bandwidth in higher volumes increases both the quality and lowers the cost of bandwidth to its members. Models all over the world (such as TIEN in Europe and Asia and CLARA in Latin America) as well as within Africa (TENET South Africa and EUMEDCONNECT in North Africa) reinforce this potential value. Almost all the universities surveyed indicated a strong desire to join a bandwidth consortium if it would lower the current costs those institutions are facing. Through such an initiative, not only will African researchers and academics be able to increase the quality of their research, but it will also stimulate collaborations across the continent. The networks that such initiatives will create will have long-term impacts on the overall

bandwidth market in Africa and enable a host of innovations that can bring the dream of a truly connected continent closer to reality.

Key findings of ATICS

Bandwidth type

- The majority of the sampled universities use terrestrial based leased lines for connectivity purposes with satellite (VSAT) coming closely in second place. In particular 32% of the sampled institutions use leased line wire connections for Internet access. Unfortunately, over 7% of institutions still rely on dial up connections for their Internet connectivity.
- Only 48% of institutions surveyed had access to international fibre. As this most desirable form of connectivity is unlikely to be rolled out in the short term (along with the necessary national fibre backbones), most tertiary institutions on the continent are likely to need to rely on satellite connectivity for the next few years.

Bandwidth availability

- The average bandwidth reported for the sample is 537/769 Kbps – roughly equivalent to a broadband residential connection in North America or Europe. There is a wide gap between the lowest bandwidth capacity of 28/28 Kbps and the highest capacity of 7 Mbps/7 Mbps.
- Institutions with fibre connection tend to have the highest connectivity, with a mean of 2066/2178 Kbps, while dial up connections have the lowest capacity of 28/28 Kbps.
- Underlining the pent up demand for bandwidth amongst most institutions, the average percentage of time where links are at 100% capacity is over 60%. This is extremely high, given that this is measured over 24 hours a day every day of the month.

Bandwidth costs

- The highest bandwidth cost of US $36.33/kbps/month is being paid by Universite de Yaounde 1 of Cameroon althouth the average cost per Kbps/month is US$5.46. Some institutions such as the Universities in Senegal, Burkina Faso and the Central African Republic are paying very little, or even nothing for their bandwidth because of subsidies.
- VSAT companies, followed by national telecoms, are charging the highest prices per Kbps, while donor initiatives and academic networks charge the least. This is understandable, given the fact that VSAT all over the world tends to be more expensive and, in many cases, provides higher quality bandwidth than national telecoms or private ISPs.
- Also, direct VSAT costs were found on average to be much more expensive than land-based connections. Although land-based connectivity in most countries in Africa ultimately comes from VSAT, because the land-based services are buying in relatively large volumes, they are able to negotiate lower costs than single institutions buying VSAT services for themselves.
- The data also supports the claim that tertiary institutions which buy their bandwidth as part of a network or consortium obtain the most cost-

effective bandwidth. The best example in Africa of the power of donor consortiums to lower university bandwidth costs is EUMEDConnect, which provides high speed low cost bandwidth to Mediterranean academic networks.

- In addition, it was found that the greater the volume of bandwidth being purchased the lower the marginal cost of that bandwidth. This fact also strongly underlines the argument for bandwidth buying consortiums for African tertiary institutions. The further implication is that even small groups of institutions coming together can dramatically lower their per-unit bandwidth costs.
- None of the respondents gave a negative response to the idea of joining a bandwidth purchasing consortium, and the majority is clearly willing to join a bandwidth consortium, with only 16% indicating a lower possibility of their inclusion in such an initiative.
- Regionally, institutions from West Africa are paying the highest amount of US$8/Kbps while institutions from North Africa are paying only US$0.52/Kbps. Institutions in North Africa are also ahead of those in the other regions in having the highest average bandwidth capacity of 4352 (up)/4403 (down) Kbps. They are followed by those in Southern Africa, which shows a significantly lower average of 352/655 Kbps.
- Institutions in North Africa are certainly in a different situation than those in Sub Saharan Africa. This is due primarily to the presence of national backbones and the utilization of undersea cables connecting the National Research and Education Networks in North Africa to the Internet. In the rest of Africa, Central Africa has the poorest connectivity, and Southern Africa is slightly better off than both East and West Africa.
- Donor initiatives (e.g., UNDP, Leland Initiative) and academic networks (e.g., TENET, KENET, EU MedConnect) have the largest average bandwidth capacity). About 18 institutions from the survey (22%) are members of national research and education networks, while seven of the 40 surveyed countries (18%) have national research and education networks. The smallest average bandwidth capacity was recorded for institutions using private ISPs.

Bandwidth quality

- Most of the institutions surveyed (66%) reported either that they did not have a Committed Information Rate for their connectivity or that they did not know what a Committed Information Rate was. In this regard, donor initiatives/academic networks were more likely to provide CIR than other Internet service providers.
- Furthermore, institutions where the respondent claimed not to know if they had a CIR or not are, in fact, paying the most for their bandwidth, while those who are part of a consortium and have the highest quality of bandwidth get the lowest cost. This dramatically shows the power of knowledge and volume in bandwidth purchasing decisions.

National regulations and bandwidth access

- Regulatory restrictions on the use of VSAT continues to be an issue for institutions in some countries.. About 20% of the respondents indicated they had VSAT licenses, while 4% indicated they owned VSATs but had no license. institutions have experienced a mixed response to their attempts to obtain a VSAT license. About 14%of the respondents indicated they were unable to obtain VSAT licenses, possibly due to prohibitive restrictions/regulations on VSATs in their respective countries. Altogether 55% had not been able to get proper VSAT licence at this point in time although many were still waiting for a reply. An encouraging result however is that the majority of the VSAT owning institutions (58%) said they had free licenses, in most cases through waivers for educational institutions. This follows recent trends toward educational exemptions, such as the recent waiver for VSAT licenses used for educational purposes in Kenya.
- Non-free licenses are held by 14% of the VSAT-owning institutions. The average annual cost of VSAT license is US$13 553. This average annual cost is far higher than the EU average of US$426, showing that VSAT is still expensive in Africa compared to the developed world. However, it should be noted that this figure is skewed toward the high side by some extreme cases. Nevertheless, it is apparent that there is a huge range in the license fees being paid by institutions, with some institutions required to pay as much as US$72 000 (Zimbabwe) compared to some paying as little as US$267 (Rwanda).

Bandwidth utilisation

- There are large differences in levels of computer access among the institutions. The highest number of users per computer is 929. The average across the sample is 55, which is still relatively high compared to developed country institutions. Central African institutions appear to have the least number of networked computers for their campus populations compared to Southern and Northern African institutions. However, even 11 users (southern Africa average) per networked computer is a high ratio compared to the average students per networked computer ratio of USA institutions, which is thought to be about five.
- The amount of Internet bandwidth that is available to each computer on the local network is a key indicator of the connectivity level of the institution, as it determines the speed of downloads and thus the utility of the Internet for each user. In some institutions with many PCs sharing a small pipe, downloading a single web page can take many minutes and make some applications, such as web-based mail or electronic journals and scientific databases, almost impossible to use. Other institutions may have sufficient bandwidth per PC to allow for video conferencing and other broadband applications. The lowest bandwidth per networked computer is 0.32Kbps compared to the highest bandwidth of about 37Kbps - roughly equivalent to a dial up modem. The average bandwidth per networked computer is 3.36Kbps. Regionally, the highest average bandwidth per networked computer was registered by institutions in North Africa (9.6 Kbps) while the lowest average bandwidth per networked computer was recorded for institutions in Southern Africa, which is likely to be the result of

having more computers within these institutions without adequate bandwidth. Central Africa has a relatively high bandwidth per network computer but this is primarily because there are so few computers at the institutions surveyed rather than because the quality is high.

- Campus networks are present in 97% of the institutions. The largest proportion (29%) of the respondents with campus networks reported they used copper (10 Base and 100BaseT) for their campus backbones. 19% said they used a mix of copper, wireless and fibre. About 7% reported using a hybrid/mixed backbone for their campus network. Almost 40% of the surveyed institutions utilized wireless links somewhere in their campus networks, while almost 50% had some fibre links in their campus network.

Bandwidth management

- Unfortunately, the majority of the respondents (59%) reported that they did not practice bandwidth management, or seldom did so, thus indicating a critical need for skills training in this vital area. Improving bandwidth management is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes.
- Although 51% indicate that they monitor their bandwidth, only five of the universities could provide basic usage figures such as average bandwidth used, indicating that monitoring is sporadic at best.
- Good benchmarking statistics for these key variables (students per networked computer and bandwidth per networked computer) are not readily available anywhere, even for developed countries, which makes comparisons and objective setting difficult.
- The results also indicated that VSATs have a higher rate of failure, with 10.63 hours per month, than other links, with fibre having the lowest rate of failure of 0.15 hours per month. It appears that, where electricity cuts are a problem, VSAT and wire are affected most. The implications of these findings is that VSAT solutions appear to be a more difficult technical solution for many institutions, and additional support is likely to be needed when implementing this solution.

Bandwidth and ICT initiatives

- Many of the tertiary institutions surveyed are planning to implement various ICT initiatives, and some of them are using e-learning to complement the conventional methods of learning in institutions. The majority listed improving connectivity as the first initiative they were planning to implement. A substantial number said that they were also planning to expand or establish campus networks so as to extend Internet access to all students. While 45% have a written e-learning/IT strategy an almost equal 42% do not.
- Perhaps more significantly, only 8 countries in Africa currently have National Educational & Research Networks, and only 22% of the institutions surveyed are members of these networks. Clearly there is a major need to support the emergence of these networks as the most effective bandwidth buying consortia and lobbying groups. Shared purchasing of online learning management and distance education tools could also be another area to

motivate the formation of consortia for reducing costs and sharing development skills.

Bandwidth requirements
In comparing current bandwidth with estimated requirements for 73 Sub Saharan universities, calculation shows that bandwidth requirements are at least 10 times the current usage. This represents the capacity of 5 to 10 transponders if a VSAT solution was to be put in place.

Recommendations

The study recommends the following:

1) *Formation of Bandwidth Buying Consortium*: VSAT based university consortium to purchase bandwidth is an obvious initiative for the immediate future. The development of such a centrally managed network using satellite technology and offering services across a large area would help to address multiple issues facing tertiary institutions.
2) *Improved Bandwidth Management*: It is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes. Improved bandwidth management ensures better quality, lower cost, maximized bandwidth availability and a boost in throughput.
3) *Centralised Network Management and Technical Capacity*: Bandwidth without adequate network management is wasteful and reduces its value. In most African countries, the available technical expertise in network management is not adequate. Satellite technologies, by their nature, route traffic through a limited number of hubs, thus creating a natural situation for centralized network management, the cost of which could be shared by all the institutions involved.
4) *Improved Regulatory Policies Regarding Educational Bandwidth*: An important role of any consortium or bandwidth initiative will be to negotiate with governments to allow the use of VSATs or eliminate license fees and monopoly pricing for educational bandwidth. A well conceived diplomatic strategy will have to be pursued in order to accomplish this. Many countries in Africa have already embraced liberalization policies although a few challenges do remain.

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Glossary of Technical Terms and Acronyms

Term	Meaning
African Digital Library	Aims to provide digitized full text resources to learners in Africa via the Internet, thereby contributing to the revitalization of education and life long learning on the continent and alleviation of the digital divide between First and Third world countries.
AGORA	**Access to Global Online Research in Agriculture.** The AGORA site provides access to over 500 journals from major scientific publishers in the fields of food, agriculture, environmental science and related social sciences. AGORA is available to students and researchers in qualifying not-for-profit institutions in eligible developing countries.
AVU	African Virtual University
Bandwidth	Rate of data transfer, i.e., the capacity of the Internet connection being used.
Burstable bandwidth	Internet Service Providers permit customers to use more bandwidth than is contractually allotted to them for a short period of time. This is called burstable bandwidth.
C-band and Ku- Band	C band and Ku-band are two common satellite frequency bands. C-band uses between 4 and 6 Ghz for transmission. Ku-band earth stations use the 14 Ghz frequency band to transmit and the 12 Ghz frequency band to receive.
CIR	Committed Information Rate. It essentially indicates the capacity of bandwidth that the Internet Service Provider will guarantee to deliver. Without a CIR the customer will be grouped with a pool of clients and there is no guarantee that they will receive anything even close to the bandwidth they think they have purchased
CLARA	Cooperacion Latino-Americana de redes Avanzadas or Latin American Co-

	operation of Advanced Networks
COMTEL	A planned fibre backbone network, promoted by the Common Market for Eastern and Southern African States (COMESA), that will cover 25 country members.
Dial Up	This involves connecting a device to a network via a modem and a public telephone network. Dial-up access is just like a phone connection, except that the parties at the two ends are computer devices rather than people. Since dial-up access uses normal telephone lines, the quality of the connection is not always good and data rates are limited. Most common maximum data rate with dial-up access is 56 Kbps but ISDN technologies have improved this.
DNS	Domain Name System (**DNS**) is a distributed internet directory service.
E- learning	This is the use of new multimedia technologies and the Internet in learning so as to improve the quality of learning and complement conventional learning methods.
EASSY	East African Submarine System (EASSY) is a planned East African fibre optic undersea cable system connecting the region with the rest of the world.
EUMEDCONNECT	European Union Mediterranean Connection Project
EUN	Egyptian Universities Network
Fibre Connection	Connection that uses fibre optic cables to communicate between nodes.
Gbps	Gigabits per second
GDP per Capita	Gross Domestic Product per Capita
GEANT	A multi-gigabit pan-European data communications network, reserved specifically for research and education use
HINARI	**Health InterNetwork Access to Research Initiative.** An initiative seeking to bridge the digital divide in health be ensuring that relevant information and the technologies for its dissemination are made available to health personnel: professionals, researchers and scientists, and policy

	makers in eligible developing countries. Providing more than 2,000 scientific publications.
ICT	Information and Communication Technologies
IDRC	International Development Research Centre
ISDN	Abbreviation of **integrated services digital network**, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. ISDN supports data transfer rates of 64 Kbps (64,000 bits per second).
ISP	Internet Service Provider
JSTOR	JSTOR is a not-for-profit organization with a dual mission to create and maintain a trusted archive of important scholarly journals, and to provide access to these journals as widely as possible
Kbps	Kilobits per second. A bit is the smallest unit of computerized data. Bandwidth is usually measured in bits, kilobits, megabits, or gigabits per second. It is important to remember that bits and bytes are not the same. One byte equals approximately eight bits.
KENET	Kenya Education Network
LANs	Local Area Networks
Leased Lines	A permanent telephone connection between two points set up by a telecommunications common carrier. Typically, leased lines are used by businesses to connect geographically distant offices. Unlike normal dial-up connections, a leased line is always active. The fee for the connection is a fixed monthly rate. Leased Lines are often wire, radio link wireless or fibre.
MARWAN	Morocco Research Wide Area Network
Mbps	Megabits per second
NRENs	National Educational and Research

	Networks
NUNet	Nigerian Universities Network
PERI	**Programme for the Enhancement of Research Information.** A programme to support capacity building in the research sector in developing and transitional countries by strengthening the production, access and dissemination of information and knowledge.
PNG	Portable Network Graphic. Pronounced ping as in ping-pong is a file format for image compression that, in time, is expected to replace the Graphics Interchange Format (GIF) that is widely used on today's Internet. The file is compressed in lossless fashion (meaning all image information is restored when the file is decompressed during viewing making it, portable, and highly efficient. images and includes an optional alpha channel.
PSTN	PSTN (public switched telephone network) is the world's collection of interconnected voice-oriented public telephone networks, both commercial and government-owned
Radio link Wireless Connection	Connection that uses high frequency radio waves rather than wires to communicate between nodes.
RNRT	National Research and Technology Network Tunisia
SAT-3 WASC	West African Submarine Cable System, which connects Europe with Africa and Asia. And lands in 16 countries along the west coast of Africa
TENET SA	Tertiary Education Network South Africa
TIEN	Trans Eurasia Information Network
VSAT	Very Small Aperture Terminal. Refers to receive/transmit terminals installed at dispersed sites connecting to a central hub via satellite using small diameter antenna dishes (0.6 to 3.8 meter). These systems operate in the Ku-band and C-band frequencies
Wire Connection	Connection that uses wires to communicate between nodes.

N.B. Some terms are defined as in the report, 'More Bandwidth at Lower Cost 2003' by the Partnership for Higher Education.

Introduction

1.1 Study Objectives

Internet connectivity has been recognised as a vital tool in African educational institutions and there is now substantial interest in supporting improved bandwidth in the educational sector amongst international development agencies. These include the World Bank (which is also supporting the African Virtual University (AVU)), the US Foundations – Rockefeller, Ford, Carnegie, and MacArthur – the International Development Research Centre (IDRC) and the Open Society Institute (OSI), the United Nations University (UNU) and the International Telecommunications Union (ITU), among others.

Initial studies have already been carried out by these agencies. These suggest that if a large group of African universities and other higher education and research institutions could come together to buy satellite bandwidth in bulk, considerable cost savings could be realized. In addition, direct connections between these institutions would improve the potential for collaboration on research and in sharing educational resources.

In preparation for these activities, this study identified higher education and research institutions in Africa and carried out an initial survey of 83 institutions in 40 countries to discover their needs and willingness to participate in a 'bandwidth purchasing club'.

The following were the study's objectives:

- To assess the types of connectivity, bandwidth capacity and costs at tertiary institutions encountered in Africa;
- To assess the existing types of Internet service providers and their arrangements with African tertiary institutions;
- To assess the VSAT use and types of VSAT licensing requirements for tertiary institutions;
- To assess the levels of computer infrastructure within tertiary institutions;
- To assess the bandwidth monitoring and management practises in tertiary institutions on the continent;
- To assess planned ICT initiatives as well as the degree of e-learning achieved
- To find out the willingness to join a bandwidth consortium of these institutions throughout Africa.

1.2 Methodology

1.2.1 Survey Approach

In order to meet the study objectives a quantitative approach was used in which surveys were distributed to identified organizations and also made available publicly via a web-based database system.

1.2.2 Sampling

A target of 100 universities in 50 countries was set for the study, i.e. 2 institutions per country. The targeted universities were selected based on their size and importance within each country. The targeted respondents were personnel from the Information Technology department/computer center or other related departments. Principal authorities – rectors, vice chancellors – were also targeted in order to assist with bureaucracy problems. Once a contact person was established for a university, the university/institution was included in the survey. A total of 83 tertiary institutions from 40 countries responded to the survey.

A full list of respondents is included as Appendix 3.

1.2.3 Methods of Data Collection

Survey Questionnaire

This was the primary tool used in data collection. A three-pronged approach self-administration, phone interviews and online surveys, was used to maximize the completion of the questionnaire and mitigate against low response rates:

Self-Administration: A structured questionnaire was used to collect data from the tertiary institutions (respondents). The questionnaire was sent to the respondents via e-mail. Since it was self-administered, respondents would send back the questionnaire via e-mail or by fax, after completing it. Three-language versions of the questionnaire – English, French and Portuguese – were sent out to the respondents to overcome language barriers.

Phone Interviews: To maximize response rates, the respondents were telephoned by the enumerators for interviews. In some cases, the respondents would answer the questionnaire during the telephone interview. However, in most cases, the respondents would request an electronic copy of the survey, which they would complete and return via e-mail.

Website/Online Database: The study's website www.atics.info has an online database. Respondents were also encouraged to register on the website and fill in the survey form available online.

1.2.4 Limitations to Data Collection

As expected, the study encountered many challenges during data collection, including:

- Tertiary institutions have been bombarded by surveys on a regular basis and as a result were often less than enthusiastic about responding.
- In some cases survey questionnaires were not completed as long as the right person was absent (in most cases this was the Information Technology manager or related personnel). Often the contacts used for the survey were not the appropriate personnel and they would need to forward the survey to the right person. University staff members are busy people and they travel a lot; thus questionnaires would take two months before they were returned or

sometimes they were not completed at all. Questionnaires would often get lost before reaching the right person. This could also have contributed to the survey collecting data from 83 tertiary institutions instead of the targeted 100.

- In some institutions (e.g. North African institutions) the process of completing the questionnaire required a number of formal processes to be carried out, thus hampering the response rate.
- A substantial number of survey questionnaires were returned with missing information. This is probably attributed to the questionnaires being filled out by less knowledgeable people. Thus the analysis had to deal with incomplete data. Critical data missing in most cases were bandwidth prices.

1.2.5 Data Entry and Analysis

The data were entered on the website database. The database contents were exported to the excel format via the export-to-CSV format. After the data was cleaned and verified in MS Excel, it was exported to SPSS (Statistical Package for Social Sciences) for analysis.

Data Analysis Approach and Methods

The descriptive analytical approach was mainly used in data analysis. The following are the methods/tools used to analyse and present the data:

- Frequencies: Frequencies were used to present values of most variables and this served as the foundation for further analysis and graphical presentation
- Pie Charts: As will be shown in the later chapters of the report, this is mostly used for graphical presentation
- Bar Graphs: They were also used in graphical presentation of variables.
- Cross Tabulations: These were carried out in presenting categorical data, e.g., CIR provided by Internet service providers.
- Maximum and Minimum: These were used in describing continuous data such as bandwidth capacity and prices. They were useful in showing the diversity across institutions.
- Measures of Central Tendency (Descriptive statistics): The arithmetic mean was used for analyzing and comparing continuous data, e.g., bandwidth prices, bandwidth capacity
- Scatter Plots: These were used to depict bandwidth capacity and costs for institutions according to the GDP for the institution's country.

Table 1 below shows the measures and variables that were considered for the analysis.

Table 1 Variables and Measurement used in Data Analysis

Objective	Variables	Measurement
To assess the types of connectivity and bandwidth capacity and costs at tertiary institutions	Connectivity type Bandwidth capacity Tertiary institutions Bandwidth prices Bandwidth cost by type of connectivity Bandwidth cost per capacity Bandwidth cost by ISP Bandwidth cost by region	Leased lines frequencies VSAT freq Dial up freq Kbps uplink and downlink mean Mean Kbps/African region (comparison) Mean Kbps/type of connectivity Mean Kbps/ISP GDP vs Kbps scatter plot GDP vs Kbps cost scatter plot CIR freq Burstable capacity freq Kbps cost mean, max, min (comparison) Kbps mean cost /region Kbps/leased lines mean, max, min Kbps/VSAT mean, max, min Kbps/Dial up mean, max, min CIR Kbps cost Cost vs Kbps scatter plot
To assess the type of Internet service providers and their arrangements with African tertiary institutions	Type of Internet service providers Bandwidth contracts CIR by ISP	Type of ISP freq Average length of bandwidth contract (max, min) Average length bandwidth contract vs. type of ISP CIR freq vs ISP cross tabulation
To assess the VSAT use and types of VSAT licensing in tertiary institutions	With VSAT license VSAT cost	VSAT license freq VSAT cost mean, max, min vs Land based connectivity cost mean VSAT allowed/ Licensed/Not allowed freq Summary table of VSAT license cost/availability for each/all countries
To assess the levels of computer infrastructure within tertiary institutions	Number of networked computers Number of servers	Networked computers mean, max, min Servers mean, max, min Average Kbps/networked computer Average students/networked computer Average students/networked computer by region Kbps per networked computer//region GDP vs Kbps per networked computer scatter plot Kbps per network computer/ size of institution (# students) scatter plot
To assess the bandwidth monitoring and management practises in tertiary institutions	Bandwidth monitoring incidence Bandwidth management practice	Bandwidth monitoring freq Bandwidth management freq

To assess any planned ICT initiatives as well as the degree of e-learning achieved	Planned ICT initiatives E-learning strategy in place E-learning applications implemented	Top 5 planned ICT initiatives with freq E-learning strategy in place freq E-learning applications implemented freq Top 5 E-learning applications with freq
To find out the willingness to join a bandwidth consortium of these institutions	Willingness to join	Willingness to join bandwidth consortium freq

N.B. All frequencies will be represented in pie charts; all mean, maximum and minimum calculations will be presented in bar graphs.

Key

Freq –	Frequency
Max –	Maximum
Min –	Minimum
Kbps –	Kilobits per second
ISP –	Internet service provider
GDP –	Gross Domestic Product
CIR –	Committed Information Rate

Findings

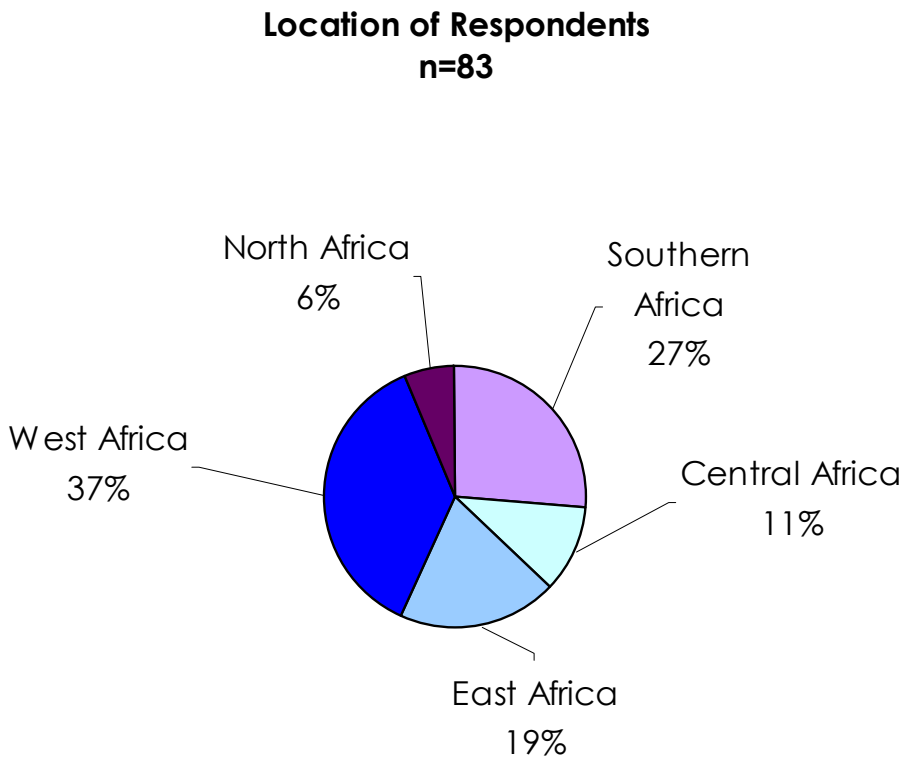
All data presented in this report are from the survey, unless stated otherwise.

Connectivity in African Tertiary Institutions

1.3 Location of Respondents

Respondents were targeted from across Africa. This report presents an analysis of 83 respondents from 40 countries. The largest group of respondents was from West Africa. The following chart shows the distribution of the respondents in the five African regions.

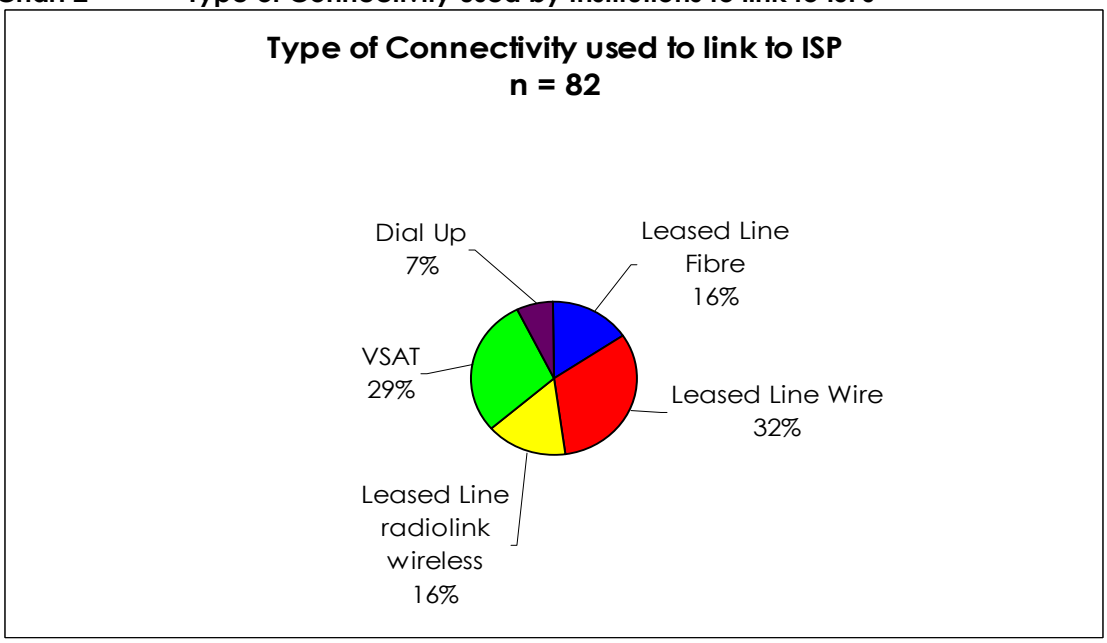
Chart 1 Location of Respondents



1.4 Type of Connectivity at African Tertiary Institutions

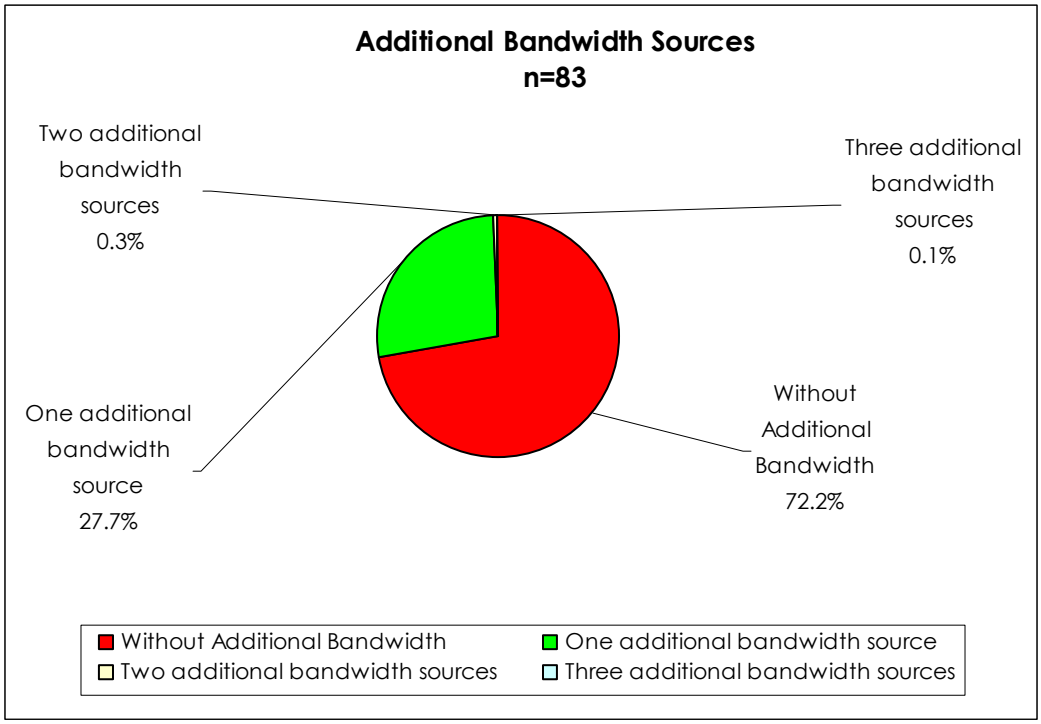
The following statistics were derived from the sample.

Chart 2 Type of Connectivity used by Institutions to link to ISPs



From the pie chart it appears the majority of the sampled universities use leased lines for connectivity purposes with satellite (VSAT) coming closely in second place. In particular 32% of the sampled institutions use leased line wire connections for Internet access. Unfortunately, over 7% of institutions still rely on dial up connections for their Internet connectivity. It also emerged from the survey that some institutions have additional bandwidth links. Chart 2.1 presents the data.

Chart 2.1 Additional Bandwidth Links/Sources

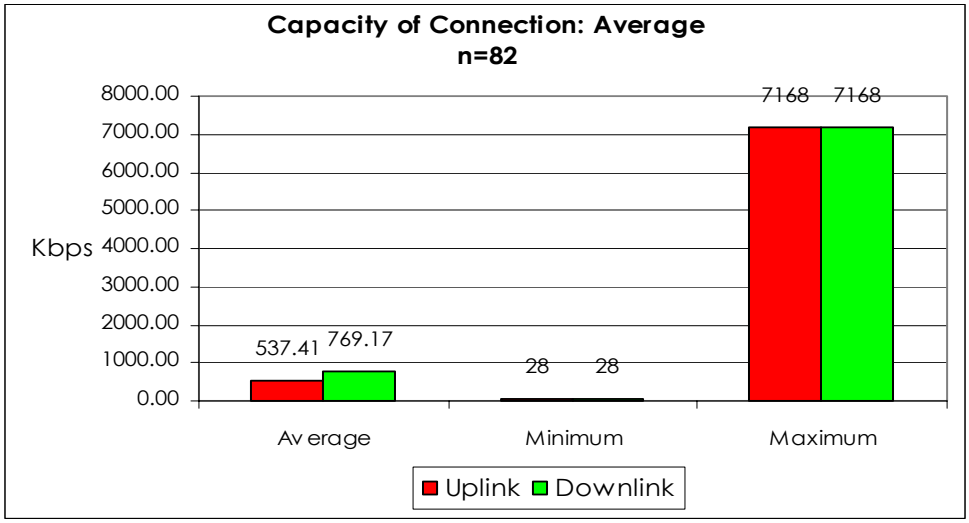


The majority of the respondents do not have additional bandwidth sources. However, about 28% have at least one additional bandwidth source.

1.5 Capacity of Connection in African Tertiary Institutions

The average, maximum and minimum capacities of connection for the sample were calculated and as one can see from Chart 3 there is a dramatic range in these characteristics

Chart 3 Capacity of Connection



The chart shows that the average bandwidth reported for the sample is 537/769 Kbps – roughly equivalent to a broadband residential connection in North America or Europe. There is a wide gap between the lowest bandwidth capacity of 28/28 Kbps and the highest capacity of 7 Mbps/7 Mbps. The following table shows the ranking of the institutions with highest and lowest bandwidth capacity.

Table 2 Rankings- Bandwidth Capacity

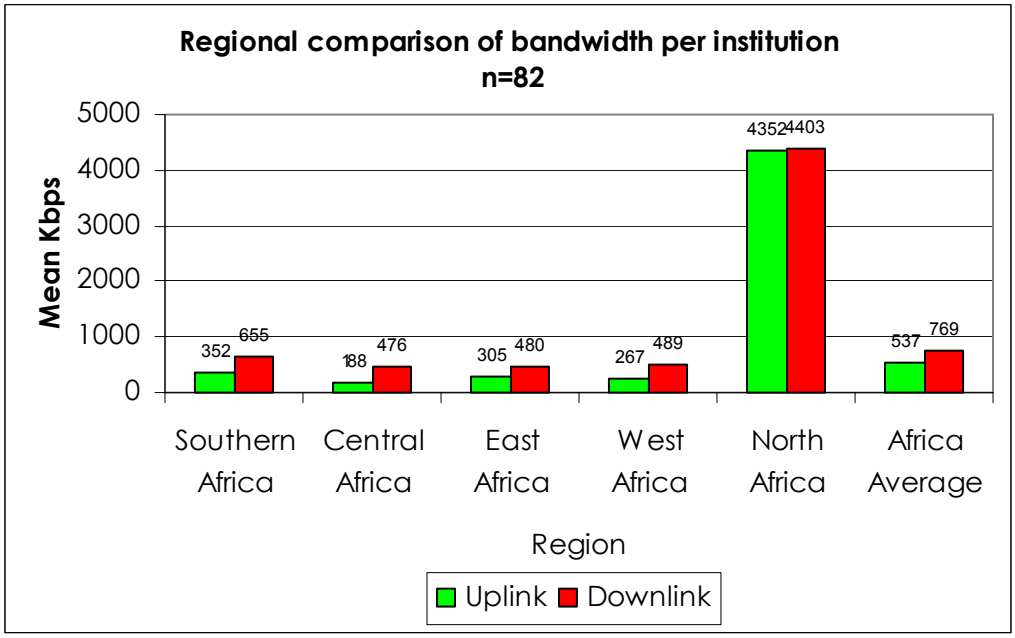
		Total Kbps (Uplink + Downlink)
Institutions with Highest Bandwidth Capacity: Top Ten		
Cairo University	Egypt	14000
Al Akhawayn University	Morocco	10000
University d'Alger	Algeria	10000
Assiut University	Egypt	8000
University of Botswana	Botswana	5000
University of Mauritius	Mauritius	4128
Universite Cheikh Anta Diop de Dakar	Senegal	4000
Makerere University	Uganda	3756
University of Zimbabwe	Zimbabwe	3024
University of Dar es Salaam	Tanzania	3000
Institutions with Lowest Bandwidth Capacity: Bottom Ten		
Bunda College of Agriculture	Malawi	128
Catholic University of Mozambique	Mozambique	128
Seychelles polytechnic	Seychelles	128
Rivers State University of Science and Technology	Nigeria	128
Kigali Independent University	Rwanda	112
Mauritius Institute of Education	Mauritius	112
African School of Architecture and Town Planning (West and Central Africa)	Togo	112
New School	Burundi	96
Universite Lumiere de Bujumbura	Burundi	96
Institut de Mathematiques et de sciences Physiques (IMSP)	Benin	56

More North African Institutions feature in the top ten institutions with highest bandwidth capacity.

2.4.1 Regional Comparison of Bandwidth Capacity per Institution

When regional averages were calculated, they revealed very distinctive differences. Institutions in North Africa are certainly in a different situation than those in Sub Saharan Africa. This is due primarily to the presence of national backbones and the utilization of undersea cables connecting the National Research and Education Networks in North Africa to the Internet. In the rest of Africa, Central Africa has the poorest connectivity, and Southern Africa is slightly better off than both East and West Africa.

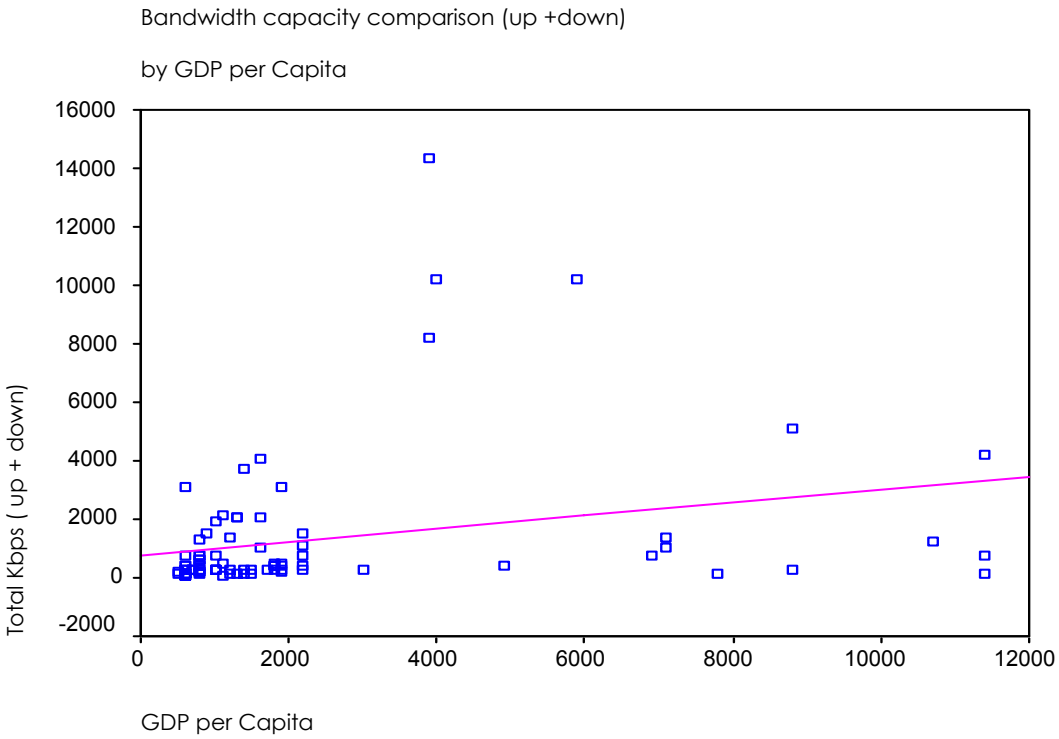
Chart 4 **Regional Comparison of Bandwidth Capacity**



As seen in the chart above, it seems institutions in North Africa are ahead of those in the other regions in having the highest average bandwidth capacity of 4352 (up)/4403 (down) Kbps. They are followed by those in Southern Africa, which shows a significantly lower average of 352/655 Kbps.

2.4.2 Bandwidth Capacity Comparison by GDP per Capita (scatter plot)

Chart 5 **Bandwidth capacities by GDP per Capita**

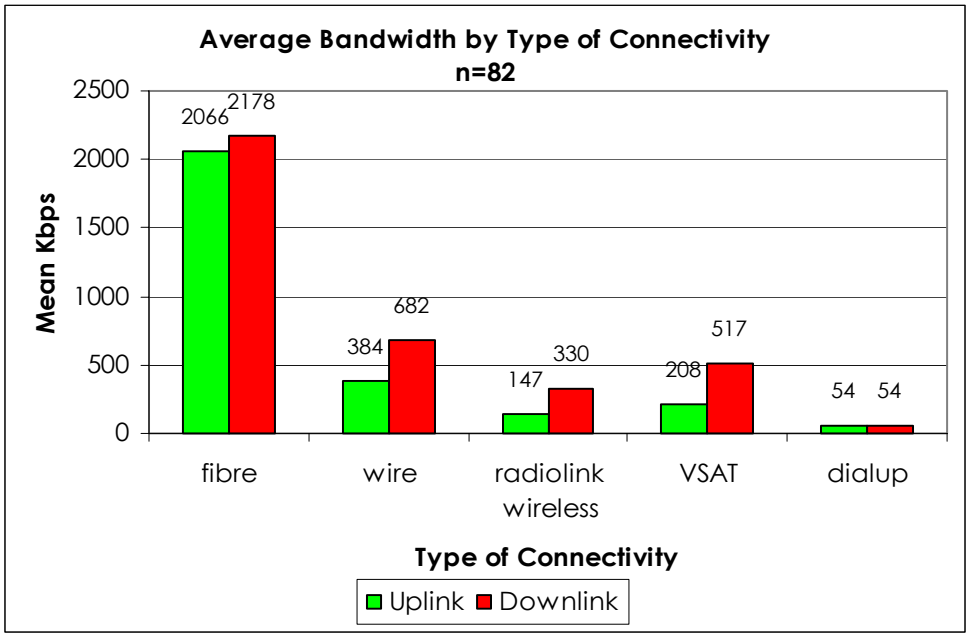


The chart above indicates that the majority of institutions in countries with lower GDP per capita – less than 3000USD – have lower bandwidth capacity, i.e., below 4000 Kbps. The fitted line indicates a moderate upward trend of a possible positive relationship between bandwidth capacity and GDP per capita. However, there are some significant deviations. These are possibly caused by regulatory impacts on bandwidth availability, together with the wide range of institutional sizes and the numbers of PCs, which were reported to be connected to the Internet.

2.4.3 Bandwidth Capacity: Comparison by Type of Connectivity

Results from the analysis indicate that institutions with fibre connection tend to have the highest connectivity, with a mean of 2066/2178 Kbps, while dial up connections have the lowest capacity of 28/28 Kbps. Chart 6 below presents the average bandwidth capacity by type of connectivity.

Chart 6 Average Bandwidth Capacities by Type of Connectivity

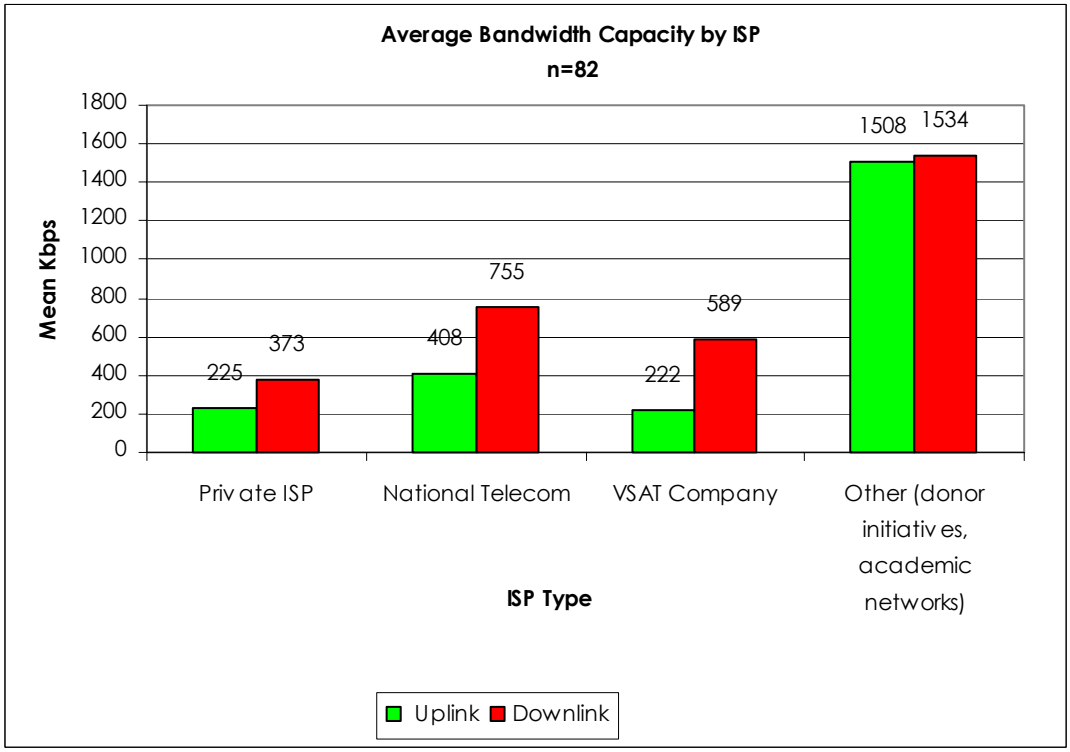


N.B Wire is any form of leased line that uses copper wire connectivity.

2.4.4 Bandwidth Capacity: Comparison by Internet Service Provider (ISP)

Chart 7 presents data on average bandwidth capacity sorted by how the institutions were getting their bandwidth.

Chart 7 Average Bandwidth Capacities by ISP



The major types of Internet Service Providers (ISP) include Private National ISPs (Commercial companies located within the country), the National Telecom company (usually government owned, VSAT companies which are also privately owned but not based in the country of origin, and other. The smallest average bandwidth capacity was recorded for institutions using private ISPs.

From the Chart, donor initiatives (e.g., UNDP, Leland Initiative) and academic networks (e.g., TENET, KENET, EU MedConnect) have the largest average bandwidth capacity *(see Appendix 2 for summary profiles of national academic networks in Africa)*. About 18 institutions from the survey (22%) are members of national research and education networks, while seven of the 40 surveyed countries (18%) have national research and education networks (NRENs). A national research and education network is being planned for Tanzania. It is currently at proposal stage.

The existing NRENs are:

- *Tertiary Education Network of South Africa, TENET SA*, a buying agent for South African, Swaziland and Lesotho universities. TENET SA was formed in 1998. It procures Internet access for 47 institutions and 91 campuses. General services provided include; procurement of Internet access, contract management and negotiation, billing services, general Internet services, technical support of service delivery, managing Telkom (ISP) performance during installation
- *Kenya Education Network, KENET* a network for 42 Kenyan universities and colleges connected to the network through leased lines. KENET was set up in 1999 with the main goal of establishing sustainable communication and networking among educational institutions in Kenya in a bid to reduce the educational community's access costs. KENET has evolved out of the PTN network design. It offers the following services; network services (network management, e.g., filtering, caching, access and security), general Internet services (domain registration, web solutions, internet infrastructure, content integration), training and E-mail
- *Egyptian University Network, EUN* was established in 1987 and intended to connect Egyptian universities to the Internet. This was part of an effort to facilitate communication and the exchange of information amongst the universities. The network is servicing 20 Universities, in addition to various other government and research institutes. It is now offering its members some of the following services; DNS registration, information services, e- learning, training, consultation, Internet connectivity, e-mail, technical support and web design and hosting. EUN has plans to connect to GEANT through the EUMED Connect project
- *Nigerian Universities Network, NUNet* is a consortium arrangement that was set up in 1995 with the main objective of purchasing VSAT bandwidth in order to improve the quality and quantity of bandwidth to educational institutions. It currently has 12 member institutions. Apart from bandwidth provision, the network also offers advisory and technical support, as well

some infrastructure (PCs) to the network, network maintenance, training, negotiating and contract management.

- *Morocco Wide Area Research Network, MARWAN* was established in 2000 as a way of reducing Internet access costs and of setting up specific networking applications, such as videoconferencing for universities and research institutions. The network is a consortium arrangement of 14 universities, with Maroc (the national telecom) being the infrastructure provider. The network is linked to GEANT through the EUMEDCONNECT project. The network offers the following services to its members; network services, helpdesk, multicast, IPv6, training, VoIP, videoconferencing and contract negotiation
- *Algeria Research Network, ARN* is a closed PTN, founded in 2002. The majority of network users are universities, research institutes and other institutes of higher education. Services provided include; basic IP provision, user support, network operations centre, security incident response, videoconferencing and support for multimedia applications. The network is linked to GEANT through the EUMEDCONNECT project.
- *National Research and Technology Network of Tunisia, RNRT* was established in 1993. RNRT links 22 centres, among them research centres, universities and academic institutes. The network aims to facilitate communication and the exchange of scientific and technical research in Tunisia, as well as to contribute to better planning and co-ordination of research activities. The network is linked to GEANT through the EUMEDCONNECT project. The network offers the following services

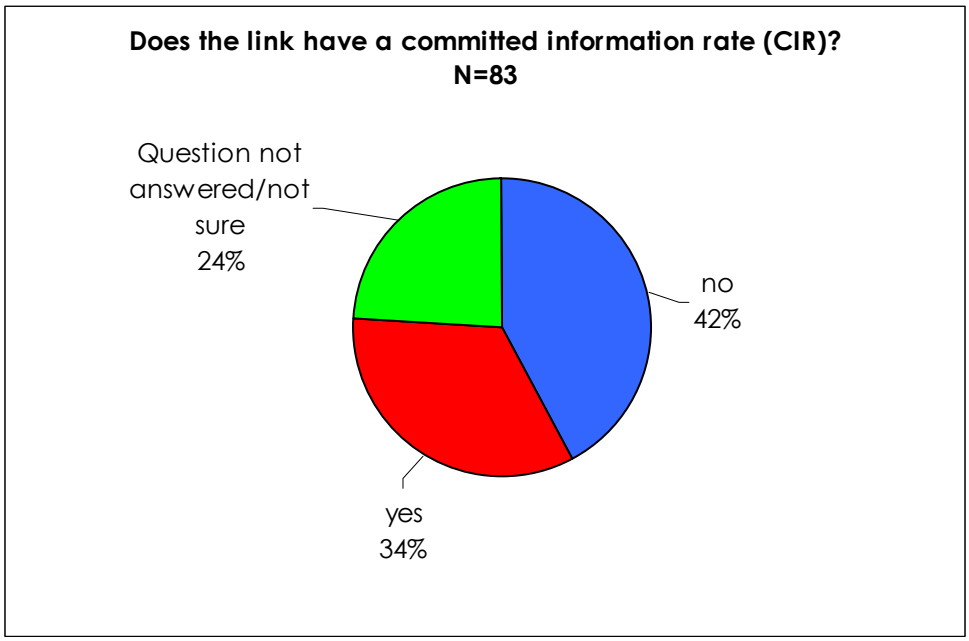
N.B Please refer to the recent IDRC study report (PAREN 2005) for comprehensive information on national academic networks.

The major academic networks – Tertiary Education Network of South Africa (TENET) and EU MedConnect get their bandwidth from international undersea fibre, which accounts for their larger bandwidth capacity. Donor initiatives like UNDP Leland Initiative offer subsidized bandwidth through VSAT. All other institutions ultimately get their bandwidth from VSAT type sources. National Telcom companies, private ISPs etc may have national networks but their international links in almost all cases are through satellite. More details on ISPs are provided in section 3.1.

2.4.5 Institutions with Committed Information Rates

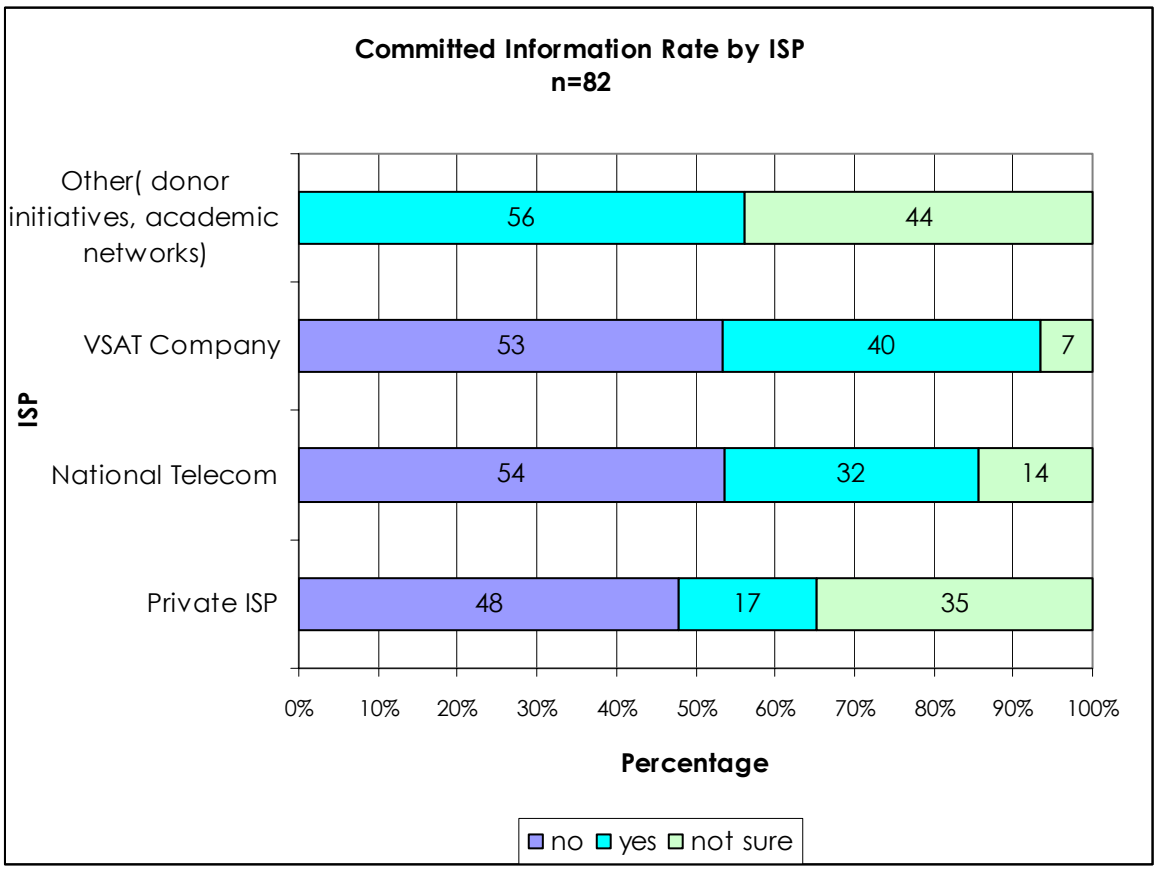
A committed information rate is one of the most critical characteristics to consider when purchasing bandwidth. It essentially indicates the capacity of bandwidth that the Internet Service Provider will guarantee to deliver. Without a CIR, customers will be grouped with a pool of clients and there is no guarantee that they will receive anything even close to the bandwidth they think they have purchased. Shared bandwidth in Africa is usually of poor quality and often unstable. One private ISP estimates that shared bandwidth users get between 40-60% of the bandwidth clients think they are paying for.

Chart 8 Percentage of Respondents with a Committed Information Rate



The majority of the respondents (66%) reported either that they did not have a Committed Information Rate for their connectivity or that they did not know what a Committed Information Rate was. In this regard, donor initiatives/academic networks were more likely to provide CIR than other Internet service providers (see Chart 8.1).

Chart 8.1 Committed Information Rate Provided by ISP

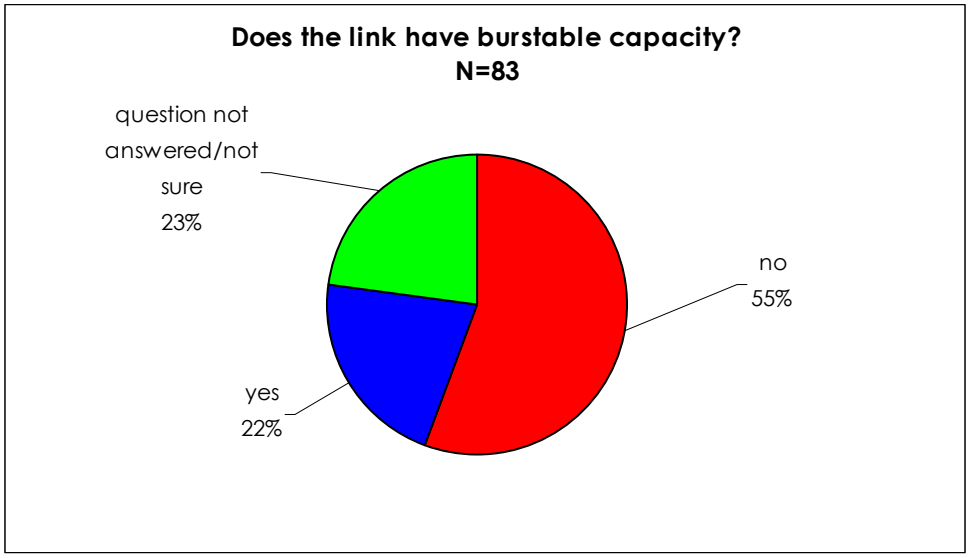


Following academic networks, VSAT companies provide more CIR than national telecoms or private ISPs.

2.4.6 Institutions with Burstable Capacity

Burstable capacity is the capacity of an Internet connection to provide bursts of extra bandwidth when there is high demand over a short period of time. Burstable capacity is rarely guaranteed, but, if the user is part of a shared pool of bandwidth, the capacity that is not being used by other members of the pool can become available for use by a single member when needed.

Chart 9 Percentage of Respondents with Burstable Capacity



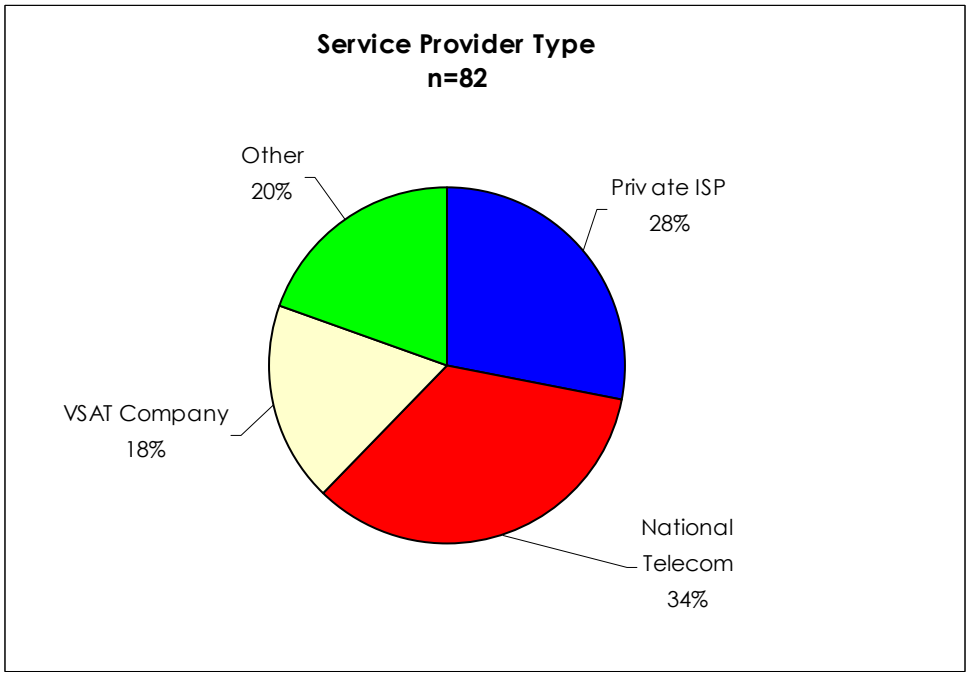
As expected, less than a quarter of the institutions have access to burstable capacity. The majority of the respondents reported that they did not have burstable capacity, as indicated by the 55% who said no to the question. Some respondents did not answer the question, as they were not sure what the question meant.

Bandwidth Provision and Costs

3.1 Type of Internet Service Providers in African Tertiary Institutions

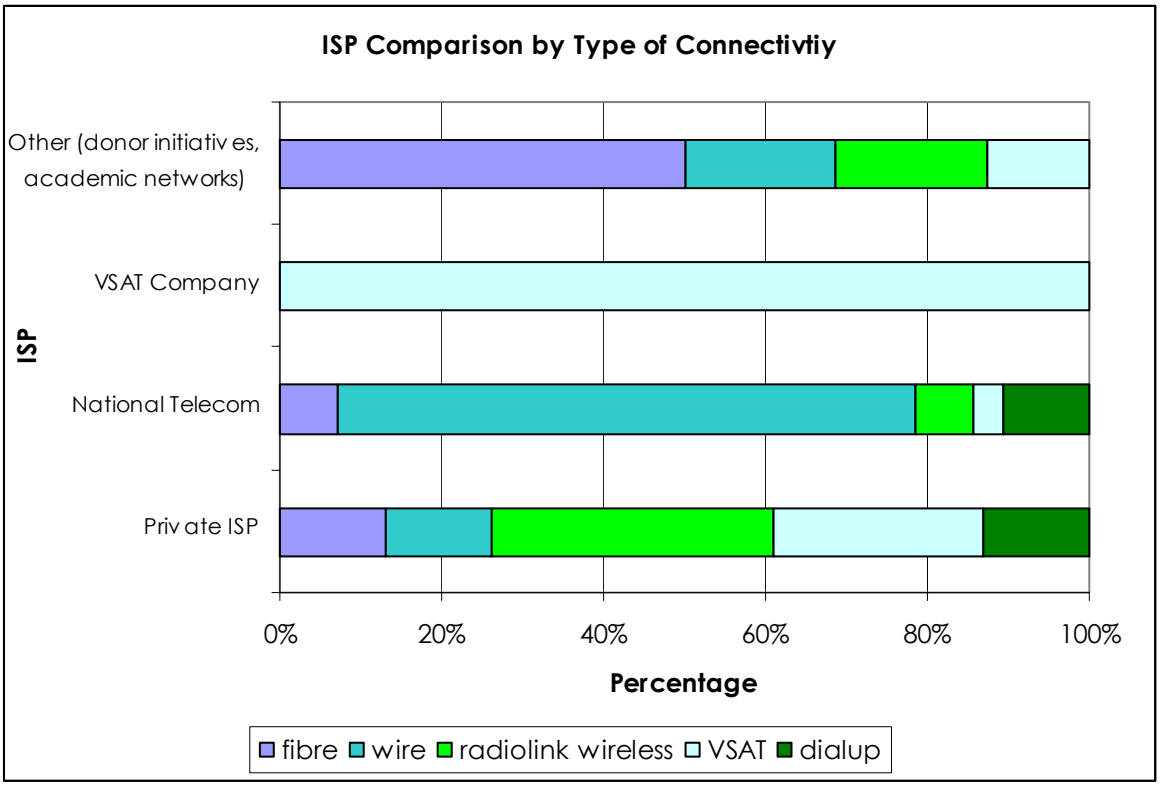
The most common type of ISP remains a National Telecom company, but other types of ISPs are rapidly gaining ground as deregulation continues to make its way across African economies.

Chart 10 Type of Internet Service Providers



Although most countries ultimately obtain their bandwidth directly via VSAT, only 18% of the respondents mentioned a VSAT company as their ISP. Other service providers mentioned in the sample indicated as "other" in the chart, are donor-driven Internet initiatives, such as the UNDP initiative being implemented in Malawi and that of the French embassy of Central African Republic. Institutions from Kenya and South Africa (including Swaziland and Lesotho) mentioned the services that are provided by TENET South Africa and Kenyan Education Network (KENET), the tertiary and education networks.

Chart 10.1 Internet Service Providers and Type of Connectivity



Donor initiatives/academic networks provide majority of their connectivity through fibre links. National telecoms tend to use wire connectivity, as would be expected, and more recently established private ISPs provide the majority of radio link wireless connectivity.

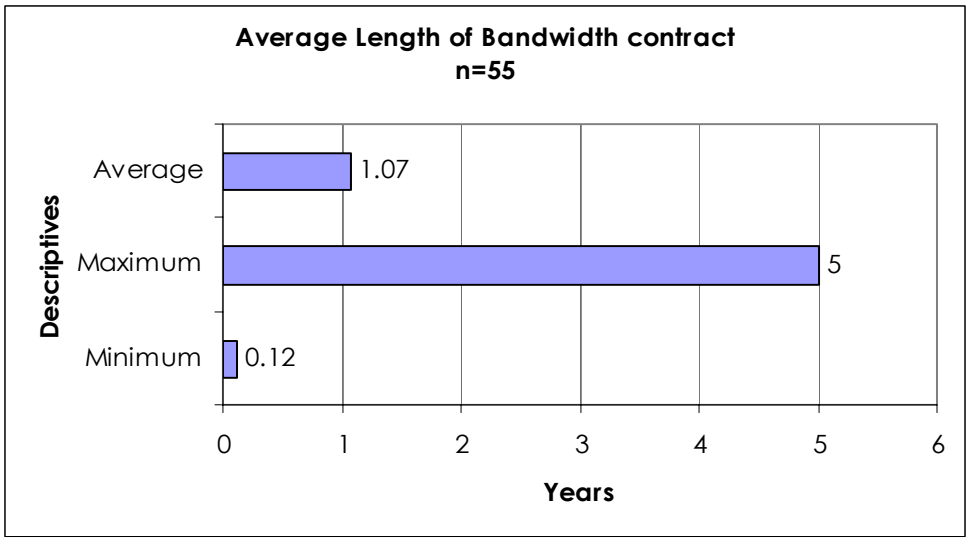
In general the highest quality and thus ultimately quantity bandwidth sources are those using international fibre links. International fibre has much lower latency since messages have a much shorter distance to travel than VSAT sources which have to travel out to the satellite and back down to the Hub on earth.

3.1.1 Length of Bandwidth Contracts

Contract arrangements between ISPs and tertiary institutions were briefly explored in the survey. The length of bandwidth contracts was analyzed as shown in Chart

11, which shows that the average length of bandwidth contracts is just over one year, although some institutions are committed to terms of up to five years.

Chart 11 Average Length of Bandwidth Contracts



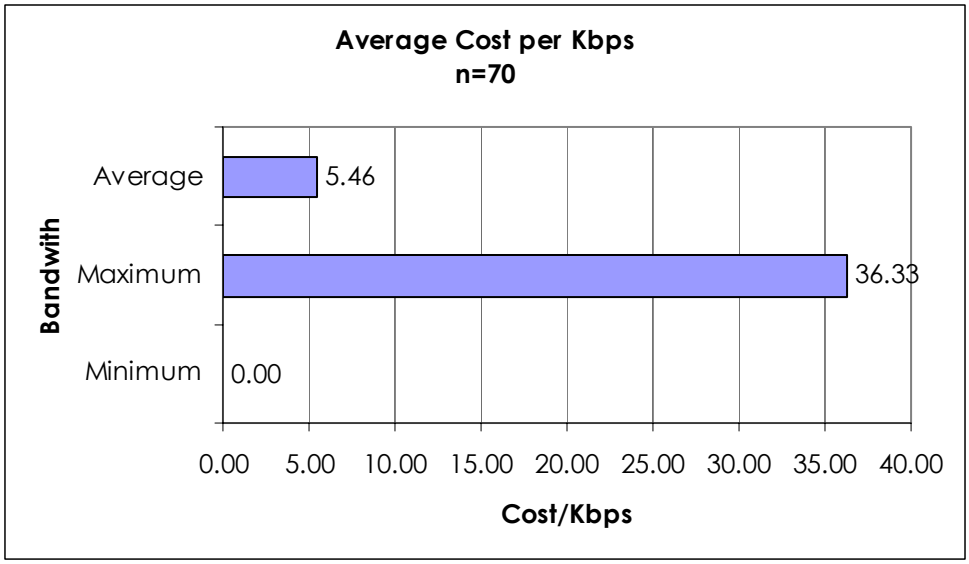
In general longer-term contracts tend to be cheaper on a per unit basis but their biggest drawback is the lack of flexibility as the bandwidth market price changes. In general bandwidth prices are continuously being reduced and it is not in the best interest of institution to commit to long term fixed price contracts.

3.2 Cost of Bandwidth per Month

Bandwidth costs are one of the most talked about elements in the quest to improve connectivity in Africa. The problem with bandwidth cost is in defining what it actually means. Factors that can dramatically affect price include committed information rate, burstable capacity and contract length.

As a result there are many dimensions to bandwidth that are not covered in a simple $/kbps figure, and, in many cases, unfair comparisons between bandwidth apples and oranges are made. With this caveat in mind, however, there is still value in broad comparisons, which provide a sense of the range of costs paid by tertiary institutions. In order to address this, the survey respondents indicated the price (USD) of bandwidth they were paying per month and then the analysts added the upward and downward kbps together. Leased line capacities were multiplied by two in order to provide a basis of comparison with asymmetric bandwidth sources such as VSATs. The results are presented in charts 12 – 17

Chart 12 Average Cost of Bandwidth/Month



With some institutions like Universite de Bangui in Central African Republic paying nothing for their bandwidth (French Embassy paying for the bandwidth) and Universite de Yaounde 1 of Cameroon paying the highest cost of US$36.33, there is truly a wide range of bandwidth costs in Africa. The average cost per Kbps is US$5.46. Table 3 ranks the institutions according to bandwidth cost.

Table 3 Rankings: Bandwidth Cost

		Cost/Kbps/Month USD ($)
Institutions with Cheapest Bandwidth: Top Ten		
Universite de Bangui	CAR	0
Universite du Sahel	Senegal	0.1
Assiut University	Egypt	0.17
Cairo University	Egypt	0.17
Ouagaduogou University	Burkina Faso	0.39
Universite Cheikh Anta Diop de Dakar	Senegal	0.5
Al Akhawayn University	Morocco	0.5
University d'Alger	Algeria	0.5
Instituto de Ciencia eTechnologia	Guinea Bissau	0.63
Universite Catholique de Bukavu	DRC	0.7
Institutions with Most Expensive Bandwidth: Bottom Ten		
Universite du Dschang	Cameroon	10.16
University of Port Harcourt	Nigeria	10.42
Sokoine University of Agriculture	Tanzania	11.72
National University of Lesotho	Lesotho	12.27
University of Saint Louis Gaston Berger	Senegal	14
Botswana College of Agriculture	Botswana	15.63
University of Abuja	Nigeria	15.63
University of Yaoundé II	Cameroon	24.22

Institut de Mathematiques et de sciences Physiques (IMSP)	Benin	26.79
Université de Yaoundé I	Cameroon	36.33

Generally more North African institutions feature in the top ten institutions with the cheapest bandwidth while more West African institutions feature in the rankings of institutions with most expensive bandwidth.

Universite de Bangui has the cheapest bandwidth. This is because the French Embassy of Central African Republic extended its local area network to the Universite de Bangui. According to the arrangement, Universite de Bangui is accessing the embassy's bandwidth (128 Kbps from VSAT) for no cost. Instituto de Ciencia eTechnologia, of Guinea Bissau has cheaper bandwidth than other institutions probably because it is renting bandwidth and thus is paying a low rental fee.

It is not quite clear why some institutions in DRC, Burkina Faso and Senegal are having cheaper bandwidth than other institutions. Universite du Sahel from Senegal gets it bandwidth from Sonatel (national telecom being privatised) as with other two surveyed institutions in Senegal. It is a 512 Kbps wire connection costing 100USD. No donor assistance was indicated thus we assume that this low price could be telecom subsidized although this is not indicated. This assumption could also explain the low costs recorded for institutions in Burkina Faso.

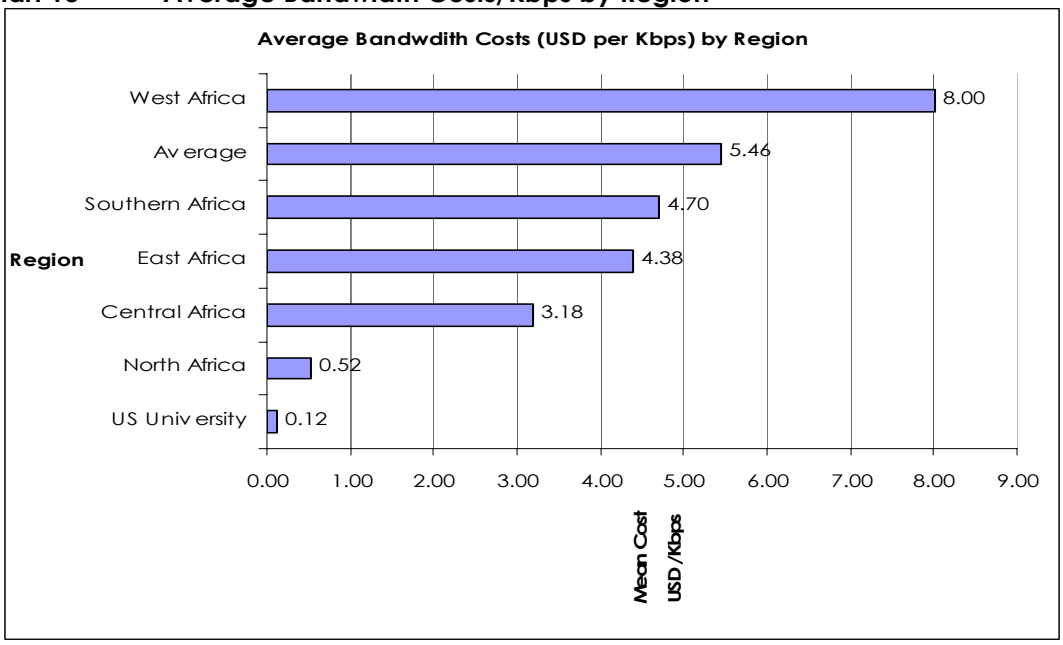
More institutions from Cameroon feature in the rankings of institutions with the most expensive bandwidth. Cameroon surprisingly has deregulated its bandwidth market. Three of the four surveyed universities have VSAT, with Yaounde II University having the most expensive bandwidth through radio-link wireless. ISPs for the universities include CAMTEL, their privatised national telecom, which provides bandwidth to 2 universities. According to the source we interviewed, bandwidth in Cameroon is still expensive as new entrants are pegging prices to levels near the former national telecom's high price. CAMTEL has the best infrastructure and service and thus could be a natural monopoly with greater market power than new entrants.

N.B Botswana College of Agriculture should not be confused for University of Botswana. Botswana College of Agriculture, while it is a part of University of Botswana, it seems it has autonomy in bandwidth issues as indicated by the different costs the two are paying to the same provider, Botswana Telecommunications Corporation. University of Botswana pays 17000USD for 1MB/4MB wire connection ($3.32/kbps) while Botswana College of Agriculture pays 4000USD for 128 Kbps wire connection ($15.63/kbps)

3.2.1 Regional Comparison of Bandwidth Costs

Further analysis of bandwidth costs by region (on the continent) gives some interesting results (Chart 13).

Chart 13 Average Bandwidth Costs/Kbps by Region



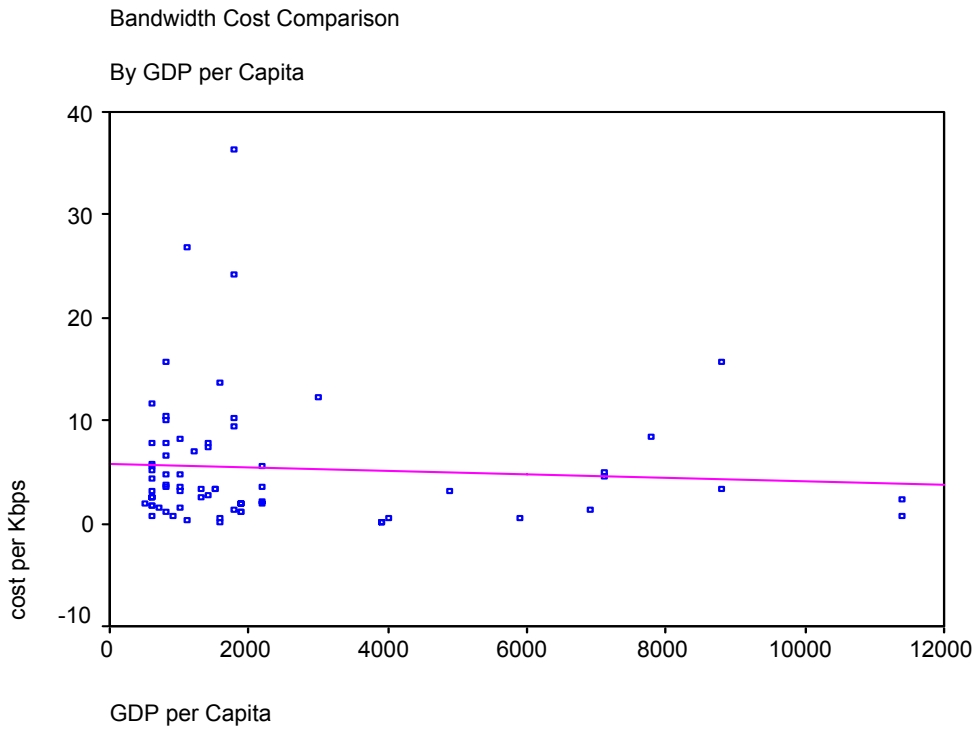
The data suggests that institutions from West Africa are paying the highest amount of US$8/Kbps while institutions from North Africa are paying only US$0.52/Kbps. This is most likely a reflection of the lower-cost international fibre connections that North African institutions are able to access.

Central African institutions appear to have a lower average cost than other countries. Countries grouped under Central Africa are: CAR, Rwanda, Burundi and DRC. In this region, University of Bangui from Central African Republic is accessing the French embassy's bandwidth for no cost (see Table 3). Other universities in the region are indeed paying less than other regions e.g. Burundi universities use the same private ISP and are paying between $2.60 and $5.63/kbps. Rwandan universities are paying between $2.6 and $3.42/kbps, for VSAT and wire. DRC universities are on VSAT paying between $0.70 and $7.81/kbps respectively. However there is nothing that indicates why these lower costs, but it could be assumed that these countries have less regulation issues and perhaps more competitive ISPs.

On average, African tertiary institutions pay US$5.46/Kbps – roughly equivalent to fifty times what a typical US University would pay for the same quantity of bandwidth.

3.2.2 Bandwidth Costs: Comparison by GDP per Capita (scatter plot)

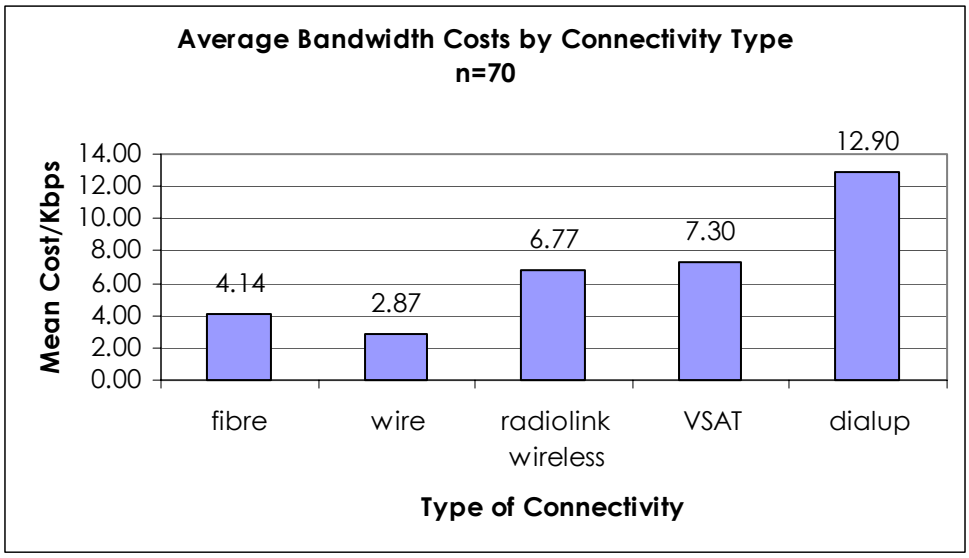
Chart 14 Bandwidth Costs: comparison by GDP per Capita



The chart indicates that, in the areas where institutions have lower GDP per capita (i.e., less than 3000USD), they seem to pay costs within the range of $0.10 -$36/Kbps. The fitted line indicates a slight downward trend in cost/Kbps as GDP per capita increases, but the level of correlation is small, and it appears that the wealth of a country does not have a significant impact on bandwidth pricing.

3.2.3 Bandwidth Costs: Comparison by Type of Connectivity

Chart 15 Average Bandwidth Costs/Kbps by Type of Connectivity



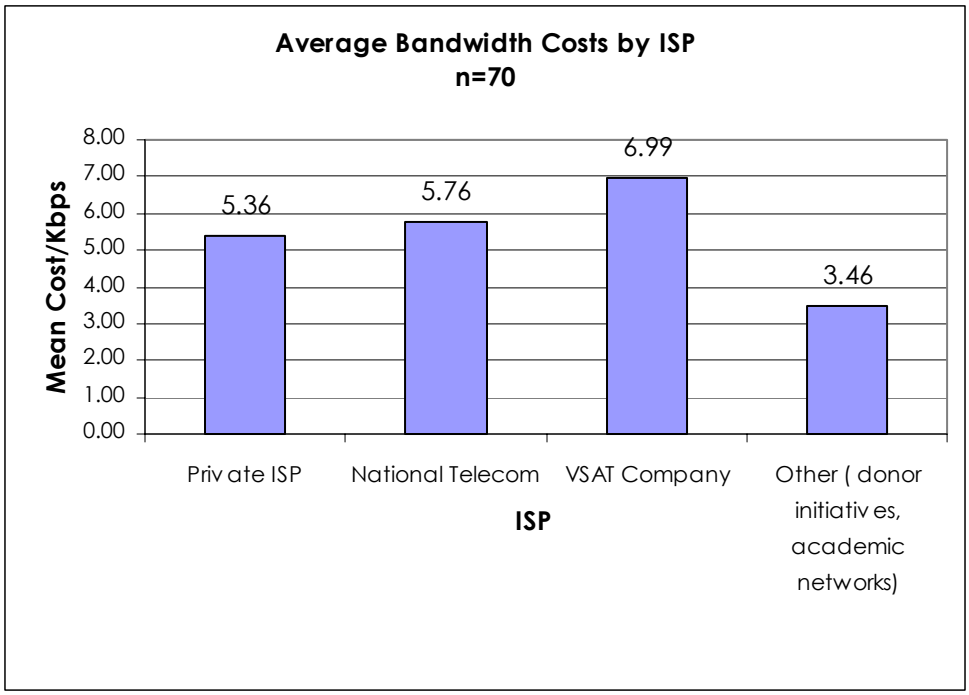
It appears that the reported dial up connection costs were much higher than other types of connection, as indicated by the highest average of $12.90 from the survey. The cheapest type of connectivity appears to be wire (leased line) followed by fibre.

A key issue that is difficult to measure is the **quality** of bandwidth being purchased. In most African countries, the national telecom operator will sell some quantity of bandwidth, but, in fact, the receiver never receives the quantity stated – in many cases, several times less. As mentioned before, the comparison above does not take into account CIR, burstable capacity or contractual terms.

3.2.4 Bandwidth Costs: Comparison by ISP Type

A comparison of bandwidth costs according to type of ISPs showed significant differences (Chart 16).

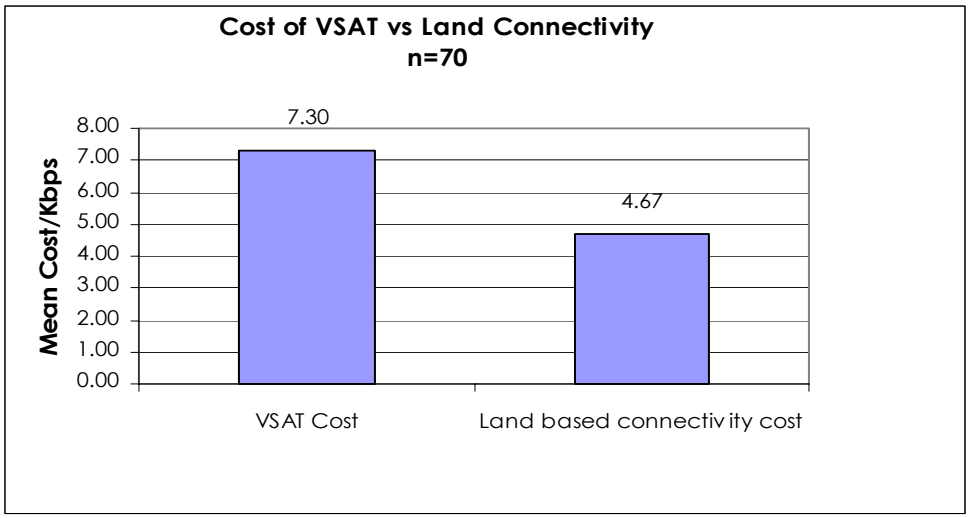
Chart 16 Bandwidth Costs: Comparison by ISP



The data indicate that VSAT companies, followed by national telecoms, are charging the highest prices per Kbps, while donor initiatives and academic networks charge the least. This is understandable, given the fact that VSAT all over the world tends to be more expensive and, in many cases, provides higher quality bandwidth than national telecoms or private ISPs. The data support the claim that tertiary institutions which buy their bandwidth as part of a network or consortium obtain the most cost-effective bandwidth. The best example in Africa of the power of donor consortiums to lower university bandwidth costs is EUMEDConnect, which provides high speed low cost bandwidth to Mediterranean academic networks. The international community is also full of examples of the effectiveness of consortia. Networks like CLARA in South America, the Silk Highway in the Caucuses and TIEN in South Asia provide compelling examples of the power of bandwidth consortia.

3.2.5 Bandwidth Costs: VSAT vs. Land-based Connectivity

Chart 17 Bandwidth Costs: Comparison by VSAT and non-VSAT



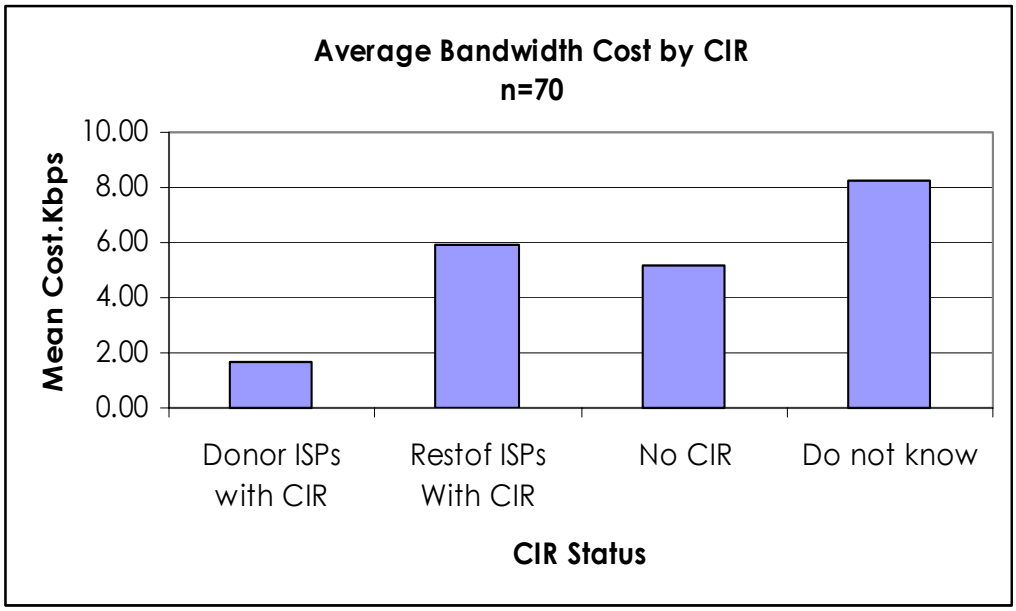
Direct VSAT costs are on average much more expensive than land-based connections. (N.B. the VSAT average differs from the average recorded when comparing ISPs, as the data analysed included institutions which had additional bandwidth links). However, it should be realized that land-based connectivity in most countries in Africa ultimately comes from VSAT. Because the land-based services are buying in relatively large volumes, they are able to negotiate lower costs than single institutions buying VSAT services for themselves.

As before, a key issue is the difficulty in measuring the **quality** of bandwidth being purchased. VSAT may be more expensive but land-based connectivity may not provide equivalent quantity and throughput. There may be a greater tendency amongst local ISPs to sell more bandwidth than they actually provide, and load their links with larger numbers of users, resulting in higher contention ratios.

3.2.6 Bandwidth Costs: Comparison by CIR

The researchers also made a comparison of bandwidth costs between institutions with CIR (committed information rate) and those without (see Chart 18).

Chart 18 Average Cost/Kbps for Institutions with CIR vs those without CIR



What is instructive about the chart above is that institutions where the respondent claimed not to know if they had a CIR or not are, in fact, paying the most for their bandwidth, while those who are part of a consortium and have the highest quality of bandwidth get the lowest cost. This dramatically shows the power of knowledge and volume in bandwidth purchasing decisions. The chart also shows that "No CIR" institutions have slightly lower costs than ones with CIR, but this is likely to be because of the poorer quality of the shared bandwidth than the committed bandwidth.

3.2.7 Bandwidth Costs and Bandwidth Capacity

According to accepted telecommunications cost models (CLARA 2004[1]), the price per bandwidth is determined by the following equation:

Price of AB = K * AB * λ(AB)

AB is bandwidth capacity
K is a constant
λ is a multiplier

Since λ (AB) = AB $^{-0,46}$ and Price (AB) can be denoted as P
Equation becomes:

P= K*AB* AB $^{-0,46}$ or P= K*AB$^{0,\ 54}$

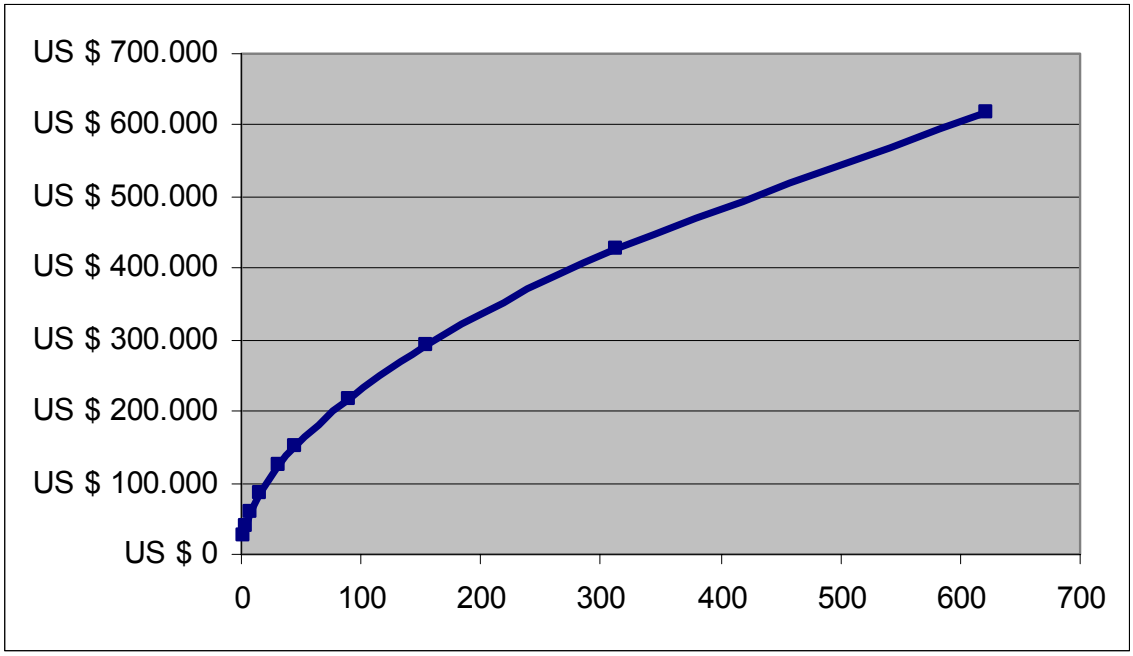
Example

[1] Cost Distribution Model, Based on Dante Model. 2004. CLARA

A link with a capacity with 10 Mbps costs US$ 250 000 per year, the constant K of the Model becomes

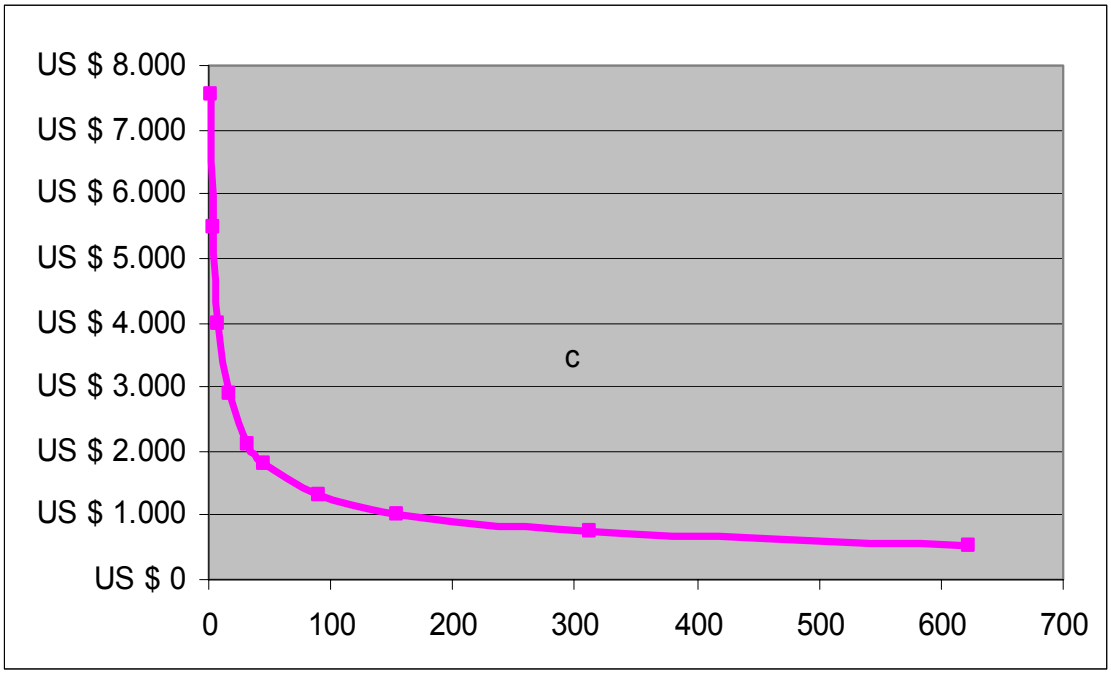
$250\,000 = K * 10 * 10^{-0,46}$
Where
$K = 250.000 / (10 * 10^{-0,46}) = 72.101$

A typical cost graph is presented below where essentially the rate of cost increase decreases as the volume of bandwidth increases.



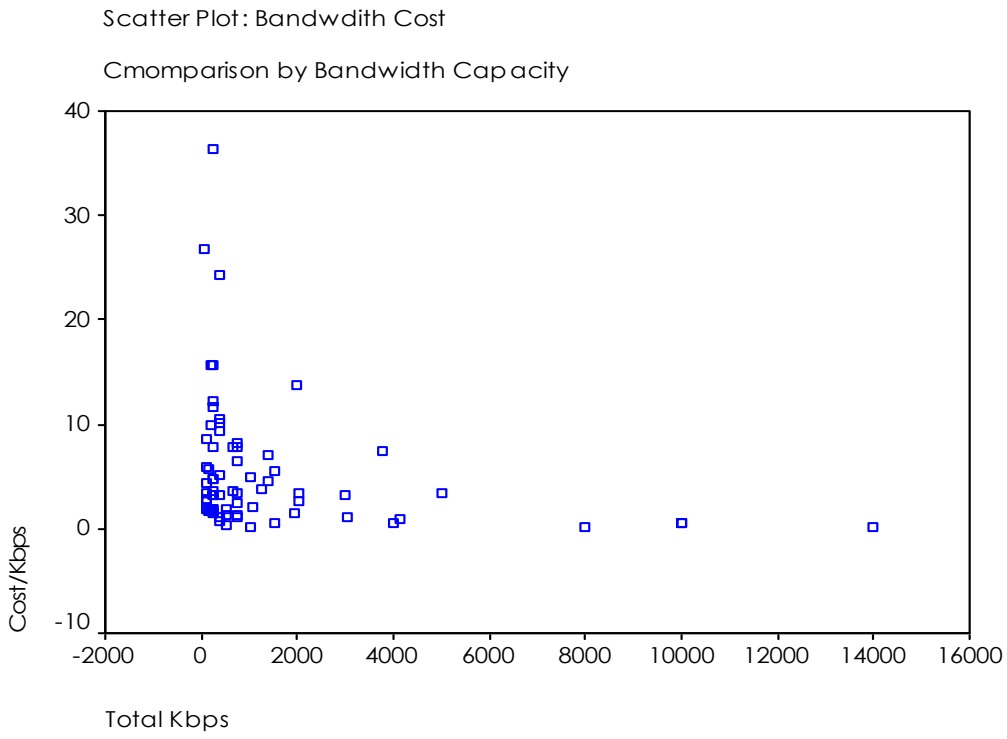
Note: The scale in this figure is just to exemplify, it is not any specific case.

As a result the marginal cost of bandwidth dramatically decreases as the volume increases:



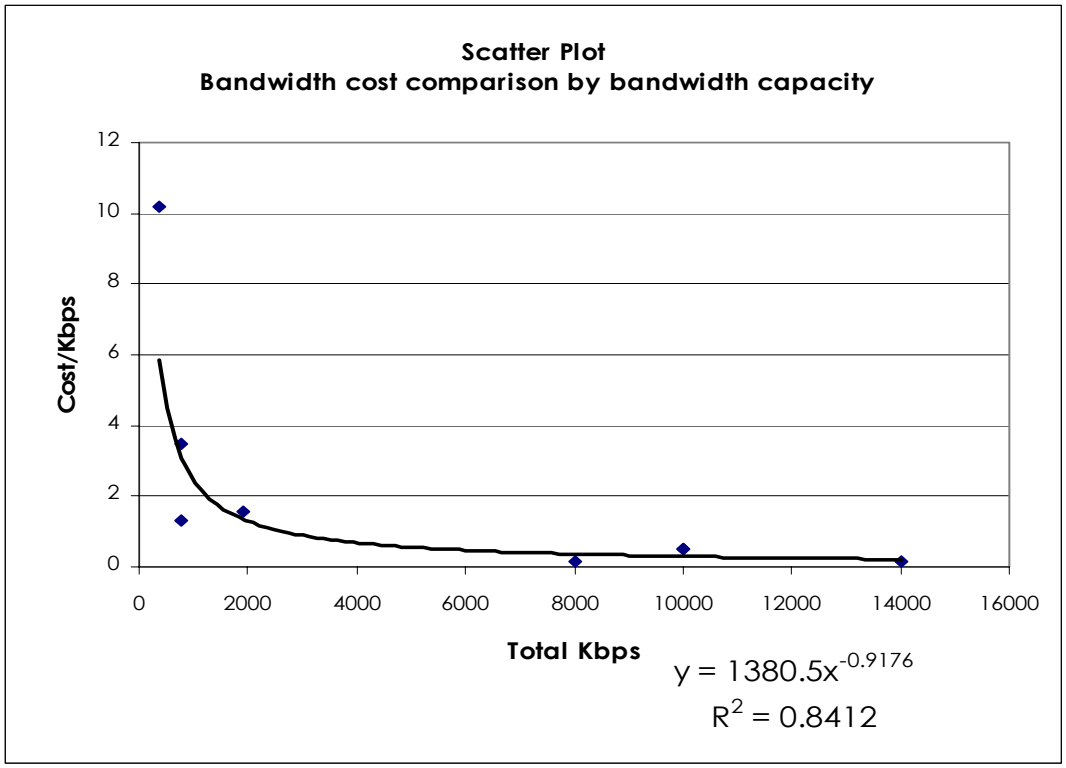
The actual data from the ATICS survey fits the standard telecommunication cost model quite well as seen in chart below:

Chart 19 Scatter Plot: Bandwidth cost comparison by Bandwidth capacity



The following chart shows the best fit to the points and the equation of the relationship between bandwidth capacity and bandwidth cost.

Chart 19.1 Fitted Line and Equation: Bandwidth cost comparison by Bandwidth capacity



ATICS Equation

$P=1380.5x^{-0.9176}$

$R^2 = 0.8412$ (very good fit)

where P is bandwdith price/cost, 1380.5 is K and x is AB (bandwidth capacity).

The implications of this model are very clear; the greater the volume of bandwidth being purchased the lower the marginal cost of that bandwidth. This fact forms the basic argument for bandwidth buying consortiums for African tertiary institutions. The further implication is that even small groups of institutions coming together can dramatically lower their per-unit bandwidth costs.

VSAT Use in Surveyed Institutions

The researchers investigated VSAT-use in the sampled institutions. The respondents described the VSAT equipment they have in place, as well as the licensing arrangements in place. See Appendix 3 for the VSAT equipment used in the sampled institutions.

Background

According to the Global VSAT Forum (Global VSAT Forum 2003), African countries have generally tended to restrict the connection of private networks or closed user groups to the PSTN (Public Switched Telephone Network). Where such connections are allowed, license or 'by-pass' fees have to be paid.

Other highlights of VSAT regulation in African countries include:

- There are liberalized regulatory frameworks where private VSAT networks are allowed to function under the authority of the incumbent operator, while the latter still retain a formal monopoly.
- Limitation on the provision of voice or Voice over Internet Protocol (VoIP) services is common and usually restricted to the national telecom operator even where private VSAT services are allowed.
- In some cases, VSAT networks are limited to domestic use only, or VSATs are restricted to receive-only status (and prohibited from sending out signals).
- In many cases, VSAT network operators are required to route their private network transmissions through the national hub of the incumbent operator (national telecom), despite the financial or even the technical disadvantages this may have for private VSAT network operators.
- Acquiring a VSAT license may require a bilateral arrangement with the incumbent operator whereby a "landing-rights fee" or tariff is paid to the operator, even if the incumbent does not participate in the service chain.
- In other monopoly environments, the national telecom is the only operator that is allowed to install and service VSATs or the only entity that may own, operate and maintain satellite earth stations.
- Additional restrictions may hamper license issuances. For example, a commercial/legal presence is typically required in Africa as a pre-condition for license issuance. This can be an obstacle to the effective establishment and expansion of VSAT services in the countries concerned, as it increases overhead costs for service providers.
- The license application process can be extremely difficult, including processing periods that require up to two years, payment of a wide variety of additional fees – including additional taxes, annual operator fees, landing rights, etc.
- Other barriers are high customs duties, which prevent cost-effective access to VSAT equipment. (Global VSAT Forum 2003)

N.B Readers are referred to the Global VSAT Forum Report " Open and Closed Skies-Satellite Access in Africa" for more information on VSAT regulations in Africa.

As part of the survey, assessment of VSAT licensing across Africa is summarized in the table below:

Table 4 VSAT Licensing in African Countries

Key
C Competitive or Fully Liberalized,
P Partially Competitive
M Monopoly
D Duopoly
FEL Free Educational License
NLR No Licenses Required
NA Not Allowed
RO Receiv-Only Licenses (VSAT receive signals but cannot send out)

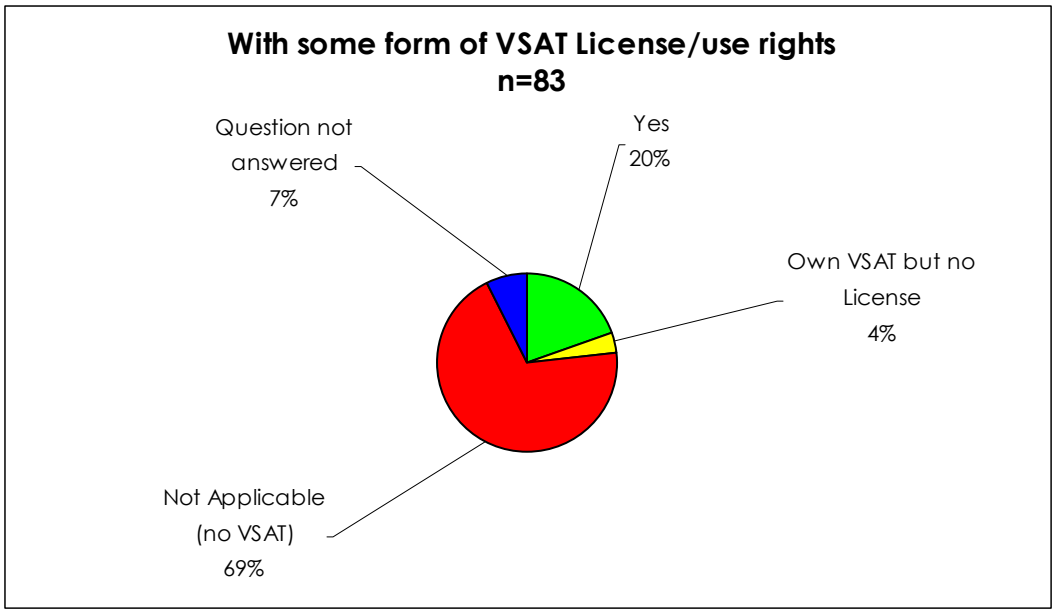
Country	ITU (2002)	GVF (2003)	ATICS (2004)	ATICS (2004) Free Educational Licenses
Algeria				
Angola	P	M		
Benin		M		
Botswana	C	C		
Burkina Faso	C	C		
Burundi	C	C		
Cameroon	C	C	C	FEL
Cape Verde	P	P		
Central African Rep				
Chad	M	M		
Comores Islands				
Congo				
Côte d'Ivoire	P	P		
Djibouti				
DRC				
Egypt		P		
Equatorial Guinea				
Eritrea				
Ethiopia		M		
Gabon	C	C		
Gambia	M	M	NA	
Ghana	P	P		FEL
Guinea		P		
Guinea-Bissau	C	C		
Kenya	M	M		FEL
Lesotho	C	C		
Liberia	P	P		
Libya	M			
Madagascar	C	C		
Malawi	P	P		
Mali	P	P		
Mauritania		P		
Mauritius				
Mayotte				
Morocco		P		
Mozambique	C	C	C	NLR
Namibia	P	M		

Niger	P	P		
Nigeria	C	C	C	FEL
Reunion				
Rwanda				FEL
S. Tomé and Principe	M			
Saharawi Republic				
Senegal		P		
Seychelles	P			
Sierra Leone	P	P		
Somalia				
South Africa	P	D		
Sudan		P		
Swaziland	C	C		
Tanzania		P		
Togo	C	C	M	
Tunisia		C		
Uganda	P	P		
Zambia	C	C		
Zimbabwe	C	P		

Sources; Global VSAT Forum 2003, ITU 2002, ATICS 2004

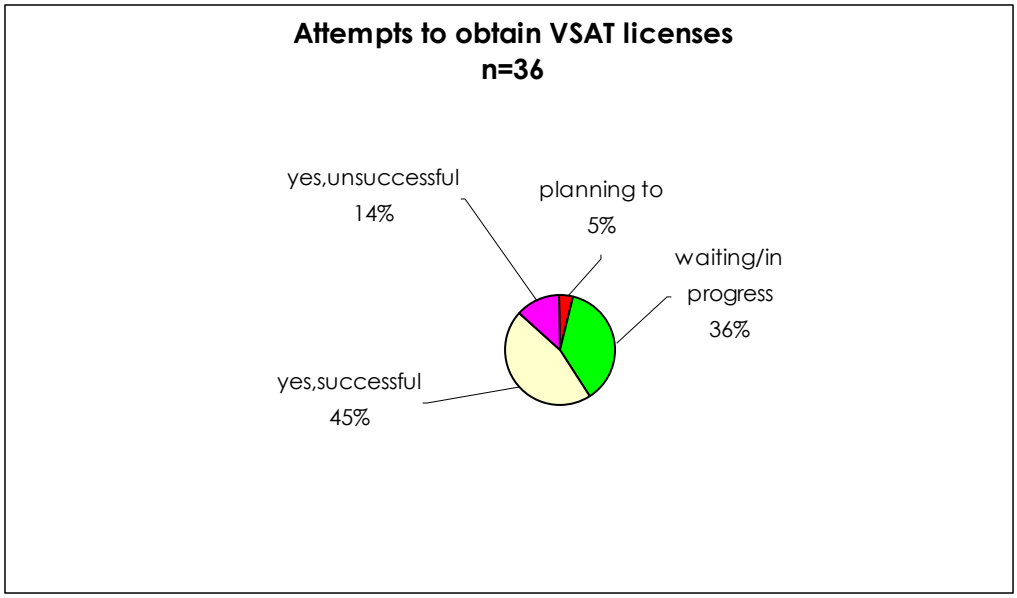
Considering this background, ATICS explored VSAT licensing within African tertiary institutions. Chart 18 indicates the percentage of respondents with VSAT licenses.

Chart 20 Percentage with VSAT Licenses (all Universities)



The results show that 20% of the respondents indicated they had VSAT licenses, while 4% indicated they owned VSATs but had no license. Chart 19.1 presents the data on institutions, which attempted to obtain VSAT licenses.

Chart 20.1 Institutions which Attempted to Obtain VSAT Licenses

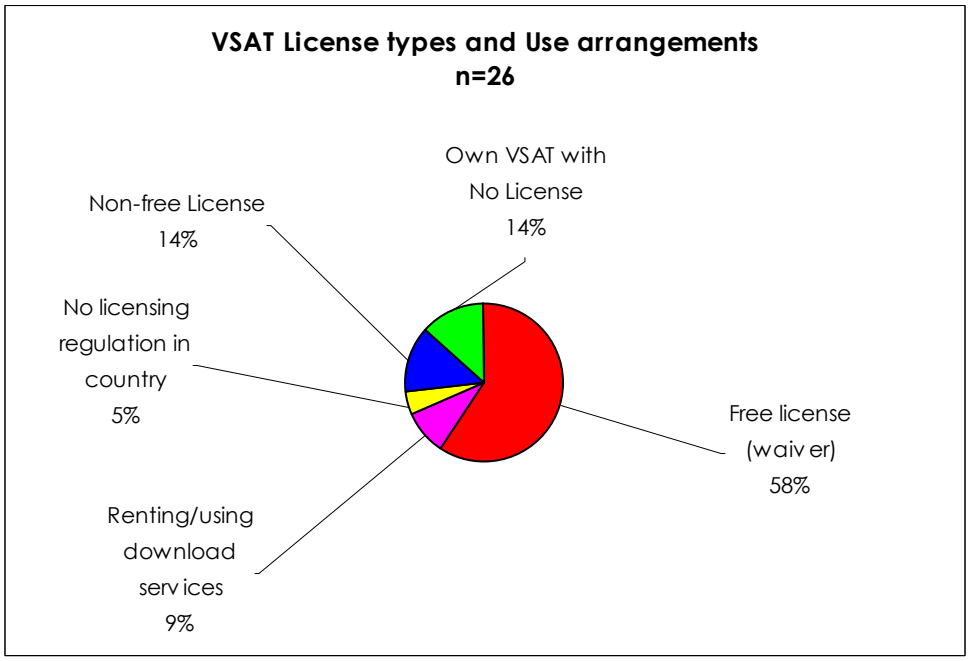


It was reported that institutions experienced a mixed response to their attempts to obtain a VSAT license. About 14% of the respondents indicated they were unable to obtain VSAT licenses, possibly due to prohibitive restrictions/regulations on VSATs in their respective countries. Altogether 55% had not been able to get proper VSAT licence at this point in time although many were still waiting for a reply.

4.2.1 VSAT License Types

Further analysis of the VSAT licensing scenario among those with VSATs revealed interesting license or use arrangements of VSATs in the surveyed institutions.

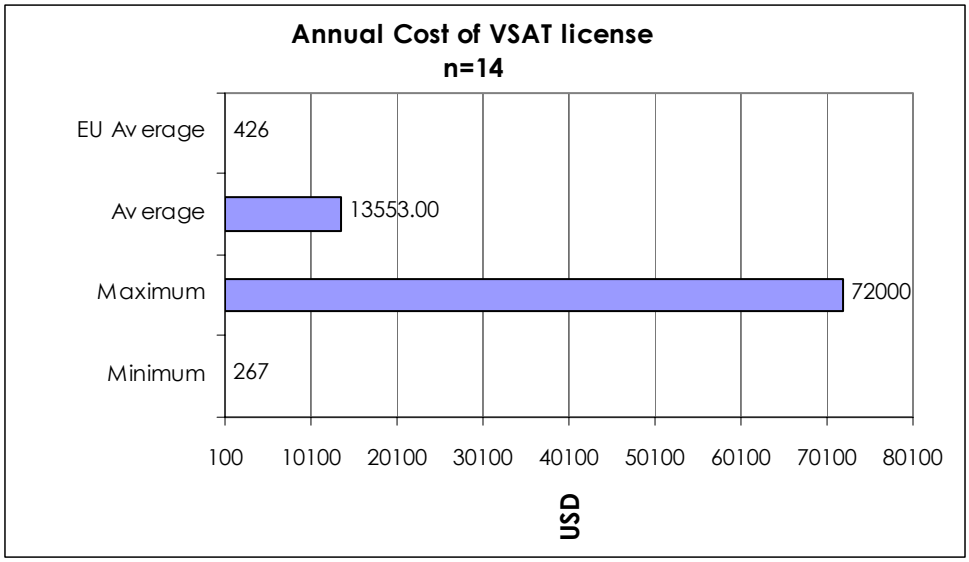
Chart 21 VSAT License Types from Sampled Institutions



An encouraging result was that the majority of the VSAT owning institutions (58%) said they had free licenses, in most cases through waivers for educational institutions. This follows recent trends toward educational exemptions, such as the recent institution of VSAT license exemption for educational purposes in Kenya. One institution indicated that there were no licensing regulations in their country (Mozambique). Non-free licenses are held by 14% of the VSAT-owning institutions.

4.2.2 Cost of Non-Free VSAT Licenses

Chart 22 Cost of Non-free VSAT Licenses



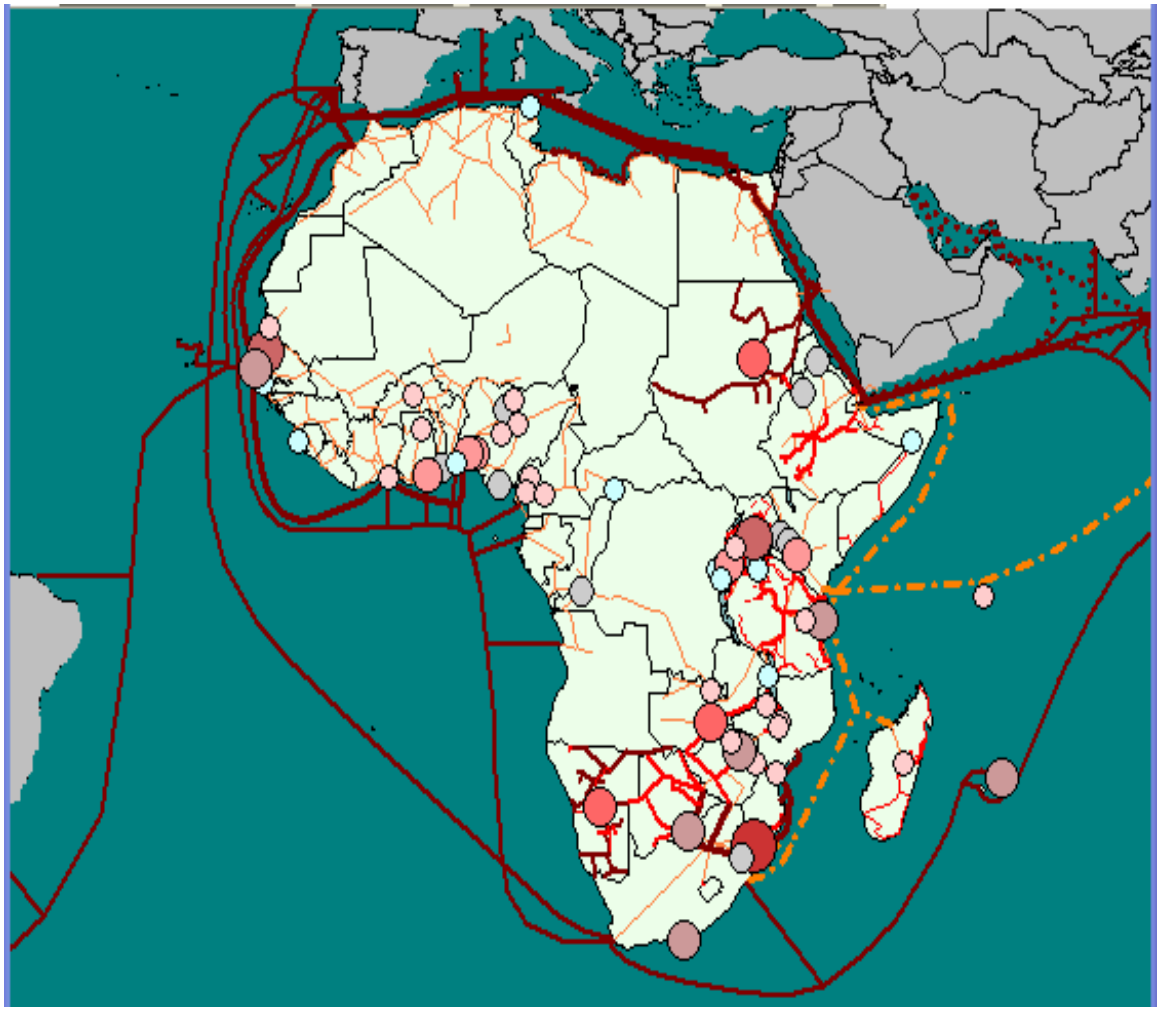
The average annual cost of VSAT license is US$13 553. This average annual cost is far higher than the EU average of US$426, showing that VSAT is still expensive in Africa compared to the developed world. However, it should be noted that this figure is skewed toward the high side by some extreme cases. Nevertheless, it is apparent that there is a huge range in the license fees being paid by institutions, with some institutions required to pay as much as US$72 000 (Zimbabwe) compared to some paying as little as US$267 (Rwanda). The range in fees could indicate the degree to which regulatory authorities want to control VSAT use in their country. It could also just reveal how little authorities understand how to price this and what impact it is.

ICT Infrastructure at Surveyed Institutions

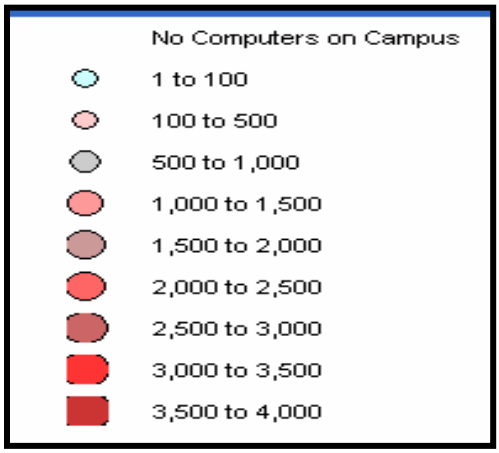
5.1 Bandwidth and Networked Computers

The survey incorporated a series of questions about campus infrastructure, including the number of computers that were networked or connected to the Internet.

Map 1 Computers on Campuses: Density across Africa

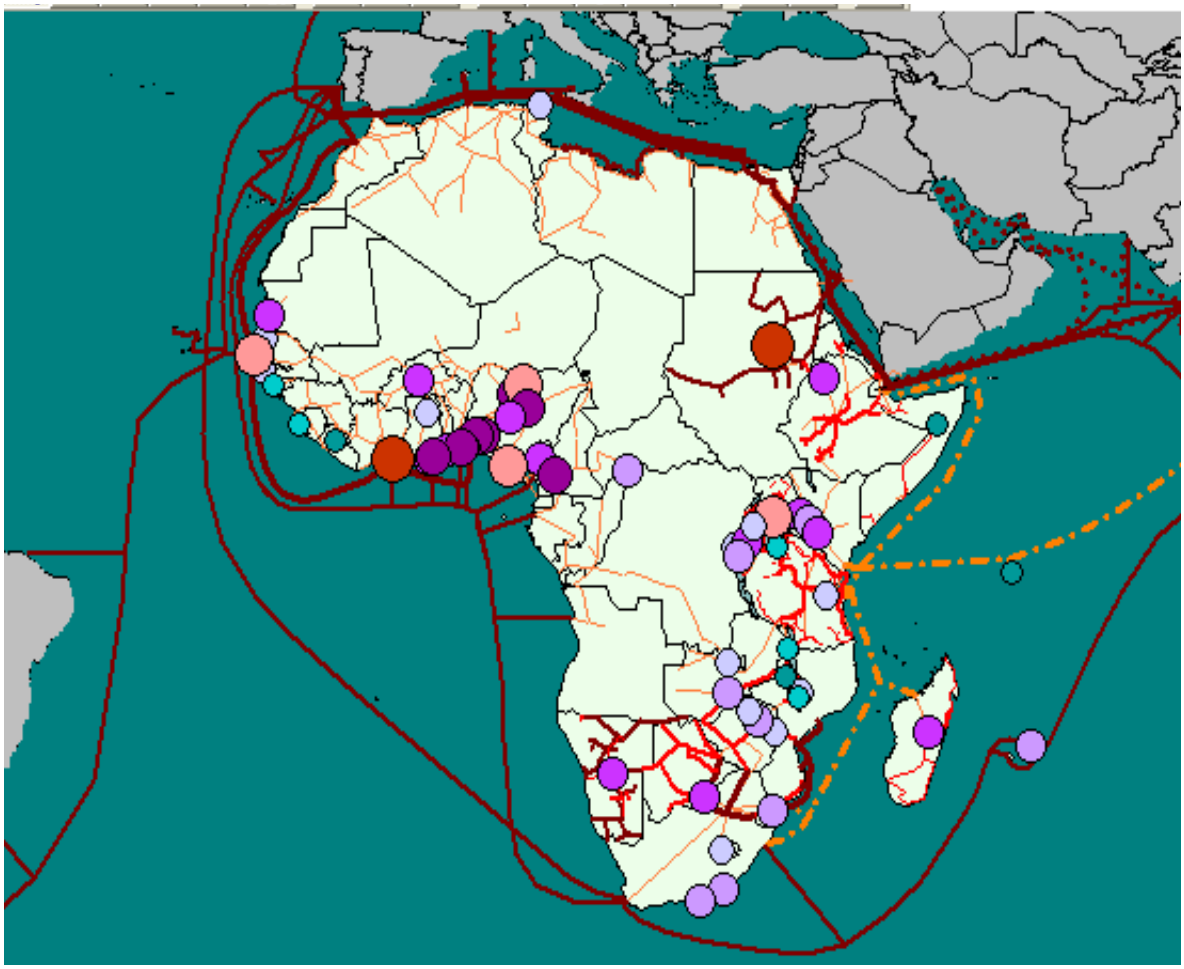


Key

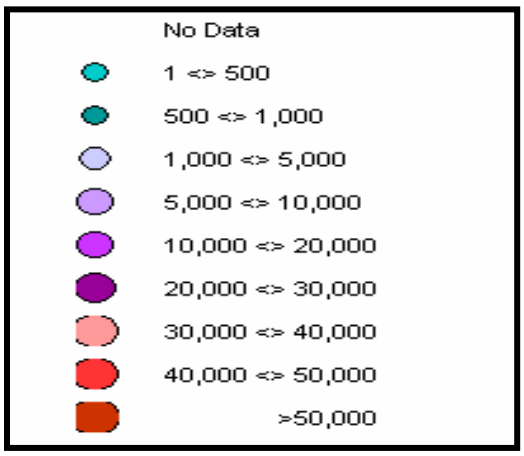


It appears that the greatest density of computers is in southern Africa. The density of users (staff and students across African Institutions) is presented in Map 2.

Map 2 Staff and Students: Density across Africa



Key

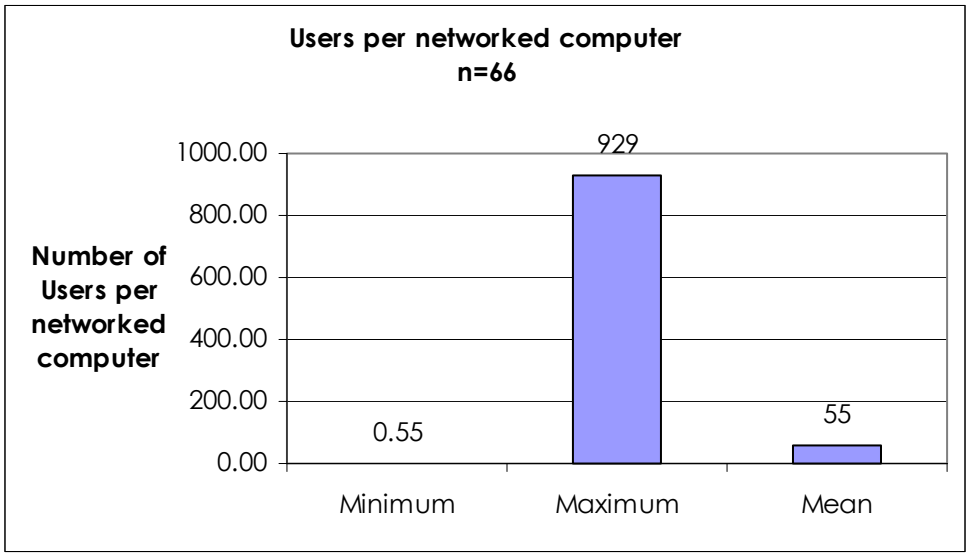


West Africa appears to have the greatest density of staff and students in African tertiary institutions.

5.1.1 Average Number of Users per Networked Computer

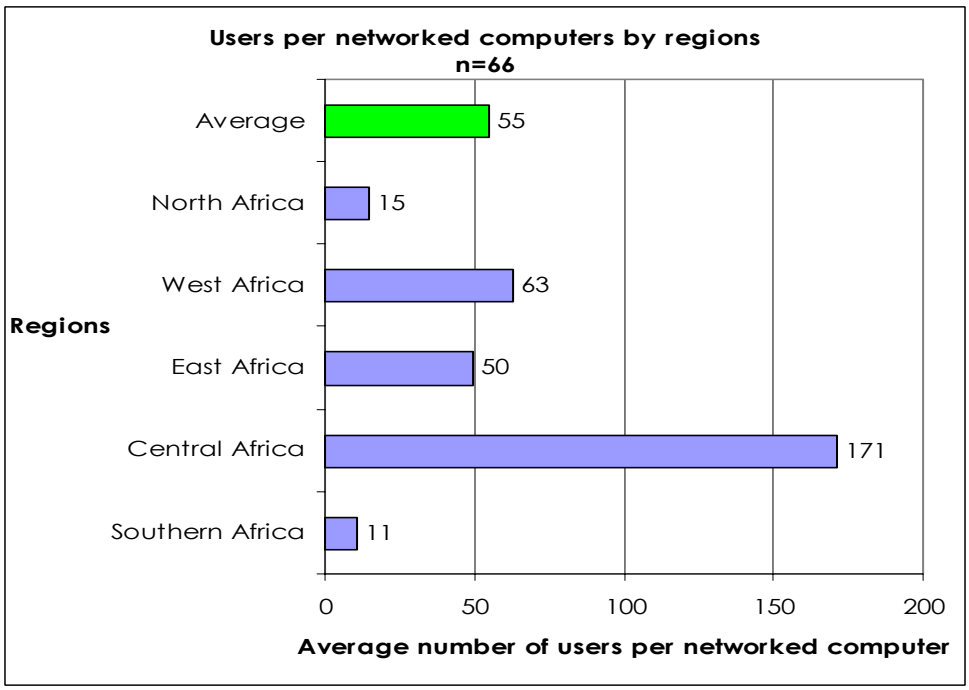
Users are defined by adding the total number of students and staff, as provided by the sampled institutions.

Chart 23 Average Number of Users per Networked Computer



The results indicate the huge differences in levels of computer access among the institutions. The highest number of users per computer is 929. The average across the sample is 55, which is still high. Chart 24 shows the density of computers on campuses across Africa.

Chart 24 Average Number of Users per Networked Computer by Region

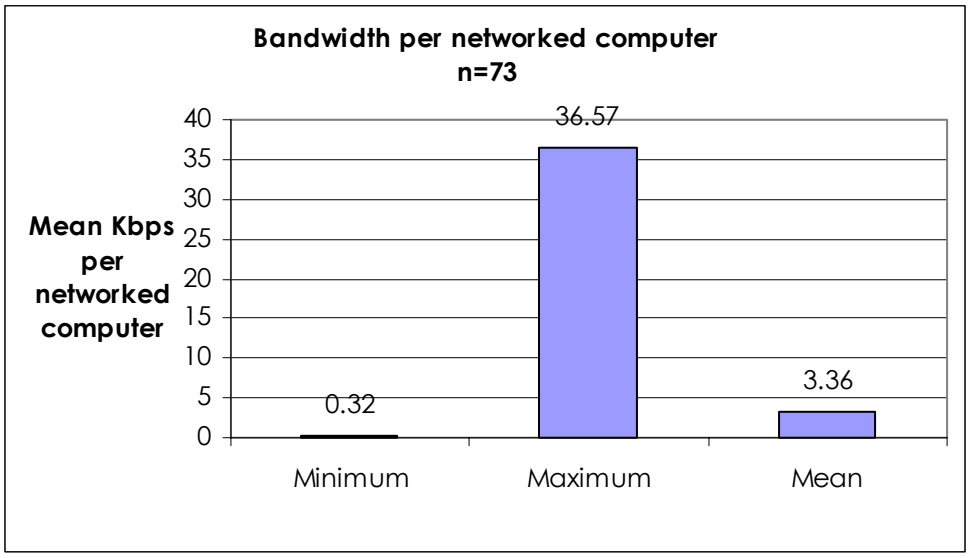


Central African institutions appear to have the least number of networked computers for their campus populations compared to Southern and Northern African institutions which have smaller numbers of users per networked computers. It is important to note, however, that 11 users (southern Africa average) per networked computer means 11 users have access to the Internet through one computer, a high ratio compared to the average students per networked computer ratio of USA institutions, which is about 5 students per networked computer. (N.B. a precise user-per-networked-computer ratio for USA institutions could not be obtained.)

5.1.2 Bandwidth per Networked Computer

The amount of Internet bandwidth that is available to each computer on the local network is a key indicator of the connectivity level of the institution, as it determines the speed of downloads and thus the utility of the Internet for each user. In some institutions with many PCs sharing a small pipe, downloading a single web page can take many minutes and make some applications, such as web-based mail or electronic journals and scientific databases, almost impossible to use. Other institutions may have sufficient bandwidth per PC to allow for video conferencing and other broadband applications.

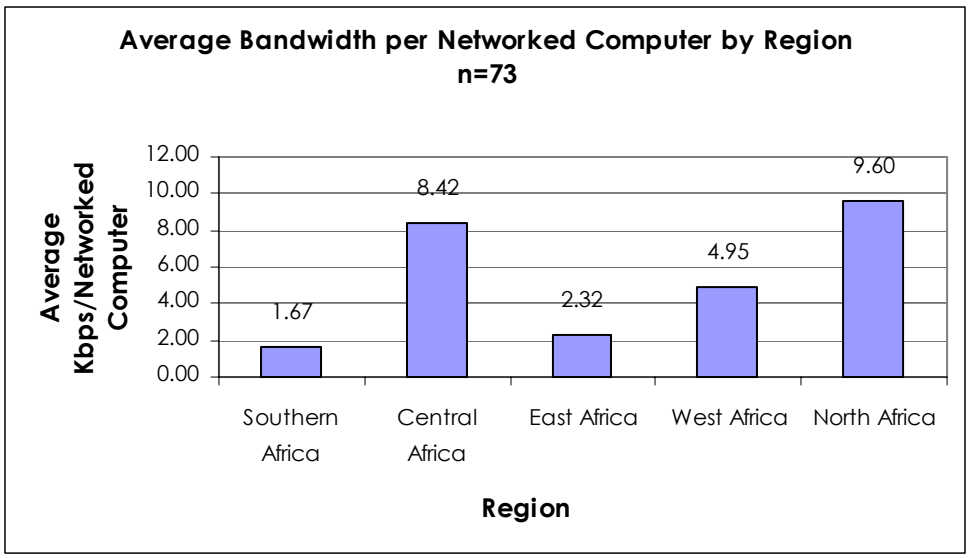
Chart 25 Average Bandwidth per Networked Computer



The lowest bandwidth per networked computer is 0.32Kbps compared to the highest bandwidth of about 37Kbps – roughly equivalent to a dial up modem. The average bandwidth per networked computer is 3.36 Kbps.

5.1.3 Regional Comparison of Bandwidth per Networked Computer

Chart 26 Regional Comparison of Bandwidth per Networked Computer



The highest average bandwidth per networked computer was registered by institutions in North Africa (9.6 Kbps) while the lowest average bandwidth per networked computer was recorded for institutions in Southern Africa, which is likely to be the result of having more computers within these institutions without adequate bandwidth. Central Africa has a relatively high bandwidth per network computer but this is primarily because there are so few computers at the institutions surveyed rather than because the quality is high. Analysis by bits per networked computer shows that institutions in North Africa have the highest average. See Chart 26.1below.

Chart 26.1 Regional Comparison of Bits per Networked Computer

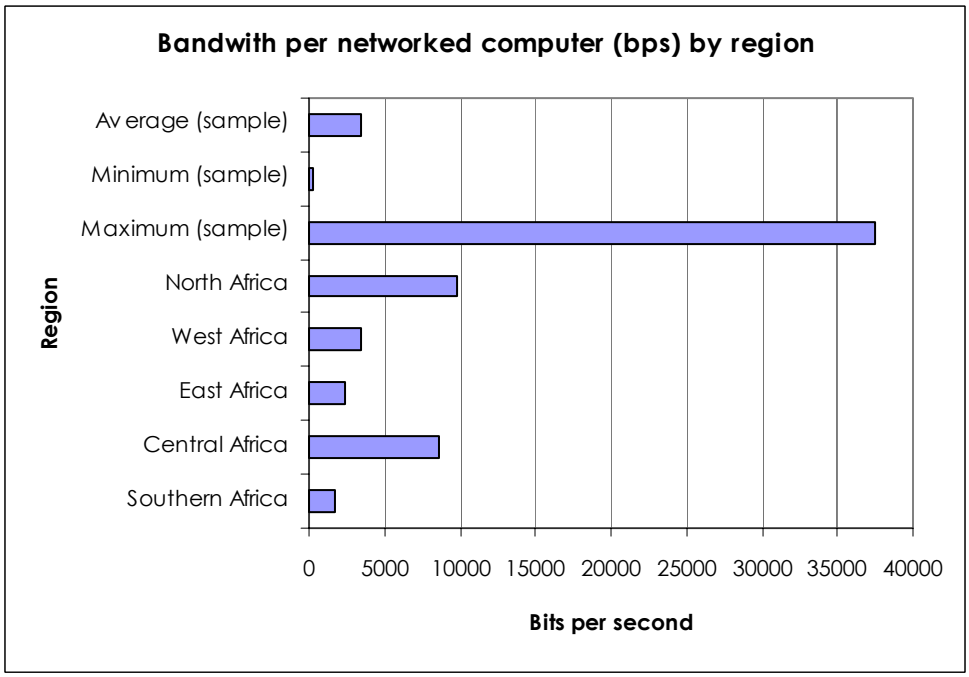


Table 5 ranks the institutions according to bits per networked computer.

Table 5 Rankings: Bits per Networked Computer

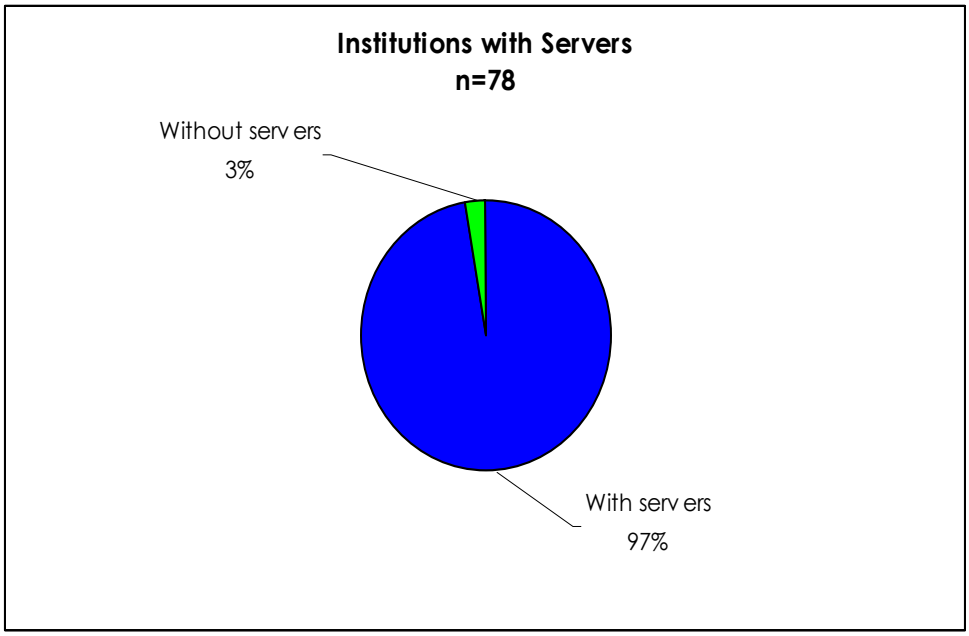
University	Country	Bits per Networked Computer
Top Ten Universities		
Universite de Bangui	Central African Republic	36571
Universite Catholique de Bukavu	DRC	15360
University of Hargeisa	Somaliland	10667
University du Sahel	Senegal	10240
Ashesi University	Ghana	10105
University of Yaoundé II	Cameroon	9600
Univeriste Libre de Tunis	Tunisia	9600
Njala University College - University of Sierra Leone	Sierra Leone	8000
Open University of Sudan	Sudan	7680
African School of Architecture and Town Planning (West and Central Africa)	Togo	7467
Bottom Ten Universities		
Sokoine University of Agriculture	Tanzania	692
Moi University	Kenya	640
University of Port Elizabeth	South Africa	620
Gondar University	Ethiopia	533
University of Asmara	Eritrea	512
Egerton University	Kenya	512
Universite du Benin	Togo	366
Eduardo Mondhlane University	Mozambique	346
University of Zambia	Zambia	320
Sudan Universityof Science and Technology	Sudan	320

It is difficult to draw many conclusions from this information because bits per networked computer depends on both available bandwidth and numbers of networked computers. In most of the top ten universities, there high scoring is the result of having so few networked computers on campus.

5.2 Servers in Sampled Institutions

In the sample, the minimum number of servers is 1 and the maximum number is 26.

Chart 27 Servers in Surveyed Institutions

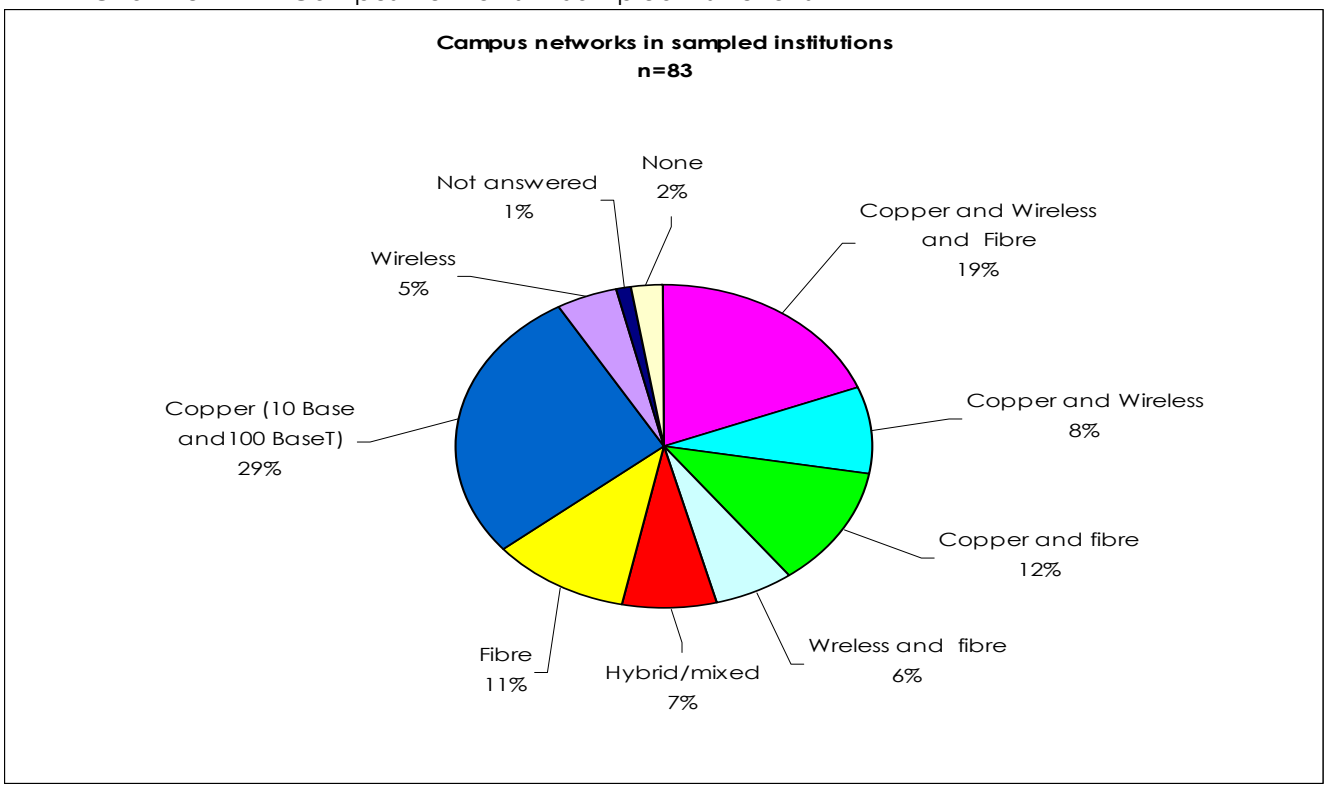


The majority of the respondents, 97%, have local servers, as would be expected, since most institutions have leased line connectivity, which would require at least some server capacity. The remaining institutions use only dial up access or have very limited campus networks.

5.3 Campus Networks

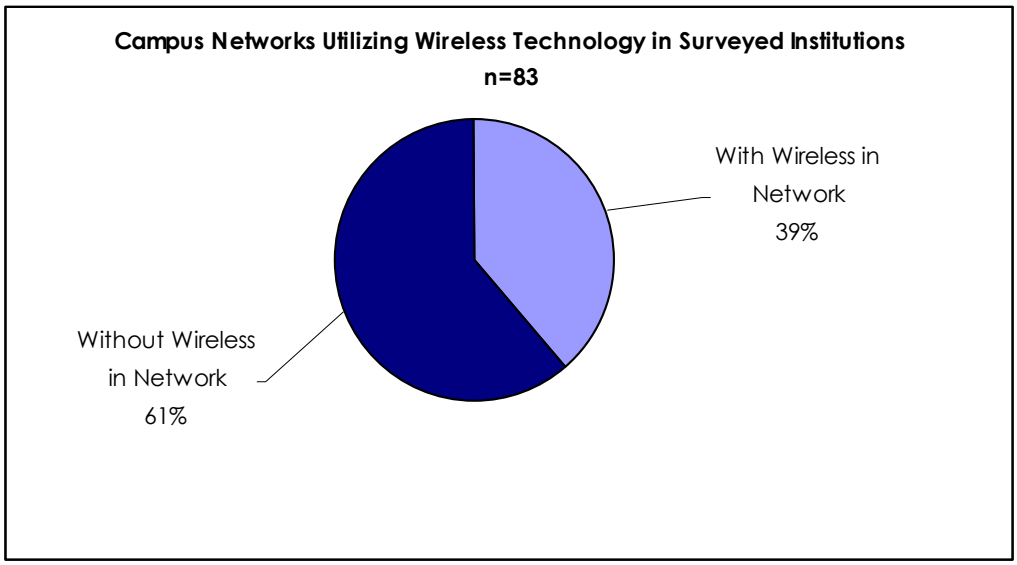
5.3.1 Campus Networks in Sampled Institutions

Chart 28 Campus Networks in Sampled Institutions



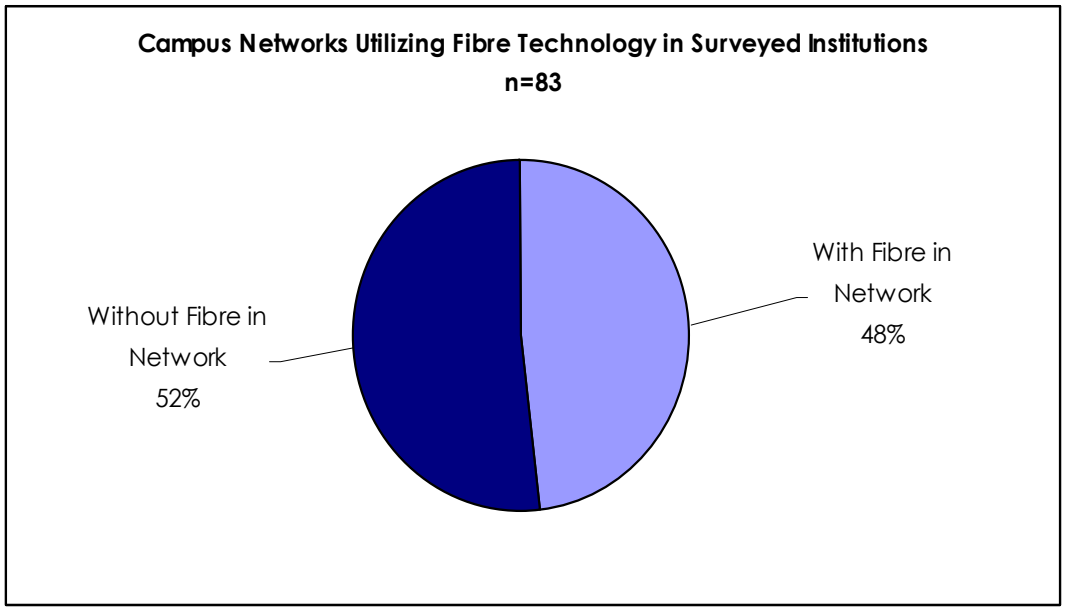
97% of the respondents indicated that they have campus networks. The largest proportion (29%) of the respondents reported they used copper (10 Base and 100BaseT) for their campus backbones. 19% said they used a mix of copper, wireless and fibre. About 7% reported using a hybrid/mixed backbone for their campus network. Charts 1.28.1 and 1.28.2 provide further insights into wireless and fibre backbone utilization among the sampled institutions.

Chart 28.1 Campus Networks Utilizing Wireless Technology in Surveyed Institutions



It was reported that almost 40% of the surveyed institutions utilized wireless links somewhere in their campus networks, while almost 50% had some fibre links in their campus network.

Chart 28.2 Campus Networks Utilizing Fibre Technology in Surveyed Institutions



5.4 Utilization of Link and Failure/Loss-of -Service Rates

Because most institutions have inadequate bandwidth, it would be expected that many would exceed available capacity for much of the time. This is borne out by the survey, which showed the average percentage of time where links are at 100% capacity is 68%. This is extremely high, given that this should be measured over 24 hours a day every day of the month.

Chart 29 Percentage of Time Link is at Maximum Capacity

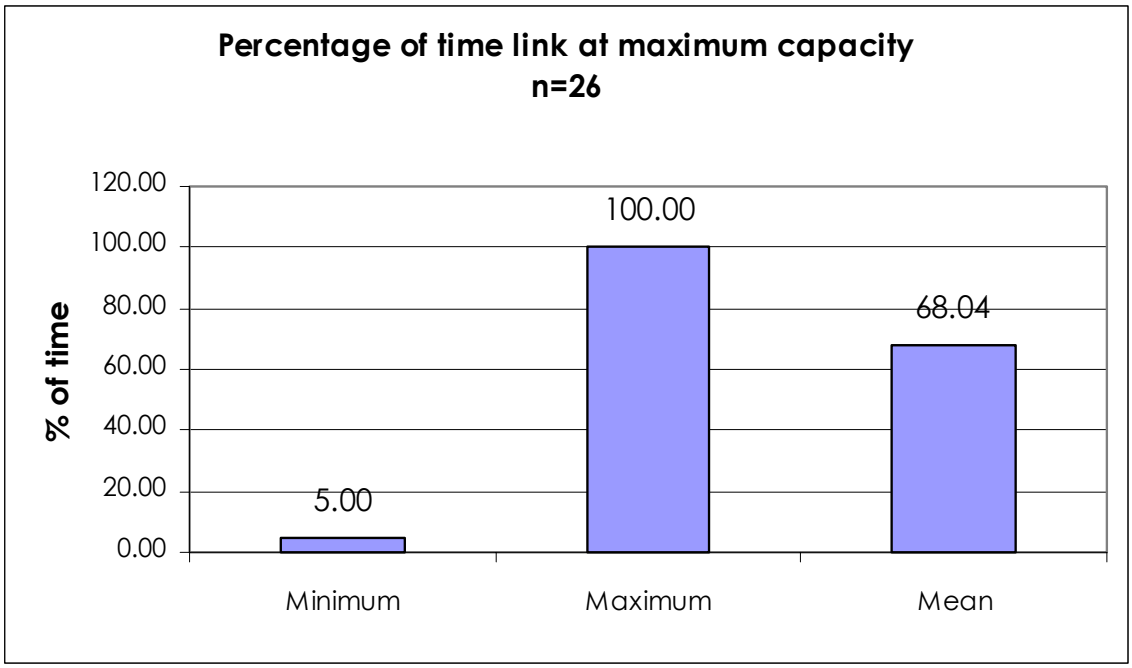
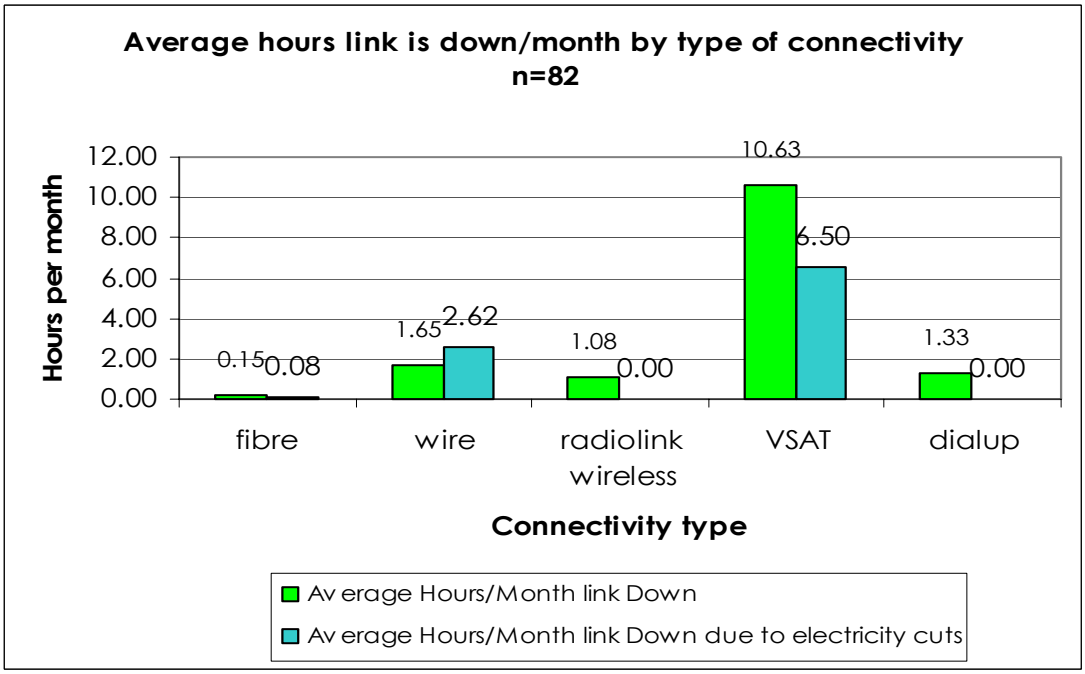


Chart 30 Average Number of Hours Link is Down: Comparison by Type of Connectivity



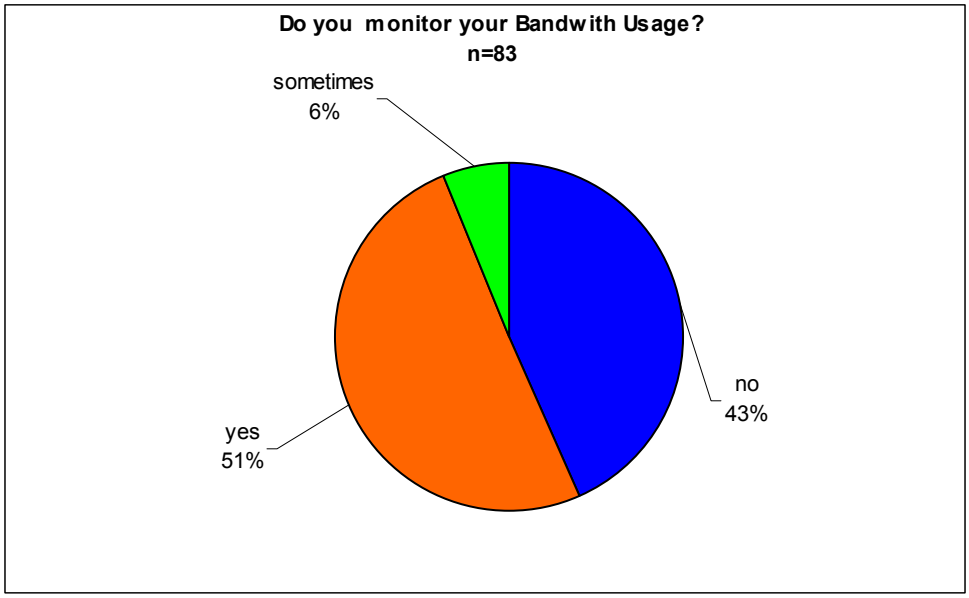
The results indicate that VSATs have a higher rate of failure, with 10.63 hours per month, than other links, with fibre having the lowest rate of failure of 0.15 hours per month. It appears that, where electricity cuts are a problem, VSAT and wire are affected most. The implications of these findings is that VSAT solutions appear to be a more difficult technical solution for many institutions, and additional support is likely to be needed when implementing this solution.

Bandwidth Monitoring and Management

6.1 Monitoring Bandwidth Usage

Respondents were asked whether they monitored their bandwidth usage. The responses are presented in charts 31 – 33.

Chart 31 Percentage of Institutions Monitoring Bandwidth Usage

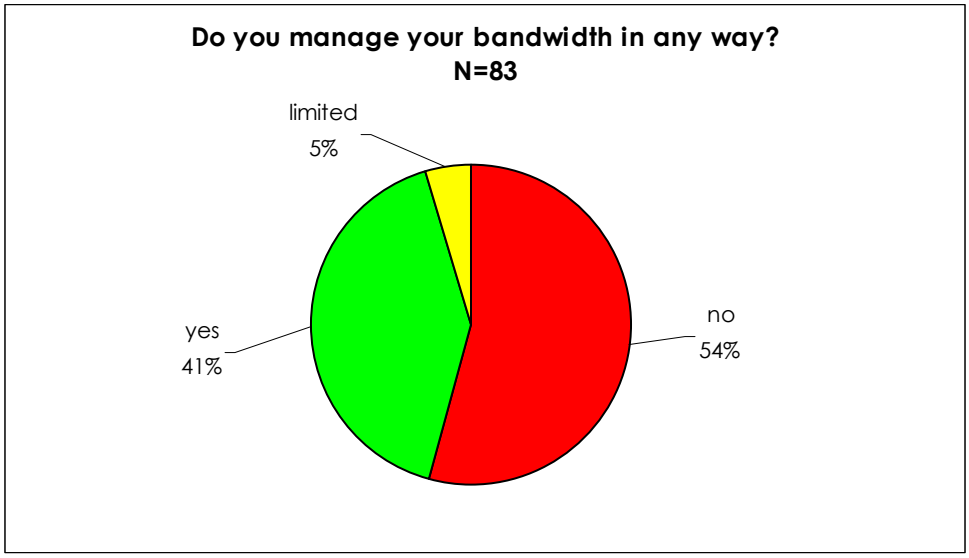


Although 51% indicate that they monitor their bandwidth, only five of the universities could provide basic usage figures such as average bandwidth used, indicating that monitoring is sporadic at best.

6.2 Bandwidth Management

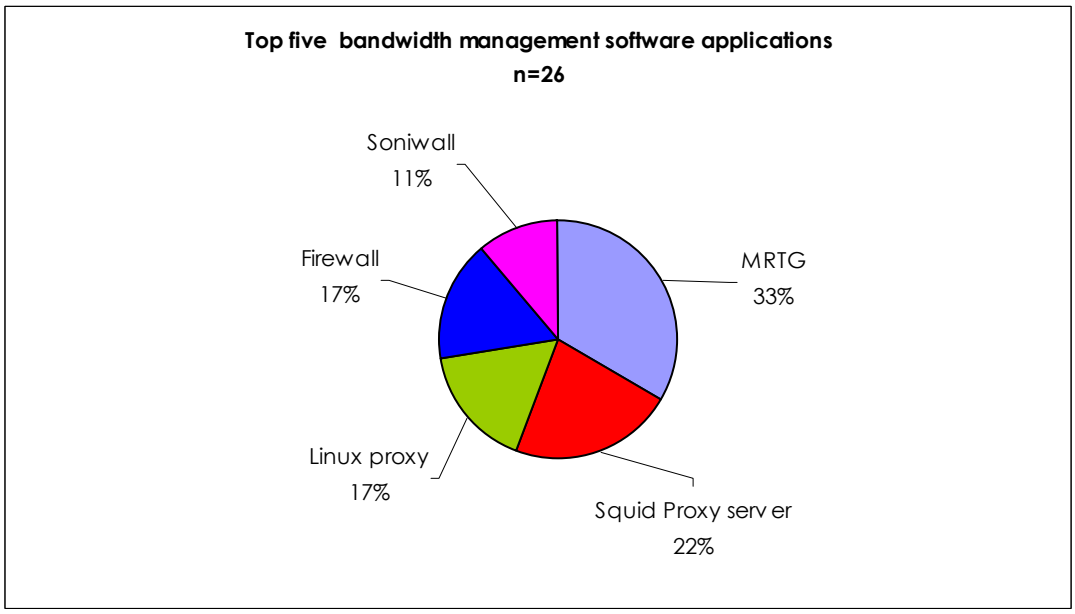
Bandwidth management is an essential service that promotes efficiency and maximum utilization of bandwidth. Without good bandwidth management, the available bandwidth is quickly used up in non-productive traffic including music files, viruses and photographs. Similarly, a few compromised PCs running as rogue SPAM relays or virus distributors can create similar problems.

Chart 32 Do you Manage your Bandwidth in any Way?



Unfortunately, the majority of the respondents (59%) reported that they did not practice bandwidth management, or seldom did so, thus indicating a critical need for skills training in this vital area. **Improving bandwidth management is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes.**

Chart 33 Software used in Bandwidth Management



Of the 26 respondents that answered this question, 33% use Multi Router Traffic Grapher (MRTG) in bandwidth management. MRTG is used to monitor the traffic load on network links. MRTG monitors bandwidth traffic by generating HTML pages containing Portable Network Graphic (PNG) images (images compressed in lossless fashion, meaning all image information is restored when the file is decompressed

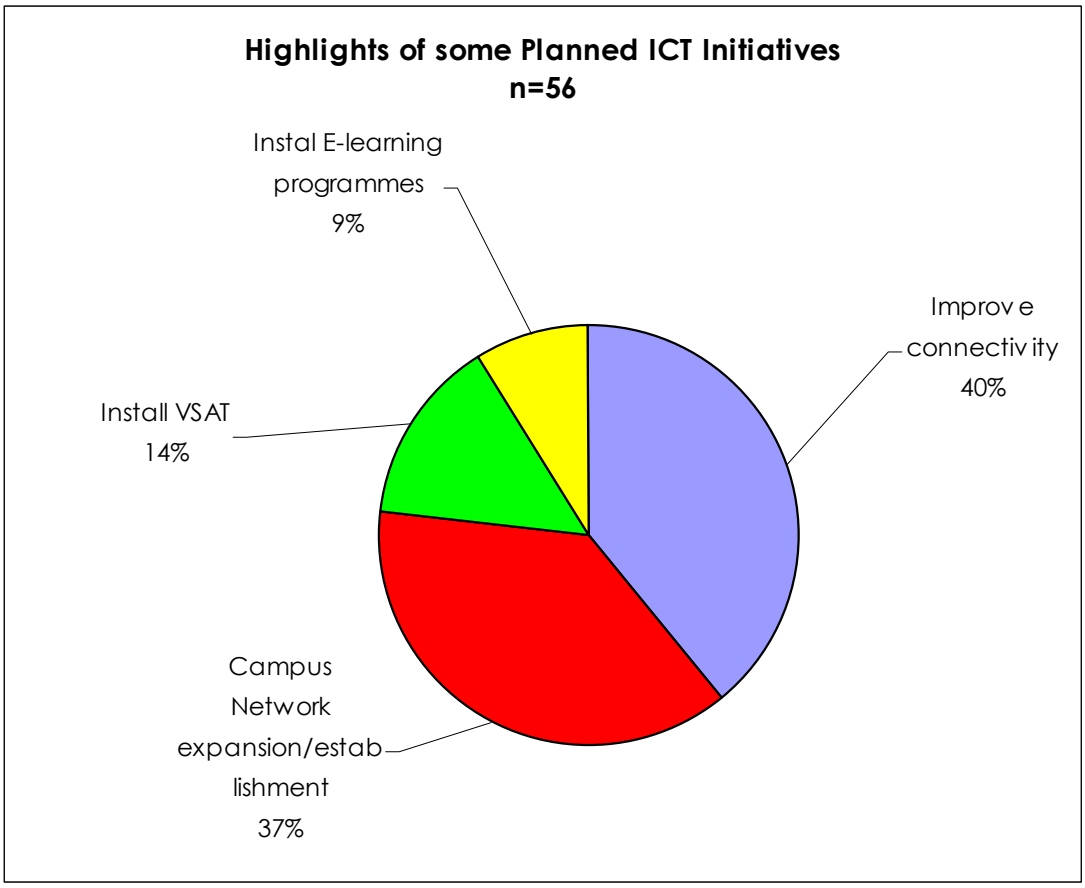
during viewing), which provide a LIVE visual representation of this traffic. However, this tool is primarily for monitoring and not for management of traffic.

ICT Projects and Bandwidth Consortia

7.1 ICT Initiatives and E-Learning

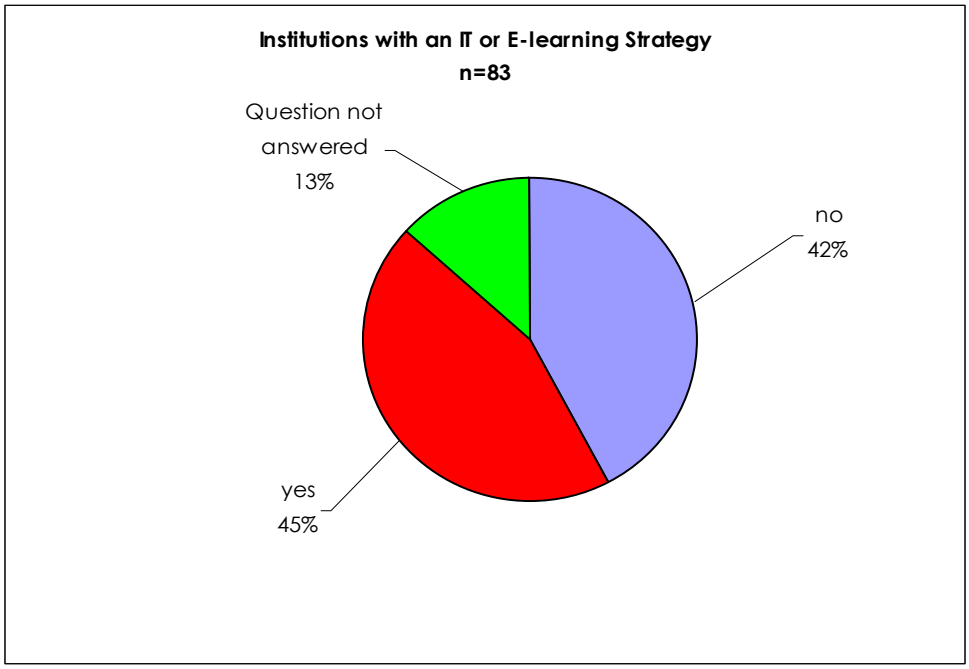
Many of the tertiary institutions surveyed are planning to implement various ICT initiatives, and some of them are using e-learning to complement the conventional methods of learning in institutions. Respondents were asked to list five planned ICT initiatives. Chart 34 shows responses for the first initiative listed.

Chart 34 Highlights of Some Planned ICT Initiatives.



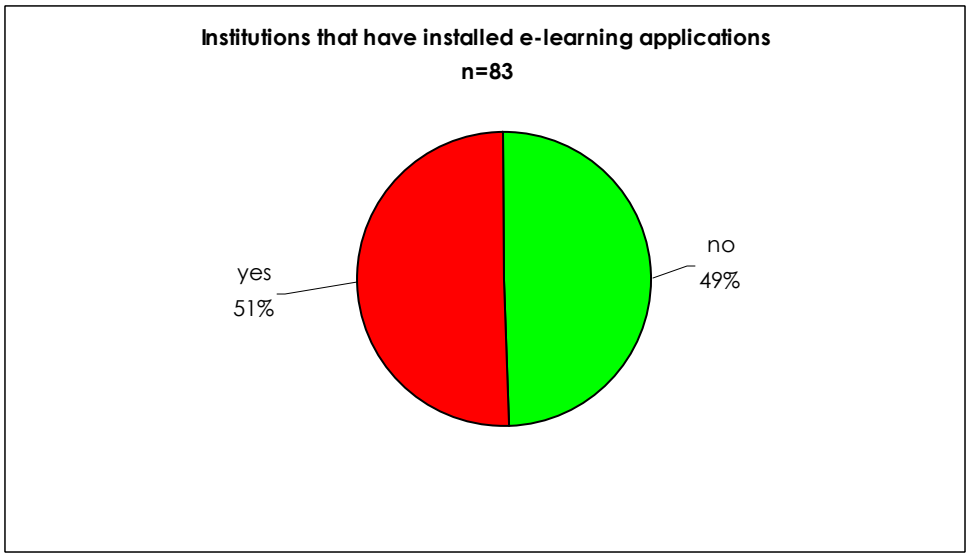
The majority listed improving connectivity as the first initiative they were planning to implement. A substantial number said that they were also planning to expand or establish campus networks so as to extend Internet access to all students.

Chart 35 E-Learning/IT Strategy in Surveyed Institutions



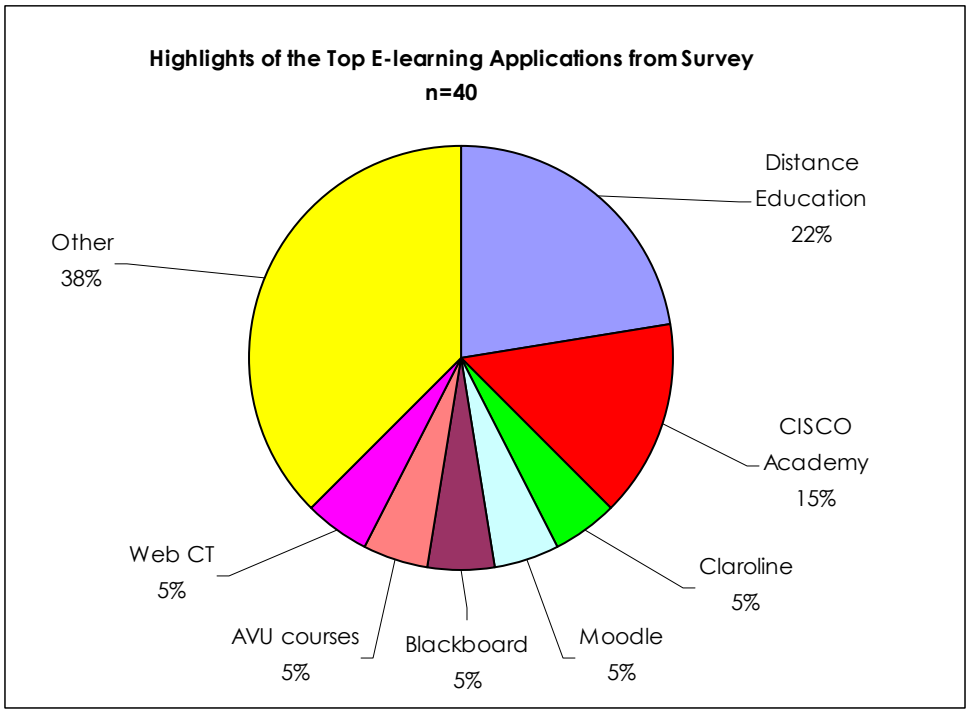
While 45% have a written e-learning/IT strategy an almost equal 42% do not, and 13% did not answer the question.

Chart 36 Institutions with E-learning Applications



Just over 50% of the respondents have installed e-learning applications. Respondents that said they had installed e-learning projects were asked to list three e-learning projects that they had installed. Chart 37 below shows the responses for the first e-learning project listed.

Chart 37 Highlights of the Top E-learning Projects



Distance education appears to be the major form of e-learning in the surveyed institutions. Other projects listed are:

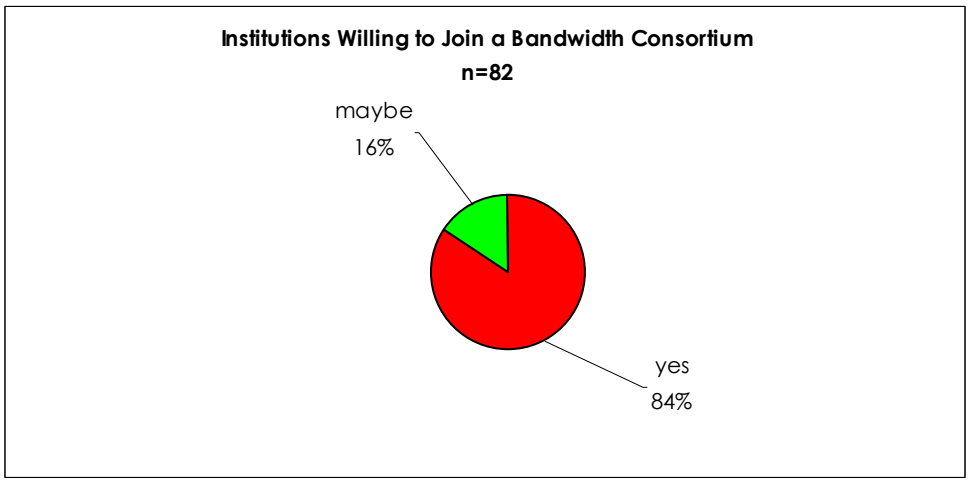
- Blackboard is a Web-based server software platform that offers course management. It is open for customization and is also scalable allowing for integration with student information systems.
- CISCO Academy is an e-learning program, which allows students to pursue IT curricula through online instructor-led training and practical lab exercises.
- Web CT. WebCT Campus Edition is a course management system that enables the delivery of online education. It is scalable and integrates with existing campus infrastructure, enabling campus-wide deployment
- Moodle is a course management system i.e. a software package designed to allow educators to create quality online courses. It is open source software with 50 language packs, currently in use at 987 sites in 74 countries.
- Claroline is Open Source software and a course management system, which allows teachers or education institutions to create and administer courses through the web.
- AVU courses. These are courses being implemented by the AVU (African Virtual University) at its 38 learning centres (housed in universities). AVU offers short courses in IT and journalism as well as a diploma and degree in computer science and business administration.

The lack of detail in many of the responses possibly means that some of the 'Distance Education', and 'Other' categories could also include the specific applications identified above.

7.2 Joining a Bandwidth Consortium

The respondents were asked if they were willing to join a bandwidth consortium. Chart 38 below presents the responses.

Chart 38 Institutions Willing to Join a Bandwidth Consortium



It is noteworthy that none of the respondents gave a negative response, and, by far, the majority is clearly willing to join a bandwidth consortium, with only 16% indicating a lower possibility of their inclusion in such an initiative.

7.3 Total Bandwidth Requirements

An interesting question to address is what is the actual bandwidth requirements for the African university surveyed? This issue was addressed in the recent Partnership for Higher Education study (Partnership for Higher Education 2003). Following considerable email debate, the study came up with the following rule of thumb method for determining bandwidth requirements:

- Computers were used as the unit of measurement because access to the Internet and bandwidth is facilitated or impeded by the number of available computers.
- Computers are in heavy use in the African universities included in this investigation—for Internet, word processing, data processing, etc.
- The study chose one hour as the ideal time an average user would like to spend identifying, downloading, and printing or saving journal articles. Thus, each computer can handle about 10 people a day. The study also estimated that that the average user would want to download about 10 MB a day while recognizing that patterns vary over the course of the year.
- Bandwidth needs were restricted to journal articles that must be downloaded from remote servers rather than materials that can be downloaded and stored on a university intranet. This is because the study authors felt that

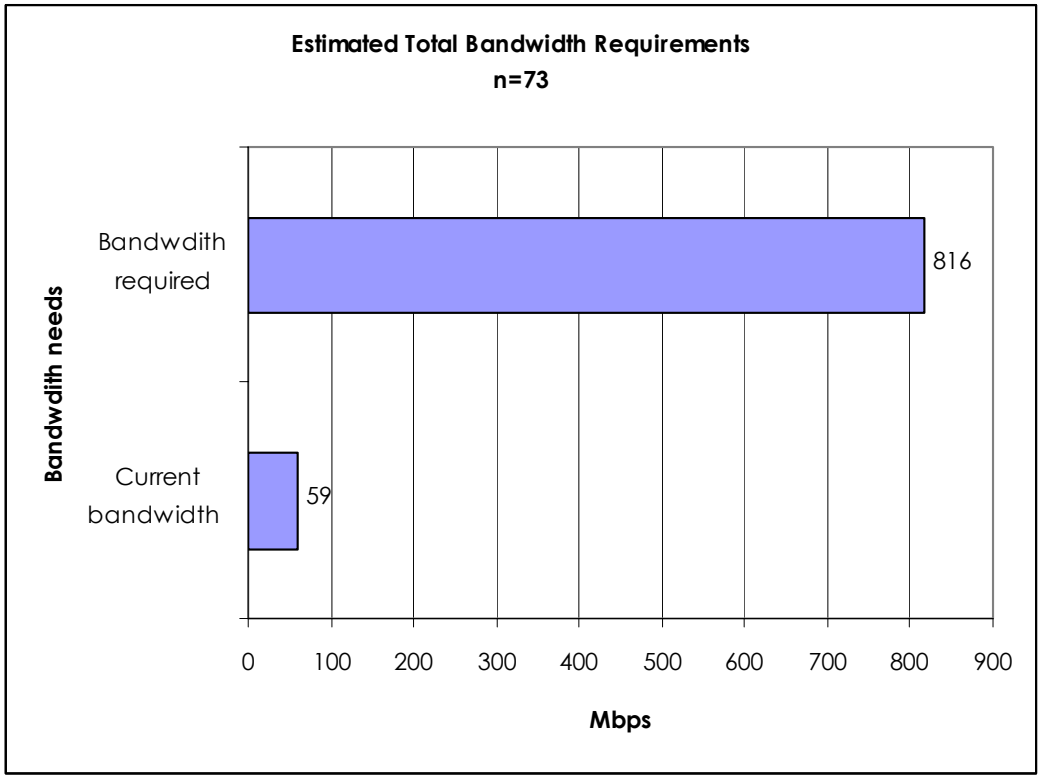
bandwidth needs for journal articles can be reported more reliably than anything else. Using bandwidth for video conferencing, exchanging research data, and other forms of academic utilization will necessitate more robust bandwidth access, of course (Partnership for Higher Education 2003)

The Partnership for Higher Education study settled on the following formula to calculate the bandwidth needs of each sampled institution:

*10Mb/day * 8 bits *10 people * No. of networked computers ÷ seconds in 10hrs=Mbps required*

Using this approach with 73 Sub Saharan universities we compared current bandwidth to bandwidth required presented in Chart 39. For individual university results please refer to Appendix 4. The calculation shows that bandwidth requirements are at least 10 times the current usage. This represents the capacity of 5 to 10 transponders if a VSAT solution was to be put in place.

Chart 39 Estimated Total Bandwidth Requirements in Mbps for 73 Universities



7.4 Potential Bandwidth Savings from a Consortium

In order to evaluate the potential impact of creating a bandwidth consortium representing African tertiary institutions, the current costs of a group of 65 institutions were analysed. North African institutions with access to undersea fibre were excluded, as were institutions where bandwidth costs where not clearly specified. The total bandwidth of all institutions was calculated, as was the total cost of this bandwidth. In order to account for varying quality of bandwidth, institutions that did not have a committed information rate were considered only to be getting 70%

of their stated bandwidth. This is in fact a very generous approximation and it is likely they are receiving far less.

With these assumptions in mind the results were as follows:

- Total bandwidth being used adjusted for CIR is about 48 Mbps.
- If a bandwidth consortium could negotiate a rate of $2.5/kbps, the universities would be able to either cut their costs by 50% or increase their bandwidth by 100% at the same price. However even if bandwidth was to be increased by 100%, Africa universities would still be well below the estimated requirements for adequate bandwidth as calculated in the previous section.

The detailed results of the calculation are as follows:

Total BW of non CIR institutions (kbps)	30,408
Total BW of CIR institutions (kbps)	27,276
Total BW (kbps)	57,684
Total BW adjusted for non CIR (70%)(kbps)	48,562
Annual Cost of Bandwidth for 65 institutions	$ 2,906,568.00
Current average Cost of BW ($/ kbps/mth)	$ 4.99
Expected cost of BW with consortium ($/kbps/mth)	$ 2.50
Expected yearly consortium cost of bandwidth for 65 institutions	**$ 1,456,848.00**
Savings per year	**$ 1,449,720.00**
Percentage savings	**50%**

In should be borne in mind that cost savings would be only one of the benefits of such a consortium. Other benefits would include:

1) Improved Bandwidth management: Being part of a consortium will encourage more effective bandwidth monitoring and management. Centralized technical expertise would increase support in several areas.

2) Increased Network Initiatives: Good connectivity will enable a plethora of new network initiatives between African institutions – initiatives that are extremely difficult to nurture given current levels of infrastructure

3) Improved Content Access: As a result of greater bandwidth availability, researchers and students will be able to take advantage of the significant scientific resources available online to developing world institutions.

4) Access to Burstable Bandwidth: Because each member of the consortium can utilize bandwidth that is not being used by other members of the consortium, bandwidth downloads can be greatly improved through burstable bandwidth.

Recommendations

8.1 Improving Access to More Bandwidth

Tertiary educational institutions in Africa, by and large, suffer from too little bandwidth. What exists is, generally, poorly managed, and it is among the most expensive in the world. Although there are some emerging exceptions to this statement, in particular in North Africa, the rest of Africa is falling increasingly behind the rest of the world when it comes to Internet access. Yet the potential of new communication technologies to improve the effectiveness of African research and educational systems has never been clearer. There are now, for example, many projects making electronic educational and scientific content available for developing countries and Africa in particular, such as the African Digital Library, HINARI, AGORA, PERI and JSTOR.

When we examine the telecommunication infrastructure (terrestrial) across Africa, we find that it is characterized by lack of coverage, low available bandwidth, and very high per-bit costs. In order to address these challenges the following recommendations are being made:

8.1.1 Formation of Bandwidth Buying Consortium

Given the fact that terrestrial infrastructure is still disjointed and sparse across much of Africa, the formation of a VSAT based university consortium or a satellite hubbed network to purchase bandwidth is an obvious initiative for the short term. The development of such a centrally managed network using satellite technology and offering services across a large area would help to address multiple issues facing tertiary institutions. Satellite-based networks offer the capacity to provide bandwidth independently of land-based infrastructure. At the moment, bandwidth is still quite volume-sensitive. As a result, centralized buying would result in a much lower per-bit cost than when organizations negotiate individually as currently the average African university bandwidth costs are 50 times more than that of an average US university. In addition the body would be more effective at negotiating for Committed Information Rates (CIR) and optimal contract lengths. This is already being explored by the AVU and the Partnership for Higher Education-sponsored universities, and, if this model is more widely adopted with support from other international donors, a major impact on connectivity in tertiary institutions across Africa could be achieved. However, as fibre networks become more widespread in the medium and long term, due to existing fibre backbones such as EUMEDCONNECT, SAT-3 Fibre Consortium and planned fibre backbones like the East African Submarine System (EASSY) and COMTEL, obtaining bandwidth through fibre will increase and is envisaged to eventually surpass satellite bandwidth. Fibre has high capacity and quality. . However, the biggest challenge with fibre is that there is monopoly-pricing by the owners of some cable currently making this bandwidth even more expensive than VSAT. Thus there is need for political pressure to bear on reducing these costs so that rapid utilization of the resource is possible. N.B. The SAT-3 cable lands in 16 countries along the West Coast of Africa. Already,

TENET South Africa is utilizing this bandwidth link to provide its 26 institutions with international connectivity. East African Submarine System (EASSY) is a planned East African fibre link. COMTEL is an initiative with plans to establish a fibre backbone, which would link all of the countries in East and Southern Africa with connections to SAT-3 and EASSY. In the next 3-4 years, this should see all countries in the region with at least one international fibre route (PAREN 2005).

8.1.2 Improved Bandwidth Management

It is critical that tertiary institutions work to improve bandwidth management, as it is probably the easiest way for universities to improve the quantity and quality of their bandwidth for educational purposes. Improved bandwidth management ensures better quality, lower cost, maximized bandwidth availability and a boost in throughput. Examples of bandwidth management techniques include modifying upload/download ratios, taking advantage of traffic patterns across several time zones to maximize availability and implementing accelerator technology. Bandwidth management would also require skilled human capital thus training of staff and even students would be beneficial while suitable private sector support is vital e.g. seeking partnerships in software provision at discounted prices with private sector firms

8.1.3 Centralised Network Management and Technical Capacity

Bandwidth without adequate network management is wasteful and reduces its value. In most African countries, the available technical expertise in network management is not adequate. It is often restricted to only one or two persons and is therefore also highly susceptible to disruption. This extends even to many national telecom operators, which, as state monopolies, often do not pay well enough to attract and retain the talent, or, as multiple small players who don't have enough market share to cover the cost of a robust technical staff. Satellite technologies, by their nature, route traffic through a limited number of hubs, thus creating a natural situation for centralized network management, the cost of which could be shared by all the institutions involved. Telecommunication network management is complex if done correctly. Poor management simply exacerbates poor connectivity. In addition, larger customers can always demand and obtain better service from upstream providers.

8.1.4 Improved Regulatory Policies Regarding Educational Bandwidth

An important role of any consortium or bandwidth initiative will be to negotiate with governments to allow the use of VSATs or eliminate license fees and monopoly pricing for educational bandwidth. A well conceived diplomatic strategy will have to be pursued in order to accomplish this. The precedents both within and outside of Africa indicate that this is possible. EUMEDCONNECT was able to assist universities in North Africa to lobby their governments for educational waiver on fees and

pricing. The Partnership for Higher Education has not had much difficulty in doing the same for the sub Saharan countries in which they operate.

Many countries in Africa have already embraced liberalization policies although a few challenges do remain. For example unless the governments with non competitive licence regimes grant special authorization to universities and research centres, 74 institutions in six countries, that is, Angola, Benin, Chad, Ethiopia, and Namibia would be unable to use VSAT for their international connectivity except through the incumbent operator.

Changing regulatory environment for improving both access to satellite and to improved national backbones is, perhaps, the most difficult issue to address, particularly by small internal players within specific countries. Thus, the value of a consortium approach goes beyond the economies of scale in purchasing larger amounts of bandwidth, but also in building clout and in sharing experience and the costs of lobbying for improved regulatory conditions.

In the regulatory world, such a service provider (particularly one which is not-for-profit and focused on education) would be in a much better position to develop support from such agencies as the ITU, AU and the like. These relationships could go far in resolving regulatory issues at the country level.

8.2 Conclusion

The results of the ATICS survey argue strongly that there is an imperative to examine the potential to create initiatives to improve bandwidth access. A range of options is available. At one end a relatively simple buying consortium can be created very similar to what the AVU is doing for a small group of universities. On the other end the potential exists to create a not-for-profit telecommunications service provider or organization, which would provide a much broader range of services and ensure that effective network and bandwidth management practices are in place. The need clearly exists for such initiatives to provide cost-effective and well-managed bandwidth services to the research and higher education sectors across Africa.

8.3 Areas for Further Research

An important area that needs further research is the regulatory environment in Africa and its impact on connectivity. It would also be interesting to know how committed governments are to deregulation and why the bandwidth markets appear to remain distorted even after deregulation. Some of the questions needing further research include:

- What are the correlations between the regulatory environment and cost and availability of connectivity in Africa?
- What are the implications of the Free Education Licenses where they have been implemented?
- How effectively is deregulation influencing competitive bandwidth markets in Africa?

- What are the factors behind the low bandwidth prices in regions like Central Africa? Are some governments opting not deregulate bandwidth markets but making other types of concessions? Are there government subsidies in bandwidth being made available to tertiary institutions in some countries?

Another important area of research that could assist tertiary institutions is the development of a comprehensive set of benchmarks for bandwidth use amongst institutions in both the north and the south, e.g. networked computers per student and bandwidth per networked computer.

Appendix 1 List of Respondents

Total of 83 tertiary institutions were surveyed. Here is the list of institutions and their contact details

Table 6 List of Respondents

Country	University	First Name	Occupation
Algeria	University d'Alger		IT Liason
Benin	Universite d'Abomey Calavi	Yebeni Kouagou	Head Informatics Services
Benin	Institut de Mathematiques et de sciences Physiques (IMSP)	J Hounsou	IT Officer
Botswana	Botswana College of Agriculture	Chibamba Mwale	Assistant Manager IT
Botswana	University of Botswana	Mrs Lilian Maswabi	IT User Support Manager
Burkina Faso	Ouagaduogou University	Romubid Sawadogo	Networking Manager
Burundi	Universite du Burundi	Apollinaire Yengayenge	IT Manager
Burundi	New School	Apollinaire	IT Universite du Burundi
Burundi	Universite Lumiere de Bujumbura	Apollinaire	IT Universite du Burundi
Cameroon	University of Yaoundé II	Roger Tsafack Nanfosso	DIrector of EPM Program
Cameroon	Universtiy of Doaula	Chantal Moukoko	Library
Cameroon	Université de Yaoundé I	Rector	Rector
Cameroon	Universite du Dschang	Marie Louise Avana Tientcheu	IT
Central African Republic	Universite de Bangui	Joachim Guelembi	Vice Rector
Cote d'Ivoire	Universite de Cocody	Toto Jerome Balou Bi	Secretary

			general
DRC	Universite Catholique de Bukavu	Sindano Kitwanga	Professor
DRC	Universite de Kinshasa	Gabriel Bombambo	IT Manager
Egypt	Assiut University	Prof. Dr. Abdel Wahab M Ali	IT
Egypt	Cairo University	Yehia Badr	IT
Eritrea	University of Asmara	Tessa Yohallnnes	Network Administrator
Ethiopia	Gondar University	Abraham Dargie	Director- ICT Resource Services
Gambia	University of the Gambia	A Remien	Network Administrator (US Pearce Corp)
Ghana	University of Ghana	Mumuni Dakubu	ICT Director
Ghana	Central University College	John Haizel Commeh	Systems Administrator
Ghana	University of Education Winneba	Hubert Asior	Network Administrator
GHANA	University for Development Studies	John Kaburise	Vice-Chancellor
Ghana	Ashesi University	Patrick Awuah	
Guinea Bissau	Instituto de Ciencia eTechnologia	Imani Na Umoia	Director of ICT
Kenya	Egerton University	Dr Githeko	IT Director (part time)
Kenya	Kenyatta University	Dr Odote Jackson	Director ICT
Kenya	Strathmore University	Raymond Mutura	ICT Services Delivery Manager
Kenya	Moi University	DR G Wanyembi	Director Information Resource Management Centre

Kenya	Jomo Kenyatta University (JKUAT)	Nyaga Gacheru	System Administrator
Lesotho	National University of Lesotho	Tsheli Moshoeshoe	IT Management
Liberia	Cuttington University College	Henrique Tokpa	President
Madagscar	Universite d Antananarivo	Joseph Rakontondralambo	IT Manager
Malawi	University of Malawi College of Medicine	Bruce Zamaere	Network Support Manager
Malawi	Mzuzu University	Paxton Zozie	Assistant Librarian
Malawi	Bunda College of Agriculture	Geoffrey Salanje	College Librarian
Malawi	Chancellor College	Thomas Bello	Systems Librarian
Mauritania	Universityof Nouakchott	Ahmed Salem Ould Cheikh	IT Manager
Mauritius	Mauritius Institute of Education	Dr Papayah Guruvadoo	Computer Science Department Head
Mauritius	University of Mauritius	Arvindnath Rosunee	Director- Centre for Information Technology and Systems
Mauritius	University of Technology Mauritius	Rishi Heerasing	Lecturer
Morocco	Al Akhawayn University	Latifa Quanaim	Registrar
Mozambique	Eduardo Mondhlane University	Americo Mushanga	IT Director
Mozambique	Cathilic University of Mozambique	David Ucama	IT Officer
Namibia	Univeristy of Namibia	K.S. Suresh	IT Director
Namibia	Polytechnic of Namibia	Laurent Evrard	Director Computer

			Services
Nigeria	University of Abuja	Dr Iseyimwe Okoli	Director Computer Centre
Nigeria	University of Ibadan	S.S.A Odularu	Acting University Librarian
Nigeria	Obafemi Awolowo University	M.V. Afolabi	University Librarian
Nigeria	Ahmadu Bello University	Adedokun Adewale	Systems Administrator
Nigeria	Bayero University	Ado Dan Isa	NUnet Chairman
Nigeria	University of Port Harcourt	Awatua-Efebo Kehinde	Director
Nigeria	University of Jos	L.S.O Liverpool	University ICT Co-ordinator and Prof of Mathematics
Nigeria	Rivers State University of Science and Technology	Prof J.G Chinwah	Director Computer Centre
Rwanda	National University of Rwanda	Flory Rukokori	Network administrator
Rwanda	Kigali Independent University	Okoko Osambo	Webmaster and IT Lecturer
Rwanda	Kigali Institute of Science and Technology	Leonard Mselle	Internal Network Unit Co-ordinator
Senegal	University of Saint Louis Gaston Berger	Gane Jamb Lo	Director Faculty of Sciences
Senegal	Universite Cheikh Anta Diop de Dakar	Boubakar Barry	Director Computer Centre
Senegal	University du Sahel	El Hadji Sall	President
Seychelles	Seychelles polytechnic	Ben Choppy	Director General (Education Technology) Ministry of Education

Sierra Leone	Njala University College -University of Sierra Leone	Adedayo Deen	College Librarian
Somaliland	University of Hargeisa	Abdusalam Omer	UNDP Somalia
South Africa	University of Port Elizabeth	Gavin Melville	Computer Operations Manager
Sudan	Sudan Universityof Science and Technology	Dr Yahia Abdalla Hamad	Dean- College of Computer Sciences and IT
Sudan	Open University of Sudan	Mohammed El Bashir	Head IT and Systems Dept
Swaziland	University of Swaziland	Thembela Thwala	ICT director
Tanzania	Bugando University College of Health Sciences	David Smith	Head of Computing Centre
Tanzania	Sokoine University of Agriculture	A Kazwala	Professor
Tanzania	University of Dar es Salaam	Professor Beda Mutagahywa	Director Computer Centre
Togo	Universite du Benin	Jacques Atsou	Lecturer
Togo	African School of Architecture and Town Planning (West and Central Africa)	Kouadio N'da N'guessan	General Manager
Tunisia	Univeriste Libre de Tunis	Mehdi Bouebdelli	IT
Uganda	Makerere University	Apolo Kyeyune	Maintenance Manager Directorate for ICT support
Uganda	Mbarara University of Science and Technology	Kelly Tumwine	Computer Technician
Zambia	University of Zambia	Dr Hudwell Mwacalimba	University Librarian
Zambia	Copperbelt University	Bonny Khunga	Computer

			Centre Manager
Zimbabwe	Africa University	Wisdom Machacha	Network Engineer
Zimbabwe	University of Zimbabwe	Ronnie Nyaruwabvu	IT Manager
Zimbabwe	Chinhoyi University of Technology	Peter Mudereri	Technical Support Officer

Appendix 2 National Research and Education Networks (NRENs) Summary Profiles

N.B. Source: Promoting African Research and Education Networking Survey Report 2004.

Table 7 NRENs: General Information

Network	Year Established	Primary motive for network	Network Type	Role of external Support	Specific Services provided
a) National Networks					
TENET South Africa	2000	Secure internet and information technology services for South African universities and Technikons. Reduce access costs	Consortium arrangement for 28 institutions	Andrew Mellon foundation funded the two-year gestation period. Adamator trust handled the funds.	1. Procurement of Internet access 2. Contract management and negotiation 3. Billing services 4.General Internet services 5. Technical support of service delivery 6. Managing Telkom (ISP) performance during installation
TENET Tanzania	Proposal stage	Improve connectivity	Consortium arrangement for bulk buying of bandwidth		
Kenet Kenya	1999	Establish sustainable communication and networking among educational institutions in Kenya.	Consortium arrangement soon to be PTN type	Initial set up covered USAID and EDDI. KENET also partners with private cos Adnet	1. Network Services (network management e.g. filtering, caching, access and security) 2.General Internet services (domain registration, web solutions, internet infrastructure, content integration)

Network	Year Established	Primary motive for network	Network Type	Role of external Support	Specific Services provided
				Communications Limited	3. Training 4. E-mail
NuNet Nigeria		1. More bandwidth 2. Reduce access costs	Consortium arrangement	Advisory and technical support as well some infrastructure (PCs) to the network from University of Iowa Advisory support from USA IT academics	1.Training services 2. Personnel for technology 3. Telephone lines for dial ups at the Universities. 4.Contract management and negotiations
Algeria National Research Network		Improve internet connectivity and Bandwidth capacity	Closed TPN type	EUMED provides external links	Basic IP services Billing
Morocco National Research Network		Reducing access costs	Consortium	Funded by the government	-Network services -Helpdesk -Multicast -IPv6 -Training -VOIP -Videoconferencing -Contract negotiation
Egyptian National Scientific and Technical Information Network (ENSTINET)	1986	Ensuring availability and utilization of global recorded knowledge for the socioeconomic development of a Egypt	An open-ended, geographically distributed network.	1. Georgia Institute of Technology, designer and implementer of the network, funded mainly by the Cairo Mission of U.SAID Scientific 2. L'Institutute National d'Information Scientific et Technique (INIST) 3. The British Council 4. IDRC Canada	-Internet services (dial up, e-mail, leased lines, web hosting, cybercafe) -Information services (database search, document delivery, library services) -Database development -Videoconferencing -Training (Microsoft windows, macromedia applications, Microsoft applications)
Tunisia National Research Network		Improve bandwidth to Universities	PTN Type	EUMED provides external link. Gvt funds the operations	IP services Billing

Appendix 3 VSAT Equipment in Surveyed Institutions

Table 8 Antenna Size

Antenna Size	Frequency	Valid Percent
Not Answered	71.00	85.54
1.2m	1.00	1.20
2-4 and 3.5m	1.00	1.20
2-5/2-8	1.00	1.20
2.4m	1.00	1.20
2.5m	1.00	1.20
3m	2.00	2.41
3.75m	1.00	1.20
3.7m	1.00	1.20
3.8m	3.00	3.61
Total (N)	83.00	100.00

Table 9 Bandwidth Frequency

Bandwidth Frequency	Frequency	Valid Percent
Not Answered	65.00	78.31
C band	15.00	18.07
Ku Band	3.00	3.61
Total	83.00	100.00

Table 10 Antenna Model

Antenna Model	Frequency	Valid Percent
Not Answered	71.00	85.54
Channel master	3.00	3.61
Com Strain	1.00	1.20
Prodelin	6.00	7.23
Shiron Satellite	1.00	1.20
STM Wireless	1.00	1.20
Total	83.00	100.00

Table 11 Satellite Used

Satellite Used	Frequency	Valid Percent
Not Answered	69.00	83.13
C-Band Panamsat 4 (PAS 4)	1.00	1.20
Earthplanet	1.00	1.20
Intel Sat 907 (Norway)	2.00	2.40
New Skies (NSS7)	5.00	6.00
Panamsat Pas IR	3.00	3.61
PANAMSAT SAT 4	1.00	1.20
Panasat/Upstar	1.00	1.20
Total	83.00	100.00

Table 12 Indoors Electronics Make and Model

Indoors Electronics Make and Model	Frequency	Valid Percent
Not Answered	72.00	86.75
5W BUC	1.00	1.20
COMTECH CDM600 Satellite Modem	1.00	1.20
DMD2401 LB/ST Modem	1.00	1.20
DVB Platform-IPSAT Terminal-Tx-Radyne Comstream- V+ Firewall and Cisco catalyst 4506	1.00	1.20
Intersky RG 2000	1.00	1.20
IPSat Radyne Comstream Modem Model 00 10 65 1201 E5	1.00	1.20
Janux	1.00	1.20
Modem- RADYNE COMSTREAM- DMD 2401- satellite modem- DVB- Ipricot Router (2600)	1.00	1.20
Radyne Comstream-DMD 2401	1.00	1.20
Radyne Modem-RA MOD-MD240VRS	1.00	1.20
SPC Electronics	1.00	1.20
Total	83.00	100.00

Table 13 Outdoors Electronics Make and Model

Outdoor Electronics Make and Model	Frequency	Valid Percent
Not Answered	73.00	87.95
2 Watts Spot Byte Earth Station Equipment	1.00	1.20
Anacom RC/PC C-Banc Transceiver-AN-RAD-RCS-417540 California Amp LNC55dB Gain	1.00	1.20
CODAN Down converter and SSPA (5 Watts). Down converter detail model:5700	1.00	1.20
COMTECH CSAT 5060-010	1.00	1.20
Hughes	1.00	1.20
IOW BUC	1.00	1.20
NJC 2 Watts	1.00	1.20
NJR BUC/4W RF	1.00	1.20
NJT5656F 5W	1.00	1.20
Prodelin series 1252	1.00	1.20
Total	83.00	100.00

Appendix 4 Estimated Total Bandwidth Requirements in Surveyed Tertiary Institutions

Table 14 Estimated Total Bandwidth Requirements in Surveyed Tertiary Institutions

Institutions	Country	User size	Total No. Networked Computers	Total Mbps Available	Mbps Required	Bandwidth Difference
Eduardo Mondhlane University	Mozambique	10000	4000	1.38	88.89	87.51
Makerere University	Uganda	41000	2600	3.76	57.78	54.02
University of Zambia	Zambia	7464	2000	0.64	44.44	43.80
University of Port Elizabeth	South Africa	8000	2000	1.24	44.44	43.20
Sudan Universityof Science and Technology	Sudan	43300	1600	0.51	35.56	35.05
University of Dar es Salaam	Tanzania	0	1500	3.00	33.33	30.33
University of Zimbabwe	Zimbabwe	10000	1500	3.02	33.33	30.31
University of Botswana	Botswana	15900	1500	5.00	33.33	28.33
University of Mauritius	Mauritius	6250	1200	4.13	26.67	22.54
Obafemi Awolowo University	Nigeria	30950	1000	0.77	22.22	21.45
Univeristy of Namibia	Namibia	9250	1000	1.02	22.22	21.20
Polytechnic of Namibia	Namibia	5420	1000	1.41	22.22	20.81
Universite Cheikh Anta Diop de Dakar	Senegal	37100	1000	4.00	22.22	18.22
University of Ibadan	Nigeria	27300	805	1.26	17.89	16.63
University of Saint Louis Gaston Berger	Senegal	3000	835	2.00	18.56	16.56
Universite du Benin	Togo	15250	700	0.26	15.56	15.30
Jomo Kenyatta University (JKUAT)	Kenya	3603	620	1.92	13.78	11.86
University of Swaziland	Swaziland	300	550	0.38	12.22	11.84
University of Ghana	Ghana	23700	600	1.51	13.33	11.82
University of Asmara	Eritrea		500	0.26	11.11	10.85
Egerton University	Kenya	9000	500	0.26	11.11	10.85
Gondar University	Ethiopia	12520	480	0.26	10.67	10.41
National University of Rwanda	Rwanda	7000	546	2.02	12.13	10.11
Ahmadu Bello University	Nigeria	29400	450	0.64	10.00	9.36
Moi University	Kenya	16376	400	0.26	8.89	8.63
Strathmore University	Kenya	5150	400	0.77	8.89	8.12
Sokoine University of Agriculture	Tanzania	2000	370	0.26	8.22	7.96
University of Education Winneba	Ghana	16000	400	1.06	8.89	7.83
University of Malawi College of Medicine	Malawi	253	350	0.38	7.78	7.40
Universite d Antananarivo	Madagascar	16700	350	0.51	7.78	7.27
Kigali Institute of Science and Technology	Rwanda	3160	400	2.02	8.89	6.87
Africa University	Zimbabwe	1570	300	0.26	6.67	6.41
Université de Yaoundé I	Cameroon	22889	300	0.26	6.67	6.41
University of Port Harcourt	Nigeria	15000	300	0.38	6.67	6.29
University of Jos	Nigeria	26150	300	0.77	6.67	5.90
Universtiy of Doaula	Cameroon	0	275	0.38	6.11	5.73
Copperbelt University	Zambia	5000	250	0.26	5.56	5.30

Universite du Dschang	Cameroon	11508	250	0.38	5.56	5.18
Universityof Nouakchott	Mauritania	15430	250	0.51	5.56	5.05
Botswana College of Agriculture	Botswana	950	238	0.26	5.29	5.03
Chancellor College	Malawi	2500	220	0.26	4.89	4.63
Kenyatta University	Kenya	13000	200	0.26	4.44	4.18
Universite de Cocody	Cote d'Ivoire	57000	200	0.26	4.44	4.18
Ouagaduogou University	Burkina Faso	14000	200	0.51	4.44	3.93
University of Technology Mauritius	Mauritius	1340	210	0.77	4.67	3.90
Bayero University	Nigeria	32224	178	0.19	3.96	3.77
Central University College	Ghana	2600	180	0.26	4.00	3.74
Universite de Kinshasa	DRC	0	200	0.77	4.44	3.67
Seychelles polytechnic	Seychelles	970	150	0.13	3.33	3.20
Chinhoyi University of Technology	Zimbabwe	1975	120	0.19	2.67	2.48
Kigali Independent University	Rwanda	6935	100	0.11	2.22	2.11
Mauritius Institute of Education	Mauritius	2500	100	0.11	2.22	2.11
Bunda College of Agriculture	Malawi	700	100	0.13	2.22	2.09
Rivers State University of Science and Technology	Nigeria	25400	100	0.13	2.22	2.09
Universite du Burundi	Burundi	8802	80	0.16	1.78	1.62
Universite Lumiere de Bujumbura	Burundi	1200	60	0.10	1.33	1.23
Mbarara University of Science and Technology	Uganda	1234	60	0.13	1.33	1.20
Cathilic University of Mozambique	Mozambique	0	60	0.13	1.33	1.20
University du Sahel	Senegal	500	100	1.02	2.22	1.20
Bugando University College of Health Sciences	Tanzania	59	59	0.16	1.31	1.15
Univeriste Libre de Tunis	Tunisia	1177	80	0.77	1.78	1.01
Ashesi University	Ghana	.	76	0.77	1.69	0.92
University of the Gambia	Gambia	2000	45	0.26	1.00	0.74
Open University of Sudan	Sudan	21100	50	0.38	1.11	0.73
University of Yaoundé II	Cameroon	315	40	0.38	0.89	0.51
Mzuzu University	Malawi	500	25	0.13	0.56	0.43
Institut de Mathematiques et de sciences Physiques (IMSP)	Benin	50	15	0.06	0.33	0.27
New School	Burundi	0	15	0.10	0.33	0.23
Njala University College - University of Sierra Leone	Sierra Leone	477	16	0.13	0.36	0.23
African School of Architecture and Town Planning (West and Central Africa)	Togo	215	15	0.11	0.33	0.22
University of Hargeisa	Somaliland	532	18	0.19	0.40	0.21
Universite Catholique de Bukavu	DRC	1276	25	0.38	0.56	0.18
Universite de Bangui	Central African Republic	6500	7	0.26	0.16	-0.10
University of Abuja	Nigeria	11010.		0.19.		
National University of Lesotho	Lesotho	5190.		0.26.		
Cuttington University College	Liberia	1020.		.	.	
Instituto de Ciencia eTechnologia	Guinea Bissau	372.		1.54.		

Universite d'Abomey Calavi	Benin	61000	.	2.06	.	
University for Development Studies	GHANA	3980	.	0.38	.	
Al Akhawayn University	Morocco	1500	.	10.00	.	
University d'Alger	Algeria	0	.	10.00	.	
Assiut University	Egypt	0	.	8.00	.	
Cairo University	Egypt	0	.	14.00	.	

Appendix 4.1 Estimated Total Bandwidth Increase if selected Universities, with CIR, were members of a Bandwidth Consortium providing BW (Bandwidth) at $2.5/kbps

Table 15 Estimated Total Bandwidth Increase if selected Universities were members of a Bandwidth Consortium providing BW at $2.5/kbps, For Institutions with Committed Information Rates

Country	Institution Name	Capacity of Connection: Uplink kbps	Capacity of Connection: Downlink kbps	Total Reported	$US Bandwidth Cost / Month	$/kbps/month	Total BW possible if using Consortium Rate (kbps)	% Increase in BW
Botswana	Botswana College of Agriculture	128	128	256	$ 4,000	15.63	1,600	525%
Botswana	University of Botswana	1024	4096	5120	$ 17,000	3.32	6,800	33%
Burkina Faso	Ouagaduogou University	256	256	512	$ 200	0.39	80	-84%
Burundi	New School	32	64	96	$ 250	2.60	100	4%
Ghana	University of Ghana	512	1024	1536	$ 8,448	5.50	3,379	120%
Kenya	Egerton University	128	128	256	$ 800	3.13	320	25%
Kenya	Jomo Kenyatta University (JKUAT)	960	960	1920	$ 3,000	1.56	1,200	-38%
Malawi	Bunda College of Agriculture	64	64	128	$ 550	4.30	220	72%
Mauritius	University of Technology Mauritius	256	512	768	$ 1,865	2.43	746	-3%
Mozambique	Eduardo Mondhlane University	384	1024	1408	$ 10,000	7.10	4,000	184%
Namibia	Univeristy of Namibia	512	512	1024	$ 5,000	4.88	2,000	95%
Nigeria	University of Jos	256	512	768	$ 5,000	6.51	2,000	160%
Nigeria	University of Ibadan	256	1024	1280	$ 4,800	3.75	1,920	50%

Rwanda	National University of Rwanda	512	1536	2048	$ 7,000	3.42	2,800	37%
Senegal	University of Saint Louis Gaston Berger	1024	1024	2048	$ 28,000	13.67	11,200	447%
Sudan	Open University of Sudan	128	256	384	$ 456	1.19	182	-53%
Sudan	Sudan Universityof Science and Technology	256	256	512	$ 1,000	1.95	400	-22%
Swaziland	University of Swaziland	192	192	384	$ 1,210	3.15	484	26%
Tanzania	University of Dar es Salaam	1024	2048	3072	$ 10,000	3.26	4,000	30%
Uganda	Makerere University	1256	2500	3756	$ 28,000	7.45	11,200	198%
	Average	458	906	1364	$ 6,829	$ 4.76	2732	100%

Appendix 4.2 Estimated Total Bandwidth Increase if selected Universities, without or not known CIR, were members of a Bandwidth Consortium providing BW (Bandwidth) at $2.5/kbps

Note: In many cases where % change is negative bandwidth is either subsidized or actual bandwidth is significantly less than reported.

Table 16 Estimated Total Bandwidth Increase if selected Universities were members of a Bandwidth Consortium providing BW at $2.5/kbps, For Institutions without or not known Committed Information Rates

Country	Institution Name	Capacity of Connection: Uplink kbps	Capacity of Connection: Downlink kbps	Total Reported	Adjusted Total Taking into account actual BW (kbps)	$US Bandwidth Cost / Month	$/kbps/mth (adj total)	Total BW possible if using Consortium Rate (kbps)	% Increase in BW
Benin	Institut de Mathematiques et de sciences Physiques (IMSP)	28	28	56	39	$ 1,500	$ 38.27	600	1001%
Burundi	Universite Lumiere de Bujumbura	32	64	96	67	$ 250	$ 3.72	100	34%
Burundi	Universite du Burundi	32	128	160	112	$ 900	$ 8.04	360	155%
Cameroon	Université de Yaoundé I	128	128	256	179	$ 9,300	$ 51.90	3,720	1383%
Cameroon	Universtiy of Doaula	128	256	384	269	$ 3,600	$ 13.39	1,440	305%
Cameroon	Universite du Dschang	128	256	384	269	$ 3,903	$ 14.52	1,561	337%
Cameroon	University of Yaoundé II	128	256	384	269	$ 9,300	$ 34.60	3,720	899%
Cote d'Ivoire	Universite de Cocody	128	128	256	179	$ 2,000	$ 11.16	800	243%
DRC	Universite Catholique de Bukavu	128	256	384	269	$ 270	$ 1.00	108	-42%
DRC	Universite de Kinshasa	256	512	768	538	$ 6,000	$ 11.16	2,400	243%
Ethiopia	Gondar University	128	128	256	179	$ 400	$ 2.23	160	-8%

Ghana	Ashesi University	256	512	768	538	$ 2,667	$ 4.96	1,067	69%
Ghana	Central University College	128	128	256	179	$ 500	$ 2.79	200	8%
Ghana	University of Education Winneba	64	1024	1088	762	$ 2,250	$ 2.95	900	13%
Guinea Bissau	Instituto de Ciencia eTechnologia	512	1024	1536	1075	$ 968	$ 0.90	387	-45%
Kenya	Kenyatta University	128	128	256	179	$ 909	$ 5.07	364	72%
Kenya	Strathmore University	256	512	768	538	$ 6,335	$ 11.78	2,534	260%
Kenya	Moi University	128	128	256	179	$ 1,200	$ 6.70	480	118%
Lesotho	National University of Lesotho	128	128	256	179	$ 3,141	$ 17.53	1,256	421%
Malawi	Chancellor College	128	128	256	179	$ 450	$ 2.51	180	0%
Malawi	Mzuzu University	64	64	128	90	$ 750	$ 8.37	300	164%
Malawi	University of Malawi College of Medicine	128	256	384	269	$ 2,000	$ 7.44	800	138%
Mauritania	Universityof Nouakchott	256	256	512	358	$ 640	$ 1.79	256	-20%
Mauritius	University of Mauritius	1152	3072	4224	2957	$ 3,500	$ 1.18	1,400	-37%
Namibia	Polytechnic of Namibia	704	704	1408	986	$ 6,500	$ 6.59	2,600	115%
Nigeria	University of Port Harcourt	128	256	384	269	$ 4,000	$ 14.88	1,600	347%
Nigeria	Ahmadu Bello University	128	512	640	448	$ 5,000	$ 11.16	2,000	243%
Nigeria	University of Abuja	64	128	192	134	$ 3,000	$ 22.32	1,200	555%
Nigeria	Bayero University	64	128	192	134	$ 1,920	$ 14.29	768	330%
Rwanda	Kigali Institute of Science and Technology	512	1536	2048	1434	$ 5,400	$ 3.77	2,160	35%

Senegal	University du Sahel	512	512	1024	717	$ 100	$ 0.14	40	-66%
Senegal	Universite Cheikh Anta Diop de Dakar	2048	2048	4096	2867	$ 2,000	$ 0.70	800	-50%
Seychelles	Seychelles polytechnic	64	64	128	90	$ 1,090	$ 12.17	436	271%
Sierra Leone	Njala University College - University of Sierra Leone	64	64	128	90	$ 250	$ 2.79	100	8%
Tanzania	Bugando University College of Health Sciences	32	128	160	112	$ 285	$ 2.54	114	1%
Tanzania	Sokoine University of Agriculture	128	128	256	179	$ 3,000	$ 16.74	1,200	399%
Togo	African School of Architecture and Town Planning (West and Central Africa)	56	56	112	78	$ 380	$ 4.85	152	66%
Togo	Universite du Benin	128	128	256	179	$ 840	$ 4.69	336	61%
Tunisia	Univeriste Libre de Tunis	256	512	768	538	$ 999	$ 1.86	400	-18%
Uganda	Mbarara University of Science and Technology	64	64	128	90	$ 351	$ 3.92	140	40%
Zambia	Copperbelt University	128	128	256	179	$ 1,200	$ 6.70	480	118%
Zambia	University of Zambia	128	512	640	448	$ 2,320	$ 5.18	928	75%
Zimbabwe	Chinhoyi University of Technology	64	128	192	134	$ 367	$ 2.73	147	6%
Zimbabwe	Africa University	128	128	256	179	$ 500	$ 2.79	200	8%
Zimbabwe	University of Zimbabwe	1536	1536	3072	2150	$ 3,400	$ 1.58	1,360	-26%
	Average	256	420	676	473	2347	$ 9.03	939	69%

Appendix 5 Survey Questionnaire

English Version of Survey Questionnaire

INTERNET CONNECTIVITY SURVEY FOR HIGHER EDUCATION INSTITUTIONS IN AFRICA

From: AVU Connectivity Assessment Project
Team Leaders: Mike Jensen and Roy Steiner
Tel: 263 4 777162
Fax: 263 4 777152
URL: www.atics.info

To: Selected University/higher-ed/research institutions

The African Virtual University (AVU) is supporting an assessment of Internet connectivity needs in Higher Education and research institutions across Africa. Internet connectivity has been recognised as a vital tool in these organizations, and there is now substantial interest in supporting improved bandwidth in the educational sector amongst international development agencies. These include the World Bank (which is also supporting the AVU), the US Foundations – Rockefeller, Ford, Carnegie, and MacArthur, the International Development Research Centre (IDRC) and the Open Society Institute (OSI), the United Nations University and the International Telecommunications Union.

Initial studies have already been carried out by these agencies, which indicate that if a large group of African universities and other higher education and research institutions can club together to buy satellite bandwidth in bulk, very considerable cost savings can be made. In addition direct connections between these organisations will much improve the potential for collaboration on research and in sharing educational resources. As a result it is expected that a major support programme to help establish an international backbone for African higher education and research institutions and national networks will shortly be established.

In preparation for these activities, the AVU is identifying higher education and research institutions in Africa and carrying out an initial survey of two of these organisations in each country to discover their needs and willingness to participate in a 'bandwidth purchasing club''. If your institution might be interested in participating in this network and project please fill out this questionnaire. Once the questionnaire is completed the AVU team will then assist your organisation to jointly apply for a special educational VSAT satellite license that will be needed to be able to participate in the network.

You can fill out the questionnaire in a variety of ways:
- You can also fill in the form attached to this email message and email it back to us
- You can fill in the attached document and fax it back to us at the above fax number.

We will keep your answers confidential. Please return this as soon as possible but no later than September 24th 2004.

Many Thanks
The African Tertiary Institutions Connectivity Survey Team

Section One: Organizational Details

Organisational Details	
Institution Name:	
City:	
Country:	
Website address:	
Number of full-time students	
Number of part-time students	
Number of faculties	
Number of teaching and research staff	
Is there a national research and education network (NREN) in the country?	**If yes, please give any relevant details and comments.**
Questionnaire Respondent/Satellite Bandwidth Project Contact Information	
Name:	
Position:	
Telephone Number:	
Email address:	

Section Two: Connectivity Details

1. Type of connectivity used to link the Institution to the Internet Service Provider (please check)	
Leased Line – Fibre	☐
Leased Line – Wire	☐
Leased Line – Radio link/Wireless	☐
Satellite/VSAT	☐
Dial Up	☐
2. Capacity of connection:	
Uplink (Kbps):	
Downlink (Kbps):	
3. Does the link have a committed Information rate (CIR) (Guaranteed bandwidth rate)?	
Yes	☐
No	☐
Question not answered/Not Sure	☐
3a: If there is a CIR what is the rate:	
(a) national	
(b) International	
4: Does the link have burstable capacity	
Yes	☐
No	☐
Question not answered/Not Sure	☐

4a: If yes what can it burst to over what period:	
5. Service Provider Name:	
5a. Service Provider URL:	
6. Service Provider Type	
Private ISP	☐
National Telecom	☐
VSAT company	☐
Other:	☐
7. Cost of Bandwidth per month (if dialup is being used, please include phone costs and Internet fees)	
Local currency	
Converted to $US	$
8. Length of bandwidth contract commitment (years)	
9. If Institution uses VSAT what type of licence is in place (if any)	
10. What is the current cost of a VSAT license in the country if any (in $US/year per installation)	
11. Have there been any attempts to get a VSAT licence? If yes please describe	
12. If VSAT is used, what is the current equipment in place? (size of dish, electronics type, cost etc)	
Size of Antenna/Dish – Diameter in Metres	
Bandwidth frequency (C Band, Ku Band, Ka band)	
Make and model number of antenna	
Make and model number of **Indoor** electronics	
Make and model number of **outdoor** electronics	
Satellite used (i.e Intelsat) – if known	
13: Are there any other additional Internet bandwidth links into the university (i.e to specific departments)	
If yes:	

Type		***Purpose***	***Bandwidth amount (uplink/downlink)***
a.			
b.			
c.			

14: How many computers do you have on campus	
a) Total number	

b) Total networked	
c) Total with Internet access	
15 How many servers do you have on campus? [excluding those for specific departments?]	
Number	
16. Type of on-campus network available (check all the apply and any description if needed)	
Copper (10BaseT or 100BaseT)	☐
Wireless	☐
Fibre	☐
Question not answered/Not Sure	☐
17. Are there any planned ICT initiatives (e.g. upgrade of connectivity, campus network, wireless systems, Enterprise Resource Planning applications). Please list:	
Initiative 1:	
Initiative 2:	
Initiative 3:	
Initiative 4:	
Initiative 5:	
18. Is there a written IT and/or E-learning strategy for the campus?	
Yes	☐
No	☐
Question not answered/ Not Sure	☐
18a. If yes can attach a copy or provide a URL link (optional)	
19 Are there any installed e-learning applications or projects (i.e Blackboard, Claroline, etc)	
Yes	☐
No	☐
19a. If yes, Please list	
E-learning project 1:	
E- learning project 2:	
E-learning project 3:	
20 Do you monitor your bandwidth usage?	
Yes	☐
No	☐
Sometimes	☐
20a. If yes	
Average/Maximum uplink usage in kps over past 3-6 months:	Ave Max
Average/Maximum downlink usage in kps over past 3-6 months:	Ave Max
% of time link 100% utilized:	
Ave Hours/month that link is down	
Ave Hours/month that link is down due to electricity problems	
21 Do you manage your bandwidth in any way (i.e content filtering, limiting department usage)	
Yes	☐

No	☐
Limited	☐
19a. Please list	
Bandwidth management software used	

22 Would your university be willing to join a bandwidth consortium if it reduced your costs?

Yes	☐
No	☐
Maybe	☐

Any Additional Comments:

French Version of Survey Questionnaire

INTERNET CONNECTIVITY SURVEY FOR HIGHER EDUCATION INSTITUTIONS IN AFRICA

Enquête sur la Connectivité de l'Internet pour les institutions d'enseignement supérieur en Afrique
Exp: Projet d'évaluation de la connectivité
Université Virtuelle Africaine (UVA)
Une projet de l'Institut de la Banque Mondiale
Mike Jensen et Roy Steiner
mike@atics.info, , roy@atics.info

Tel/Télécopie:
URL: www.atics.info / www.avu.org

To: Selected University/higher-ed/research institutions

- L'université virtuelle de l'Afrique (UVA) supporte une enquête des besoins relatifs à la connectivité de l'Internet à travers le continent africain dans les institutions d'enseignement supérieur de recherches. La connectivité Internet a été reconnue comme un outil vital dans ces organisations et nous constatons aujourd'hui un intérêt substantiel dans la soutenance d'une bande passante améliorée dans le secteur de l'éducation parmi les agences internationales du développement.

Parmi ces agences nous trouvons la Banque Mondiale (World Bank) qui supporte également ce projet avec l'UVA), ainsi que les fondations américaines Rockefeller, Ford, Carnégie et MacArthur, le Centre de Recherche pour le Développement International (CRDI) et l'Institut pour une Société Ouverte (OSI))

- Des études initiales ont déjà été effectuées par ces agences; ces études indiquent que si un grand groupe d'universités africaines et d'autres institutions d'enseignement supérieure ainsi que des instituts de recherches peuvent se réunir pour acquérir en gros de la passante sur des satellites, il est possible d'effectuer des économies considérables. En plus, des connections directes entre ces organisations va augmenter le potentiel collaboratif pour la recherche et pour partager les ressources éducatives. On espère que sous peu une telle collaboration assisterait un programme de support pour aider à la mise en place d'une épine dorsale pour l'enseignement supérieure en Afrique, interconnectant ainsi les institutions de recherche et les réseaux nationaux
-En préparation pour ces activités, l' UVA (AVU) est en train d'identifier les institutions éducatives et de recherches en Afrique; deux de ces organisations dans chaque pays feront l'objet d'une étude initiale pour évaluer leurs besoins et leurs dispositions pour participer dans la formation d'une société (club) d'achat de bande passante. Veuillez s.v.p. remplir ce questionnaire si votre institution pourrait avoir l'intention de participer dans ce projet et le réseau de communication envisagé. Une foi le questionnaire est rempli, l'équipe UVA (AVU) assisterait votre organisation à postuler pour une licence éducative spéciale satellite VSAT, nécessaire pour participer au réseau.

- Vous pouvez remplir le questionnaire de manières différentes:
- Vous pouvez remplir le formulaire attaché à ce message électronique et le renvoyer par courrier électronique.
- Vous pouvez remplir le document attaché et le renvoyer par télécopie (FAX) au numéro 263 4 777162 indiqué en haut.

Veuillez s.v.p. nous répondre aussitôt que possible, au plus tard le 30 juin 2004.

- Avec nos remerciements respectueux.

Section One: Details d'Organisation

Détails d'Organisation	
Détails d'Organisation	
Institution, Nom	
Ville	
Pays	
Adresse électronique	
Nombre d'étudiants - à plein temps	
Nombre d'étudiants - à temps partiel	
Membres de Faculté	
Est-ce qu'il y en a un réseau national de recherche et d'éducation (NREN) dans votre pays?	Si oui, donnez des détails appropriés et vos commentaires
Si oui, donnez des détails appropriés et vos commentaires	
Nom	
Position	
Numéro de téléphone	
Adresse électronique	

Deuxième Section: Détails de connectivité

1. Genre de connectivite utilisé pour lier l'institution à son fournisseur d'accès et de services internet.	
Ligne louée - fibre optique	
Ligne louée - fil electrique	
Ligne loue - liaison par radio/sans fil	
Satellite/VSAT	
Téléphone (dial-up)	
2. Capacité de connection:	
Donnees sortantes (Kbps)-	
Donees entrantes (Kbps)-	
3. Est-ce-que le lien possède un débit minimal garanti? (CIR)	
Oui	
Non	
Pas de réponse à la question, incertain	
3a: Si un débit garanti (CIR) existe, quel est le tarif applicable:	
(a) national	
(b) International	
4. Est-ce-quele lien support une augmentation brusque de la bande passante?	
Oui	

Non	
Pas de réponse à la question, incertain	
4a: Si Oui, quelle est le debit et sa duree	
5. Nom du Fournisseur d'accès et de services (et url)	
5a. Fournisseur d'accès et de services URL:	
6. Genre de fournisseur d'accès et de Internet:	
FAI privé	
Opérateur Télécoms national	
VSAT	
Autre	
7Tarif mensuel pour ~~nde~~ la bande passante (si téléphonique, indiquez frais de téléphone et de l'Internet):	
Monnaie locale	
Convertie en US $	$
8. Durée du contrat de service	
9. Si VSAT, est-ce que l'institution possède une licence VSAT la bande passante?	
10. Le type et le tarif pour licence applicable (en US $ par année))	
11. Y a-t-il eu des tentatives d'obtenir un permis de VSAT? Si oui, décrivez	
12. Si vous utilisez VSAT quel est l'équipement en place? (diamètre de la parabole de réception, type d'équipement électronique~~,~~ frais, etc)	
Taille d'antenne – Diamètre en Metres	
Fréquence (Bande C, Bande Ku, bande Ka)	
Type d'antenne	
Type de l'électronique d'**intérieur**	
Type de l'électronique d'**extérieur**	
Satellite (Intelsat, Panamsat/NSS etc)	
13: Est-ce qu'il y a d'autres liaisons avec de la bande passante Internet à l'université (c'est à dire avec des départements spécifiques).	
Si Oui	

Genre		***But envisagé***	***Montant Largeur de Bande***
a.			
b.			
c.			

14: Ordinateurs installés sur le campus de l'université	
a) Nombre total	
b) Nombre lie en réseau	
c) Total avec acces à l'Internet	

15 Combien de serveurs sont installés sur le campus de l'université (en dehors de ceux installés au sein des départements spécifiques)	
Nombre:	
16. Genre de réseau local à disposition (LAN) sur ce campus	
Cuivre (1oBaseT ou 100BaseT) Sans fil	
Fibre ~~de~~ optique	
Hybride/~~Mélange~~	
Pas de réponse/incertain	
17. Est-ce-que vous envisagez des initiatives TIC (c'est--à-dire amélioration de la connectivité, du réseau local, des systèmes sans fil, planification de ressources d'entreprise et applications	
Initiative 1:	
Initiative 2:	
Initiative 3:	
Initiative 4:	
Initiative 5:	
18. Est-ce-que vous possédez une stratégie écrite IT et/ou une stratégie pour l'enseignement par moyens électroniques?	
Oui	
Non	
Pas de réponse a la question/incertain	
18a. Si oui - vous pouvez attacher une copie (en option)	
19 Est-ce qu'il y en a des applications ou projets courants qui utilisent l'enseignement par moyens électroniques?	
Oui	
Non	
19a. Si Oui, veuillez les indiquer ci dessous E-projet	
E-projet d'enseignement 1:	
E-projet d'enseignement 2:	
E-project d'ensignement 3	
20 Est-ce-que vous surveillez votre usage de bande passante?	
Oui	
Non	
Quelques fois	
20a. Si Oui	
Usage moyen en kps sur 3-6 mois(uplink,downlink	~~Ave~~ Moy Max
Average/Maximum downlink usage in kps over past 3-6 months:	~~Ave~~ Moy Max

% du temps de connexion utilisé:	
Heures moyennes par mois hors connnexion	
Heures moyennes par mois avec le lien hors de fonction par raison d'un problème électrique	
21 Est-ce que vous contrôlez votre bande passante d'une manière ou d'autre?(filtrage du contenu, limitation de l'usage par département, etc.)	
Oui	
Non	
Limité	
21. Enumérez s.v.p	
Logiciel de ~~n~~ contrôle de la bande passante	
22 Est-ce que votre université serait disposée ~~de~~ à rejoindre un consortium "bande passante" si ceci pouvait réduire vos frais de fonctionnement?	
Oui Non Peut-être	
Vos commentaires supplémentaires:	

Portuguese Version of Survey Questionnaire

INQUÉRITO SOBRE
POSSIBILIDADES DE LIGAÇÃO À INTERNET
DE INSTITUIÇÕES DE ENSINO SUPERIOR EM ÁFRICA

De: Inquérito sobre Possibilidades de Ligação da African Virtual University (AVU)[2]
Projecto apoiado pelo World Bank Institute[3]
Mike Jensen e Roy Steiner
roy@atics.info, roy@cyberplexafrica.com
Tel: 263 4 777162
Fax: 263 4 777152
URL: www.atics.info www.avu.org

Para: Universidade/Instituição de ensino superior/Centro de pesquisa seleccionado/a

A African Virtual University (AVU) está a apoiar uma avaliação das necessidades de ligação à Internet em instituições de ensino superior e centros de pesquisa de África com a assistência do World Bank Institute. Sabe-se que a ligação à Internet é um instrumento fundamental nestas organizações, havendo agora, entre agências internacionais como o Banco Mundial, as fundações americanas Rockfeller, Ford, Carnegie, e MacArthur, o Centro de Pesquisa para o Desenvolvimento Internacional (IDRC), o Open Society Institute (OSI) e outras agências de desenvolvimento, grande interesse em apoiar uma melhor banda larga no sector da educação.

Algumas destas agências realizaram já estudos preliminares que indicaram que se um grupo de instituições de ensino superior e centros de pesquisa se puder reunir para comprar banda larga por satélite em quantidade, poder-se-á fazer uma considerável economia de custos.

Além disso, ligações directas entre estas instituições melhorarão em muito as possibilidades de colaboração na pesquisa e utilização conjunta de recursos educacionais. Espera-se então que um grande programa de apoio ajude a estabelecer uma espinha dorsal internacional para instituições de ensino superior e centros de pesquisa, e que sejam em breve criadas redes nacionais.

Na preparação destas actividades, a AVU está a identificar instituições de ensino superior e centros de pesquisa em cada país em África para determinar as suas necessidades de conectividade e o seu desejo de participar numa "associação para compra de banda larga". Caso a sua instituição esteja interessada em participar nessa rede e nesse projecto, preencha por favor o questionário que se segue. Estando completo o questionário, a equipa da AVU criará uma base de dados on-line com os resultados no sítio atics.info da Web e ajudará a sua organização a candidatar-se com o grupo a uma licença especial satélite VSAT educacional, necessária para poder participar na rede.

Pode preencher o questionário de diversas formas:

- Pode preencher também o formulário anexo a esta mensagem e-mail e devolvê-lo também por e-mail.
- Pode preencher o documento anexo e devolvê-lo por fax para o número acima indicado.

Responda o mais depressa possível, por favor, até ao dia 24 septmber 2004
Muito obrigado.

[2] Universidade Virtual Africana
[3] Instituto do Banco Mundial

Equipa do Inquérito sobre Possibilidades de Ligação de Instituições Terciárias em África

Secção Um: Informações Detalhadas sobre a Instituição

Dados da Instituição	
Nome da Instituição:	
Cidade:	
País:	
Endereço do Website:	
Número de estudantes a tempo inteiro	
Número de estudantes a tempo parcial	
Número de faculdades	
Número de professores e investigadores	
Há ou está prevista no país alguma rede nacional de pesquisa e educação (NREN) ?	**Em caso de resposta afirmativa, apresente detalhes ou comentários que considere relevantes.**
Pessoa que responde ao questionário/Informação de contacto para o Projecto de Banda Larga por Satélite	
Nome:	
Cargo:	
Número de telefone:	
Endereço de e-mail:	

Secção Dois: Informações Detalhadas sobre a Conectividade

1. Tipo de conectividade utilizada para a ligação entre a instituição e o Provedor de Serviços de Internet (Marque com x por favor)	
Linha Alugada – Fibra	
Linha Alugada – Fio	
Linha Alugada – Ligação Rádio/Sem Fio	
Satélite/VSAT	
Ligação Telefónica	
2. Capacidade da Conexão:	
Uplink (Kbps):	
Downlink (Kbps):	
3. A ligação tem alguma velocidade de transmissão de informação garantida (CIR)?	
Sim	
Não	

Pergunta não respondida/Não sei bem	
3a: Se há uma CIR, qual é a velocidade:	
(a) Nacional	
(b) Internacional	
4: A ligação tem capacidade de expansão?	
Sim	
Não	
Pergunta não respondida/Não sei bem	
4a: Em caso de resposta afirmativa, o que pode a ligação expandir e durante que período?	
5. Nome do Provedor de Serviços:	
5a. Provedor de Serviços URL:	
6. Tipo de Provedor de Serviços	
Provedor de serviços de Internet privado	
Empresa nacional de telecomunicações	
Empresa de VSAT	
Outro:	
7. Custo mensal de banda larga (caso se use ligação telefónica, incluir custos de telefone e taxas de Internet)	
Moeda local	
Convertida em $US	$
8. Largura de banda garantida por contrato (anos)	
9. Se a instituição usa VSAT, que tipo de licença possui (se for o caso)?	
10. Quanto custa actualmente uma licença de VSAT no país, se for o caso (em $US/ano por instalação)	
11. Tentou alguma vez obter uma licença de VSAT? Em caso de resposta afirmativa, especifique.	
12. Se usa VSAT, que equipamento está agora instalado? (tamanho do disco, tipo electrónico, custo, etc.)	
Tamanho da Antena/Disco – Diâmetro em Metros	
Frequência da largura de banda (Banda C, Banda Ku, Banda Ka)	
Número de fabrico e de modelo da antena	
Número de fabrico e de modelo do **equipamento electrónico interior**	
Número de fabrico e de modelo do	

equipamento electrónico exterior	
Satélite utilizado (i.e Intelsat) – Se souber qual é	

13: Existem na universidade mais ligações de banda larga à Internet (i.e. para departamentos específicos)?

Em caso de resposta afirmativa:

	Tipo	***Finalidade***	***Largura de banda (uplink/downlink)***
a.			
b.			
c.			

14: Quantas têm no *campus*

a) Número total	
b) Total em rede	
c) Total com acesso à Internet	

15 Quantos servidores têm no *campus*? [excluindo os servidores para departamentos específicos?]	
Número	

16. Tipo de rede disponível no *campus* (Marque com x e qualquer descrição necessária)

Cobre (10BaseT ou 100BaseT)	
Sem fio	
Fibra	
Pergunta não respondida/Não sei bem	

17. Há alguma iniciativa de Tecnologia de Informação e Comunicação planeada (por exemplo, melhoramento de conectividade, rede no *campus*, sistemas sem fio, aplicações de gestão global de empresas (ERP). Enumere, por favor:

Iniciativa 1:	
Iniciativa 2:	
Iniciativa 3:	
Iniciativa 4:	
Iniciativa 5:	

18. Há alguma estratégia de IT e/ou e-learning para o *campus*?

Sim	
Não	
Pergunta não respondida/ Não sei bem	
18a. Em caso de resposta afirmativa, pode anexar uma cópia ou indicar uma ligação URL (opcional).	

19 Há alguma aplicação ou algum projecto de e-learning instalado (i.e. Blackboard, Claroline, etc.)?

Sim	
Não	
19a. Em caso de resposta	

afirmativa, enumere		
Projecto e-learning 1:		
Projecto e-learning 2:		
Projecto e-learning 3:		
20 Monitoriza o seu uso de largura de banda?		
Sim		
Não		
Às vezes		
20a. Em caso de resposta afirmativa		
Uso médio/máximo de uplink em kps nos últimos 3-6 meses:	Médio	Max
Uso médio/máximo de downlink em kps nos últimos 3-6 meses:	Médio	Max
% de tempo de ligação utilizado a 100%:		
Média de horas/mês em que a ligação está em baixo		
Média de horas/mês em que a ligação está em baixo por problemas de energia		
21 Gere de alguma forma a sua largura de banda (i.e filtrando conteúdos, limitando o uso dos departamentos)		
Sim		
Não		
Limitado		
19a. Enumere, por favor		
Software de gestão de largura de banda utilizado		
22 A sua universidade gostaria de aderir a um consórcio de banda larga se reduzisse os seus custos?		
Sim Não Talvez		
Outros comentários:		

Appendix 6 References

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About the Authors

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Roy Steiner is the CEO of Cyberplex Africa, a regional web solution and knowledge management company with offices in Gaborone, Harare and Pretoria. His undergraduate education was completed at the Massachusetts Institute of Technology and Harvard University after which he went to Cornell University for a Ph.D in engineering. Dr Steiner worked at the Rockefeller Foundation in New York, McKinsey &Company in Toronto and helped found two Internet companies, Africa Online, which is now the most widespread Internet Service Provider in Africa and Cyberplex Africa. He has a long standing interest in African Universities and has played critical roles in the development of TEEAL – The Essential Electronic Agricultural Library among other projects.

Nyasha Tirivayi
Nyasha Tirivayi completed her M.Sc. in Agricultural Economics at the University of Zimbabwe. She currently works as an evaluation and knowledge management consultant with Cyberplex Africa. Her research interests include ICT for development, environmental economics and management gender economics and rural development. She intends to return to graduate school in pursuit of a Ph.D in about a year or two.

Mike Jensen
Mike Jensen is an independent consultant with experience in more than 30 countries in Africa assisting in the establishment of information and communications systems over the last 15 years. He subsequently returned to South Africa to work as a journalist on the national Rand Daily Mail newspaper in Johannesburg in 1983. When the paper closed he moved back to Canada and in 1986 he co-founded the country's national Internet service provider for NGOs, called coincidentally, The Web. After helping to set up a similar ISP in Australia in 1989, he returned to South Africa where he works with international development agencies, the private sector, NGOs and governments assisting them in the formulation, management and evaluation of their Internet projects and Telecom projects, focusing on public access, wireless technologies, VSAT and IT infrastructure. Jensen is a trustee of the African IT Education Trust, a board member of the South African Internet service provider for NGOs - SangoNet - and was a member of the African Conference of Ministers' High Level Working Group which developed the African Information Society Initiative (AISI) in 1996

Karanja Gakio
Karanja Gakio is a highly respected Internet specialist in Africa. He has developed, and led teams developing Internet technology, services and applications professionally for over 10 years. As the original founder of Africa Online and its technical director he was instrumental in establishing Internet infrastructure in six African countries. Most recently he was director of international engineering for iBasis in Boston, the largest Internet telephony company in the world. In this position, he led engineering and deployment of the network, growing coverage from 2 to over 60 countries and was instrumental in successful project management throughout the organization. Karanja is currently COO of Cyberplex Africa based in Botswana.