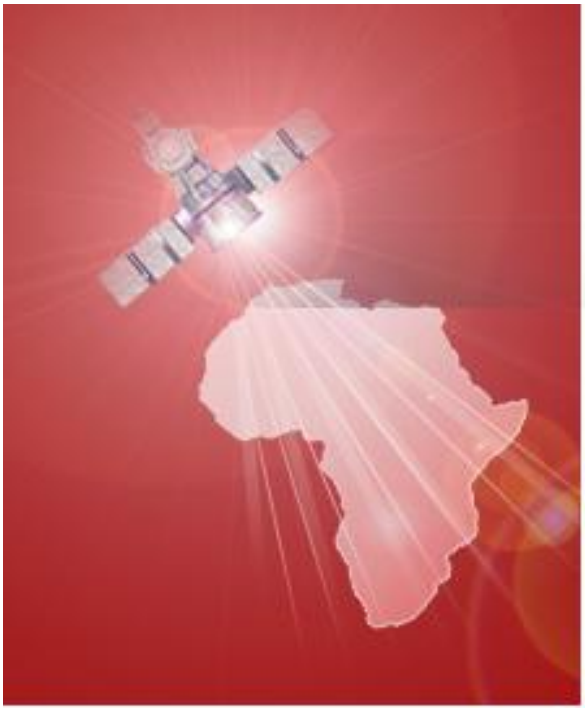
AFRICAN TERTIARY INSTITUTIONS CONNECTIVITY SURVEY (ATICS)

2006 REPORT



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CRDI Centre de recherches pour le développement international
Canada

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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 via high speed undersea fibre networks to the European academic and research network - GEANT. 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.

Building on the initial African Tertiary Institutions Connectivity survey carried out in 2004, this follow-up study collected information from 54 institutions, representing 27 countries in Africa (full results will be available at ww.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 networks which do exist are not independently owned or managed. As a result, 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[1] with satellite (VSAT) coming in second place. In particular 69% (64% in 2004) use terrestrial leased lines (wire, fibre or radio link) for connections to their ISPs, while 25% (29% in 2004) use VSAT. Unfortunately, over 6% of institutions still rely on dial up connections for their Internet connectivity.

Bandwidth availability

- The average bandwidth reported for the sample is 706/1254 Kbps (upstream/downstream) – roughly equivalent to a low-end broadband residential connection in North America or Europe[2]. Average bandwidth has increased by 31%/63% from the 537/769 kbps reported in 2004. There is a wide gap between the lowest bandwidth capacity of 7 /20 Kbps and the highest capacity of 8 /8 Mbps.
- Institutions reporting fibre connections tend to have the highest connectivity, with a mean of 1582/2700 Kbps, while radio link connections have the lowest capacity of 300/362 Kbps.
- Underlining the pent up demand for bandwidth amongst most institutions (and potentially, the heightened need for better bandwidth management), Internet links are at 100% capacity over 67% of the time. This is extremely high, given that this is measured over 24 hours a day every day of the month.

Bandwidth costs

- The highest monthly bandwidth cost is US$28.61/kbps which is less than the US$36.33 reported in the 2004 ATICS study. The average monthly cost per Kbps is US$4.58, which is lower than the US$5.46 reported in 2004. While still very high these reductions in cost are encouraging and point to the increasingly competitive market for bandwidth in Africa.
- VSAT companies, followed by national telecom operators, are charging the highest prices, while donor initiatives and academic networks charge the least. This is understandable, given the fact that direct 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, monthly direct VSAT costs (at US$7.13/kbps) were found on average to be much more expensive than land-based connections (at

1 Although many of their upstream providers may in turn use a satellite to connect internationally.

2 20Mbps residential broadband connections are now available in Europe for less than $50/month.

US$4.30/kbps). One reason for this may be that although land-based connectivity in most countries in Africa ultimately comes in via VSAT, the land-based services are buying in relatively large volumes, and are therefore 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 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 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 for bandwidth (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, largely due to the presence of South Africa's more advanced academic network.
- Donor initiatives (e.g., UNDP, EU, Leland Initiative) and academic networks (e.g., TENET, KENET, EumedConnect) have the largest average bandwidth capacity). About 18 institutions from the survey (22%) are members of national research and education networks, while eight 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 (65% - barely changed from 66% in 2004) reported either that they did not have a Committed Information Rate specified in the contract with their provider 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 11% (down from 20% in 2004) of the respondents indicated they had VSAT licenses. Institutions have experienced a mixed response to their attempts to obtain a VSAT license. About 15% (similar to 2004's 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% (identical to the number in 2004) 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.

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 accessing 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 (46%) 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 42% indicate that they monitor their bandwidth, very few 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 are 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 50% do not have a written e-learning/IT strategy, 39% do have.
- Only 28% of the institutions surveyed are members of the 13 (an increase from the 6 identified in 2004) National Educational & Research Networks

that have been identified in Africa. 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.

An association of national research and education networks, the UbuntuNet Alliance (UA) was formed in August 2005 to ensure that researchers, tertiary educators and students have sufficient bandwidth to work effectively. Currently the Alliance comprises MAREN (Malawi), MoRENet (Mozambique), KENET (Kenya), RWEDnet (Rwanda), and TENET, South Africa. The Alliance is expected to expand rapidly over the next year as new national research and education networks are formed. The activities of the UA have so far been funded by the Canadian International Development Research Centre (IDRC), Open Society Institute (OSI) based in Budapest, Hungary, and and OSI Southern Africa (OSISA). In addition IDRC and SIDA have each pledged $1million to the UA for infrastructure building projects. More recently the Association of African Universities has begun to support a process for encouraging the establishment of NRENs and regional RENs.

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*: A 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*: Bandwidth without adequate network management is wasteful and reduces its value, and improved management 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) *Shared Network Management and Technical Capacity*: 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 800 journals from the 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	**Cooperation Latino-Americana de redes Avanzadas or Latin American Cooperation of Advanced Networks**
COMTEL	**A planned fibre backbone network, promoted by the Common Market 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 by 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 3,000 scientific journals.**
ICT	**Information and Communication Technologies**
IDRC	**International Development Research Centre**
ISDN	**Abbreviation of International 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.

1. Introduction

1.1 Study Objectives

For African higher education institutions to carry out meaningful research and fulfill their mandates as centres of excellence, they need ample and reliable Internet connections. The International Development Research Centre (IDRC) is supporting a follow-up assessment of Internet connectivity needs in higher education and research institutions across Africa, thus the title African Tertiary Institution Connectivity Survey (ATICS).

Internet connectivity has been recognised as a vital tool in these organizations, and there is now substantial interest amongst international development agencies in supporting improved bandwidth within the educational sector.

ATICS recognizes the influence of policies and regulations, regionally and nationally, on the bandwidth landscape in Africa. This report summarizes the results of a similar survey whose results were published in the ATICS 2004 Report. Several recommendations were made, including: the formation of bandwidth buying consortia, improved bandwidth management, centralised network management and technical capacity, and improved regulatory policies regarding educational bandwidth.

IDRC chose to support a second follow-up survey of Internet connectivity needs in African tertiary institutions, considering that there are likely to have been changes in the Internet connectivity needs since 2004 as well as the importance of updating information collected earlier for future referencing and policy making. Moreover, this update will provide critical information to interested development agencies who are also stakeholders in facilitating initiatives aimed at increasing connectivity in tertiary institutions.

The ATICS 2006 study identified higher education and research institutions in Africa and carried out an initial survey of 54 institutions in 27 countries to discover their internet connectivity and bandwidth utilization.

The following were the study's objectives with respect to African tertiary institutions:

- To assess the types of connectivity, bandwidth capacity and costs
- To assess the existing types of Internet service providers and their arrangements with tertiary institutions
- To assess VSAT use and types of VSAT licensing requirements for tertiary institutions
- To assess quantities and levels of computer infrastructure available within these institutions
- To assess bandwidth monitoring and management practices
- To assess planned ICT initiatives and the degree of e-learning achieved
- To determine the willingness of tertiary institutions to join bandwidth consortia

- To update information collected in 2004 for future referencing and policy making

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 specific individuals within identified tertiary institutions.

1.2.2 Sampling

A target of 100 universities in 50 countries was set for the study (an average of 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 help increase participation rates. Once a contact person was established for a university, the university/institution was included in the survey. A total of 54 tertiary institutions from 27 countries responded to the survey.

A full list of respondents is included as Appendix 1.

1.2.3 Methods of Data Collection

Survey Questionnaire

This was the primary tool used in data collection. A two-pronged approach of self-administration and phone interviews was used to maximize the completion of the questionnaire and increase 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 return the questionnaire via e-mail or by fax, after completing it. English was the primary language in which the survey was conducted, but to help overcome language barriers, French and Portuguese language versions were also made available. Nevertheless, there were notable communication challenges with some Arabic speakers in North Africa.

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. Several follow on phone calls were made to remind and encourage respondents to complete and return the surveys.

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 sometimes less enthusiastic about responding
- In a number of institutions surveyed, the identified staff member had changed jobs since 2004 and either was no longer the right person to talk to, or had left the institution altogether, requiring the identification anew of the most appropriate person.
- Sometimes the questionnaires were not completed as long as the right person was absent (in some cases this was the Information Technology Manager or related personnel). Often the contacts used for the survey were not appropriate personnel and the recipients needed to forward the survey to the right person. University staff members are busy people and 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 may also have contributed to the survey collecting data from 54 tertiary institutions compared to the targeted 100. Nevertheless, the participation rate was satisfactory when compared to standard results.
- In some institutions the process of completing the questionnaire required a number of formal processes to be carried out, thus hampering the response rate and increasing the turnaround time.
- A substantial number of survey questionnaires were returned with missing or incomplete information. This may be attributed to the questionnaires being filled out by less knowledgeable people, but may also point to a need for clearer instructions and more straightforward questions. Bandwidth prices were amongst the more critical data that was often missing from the returned questionnaires.
- Some of the institutions which took part in the 2004 survey did not appear to attach as great importance to participation in the 2006 survey and did not return the questionnaires.

1.2.5 Data Entry and Analysis

The data from the questionnaires that were returned were assembled in a Microsoft Excel spreadsheet. After the data was cleaned and verified it was exported to SPSS (Statistical Package for Social Sciences) for detailed analysis.

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 widely used for graphical presentation
- Bar Graphs: These are also used widely in graphical presentation of variables.
- Cross Tabulations: These were carried out in presenting categorical data, e.g., CIRs 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	Variable	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	Type of Internet service providers	**Type of ISP freq** **Average length of bandwidth**

providers and their arrangements with African tertiary institutions	Bandwidth contracts CIR by ISP	**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

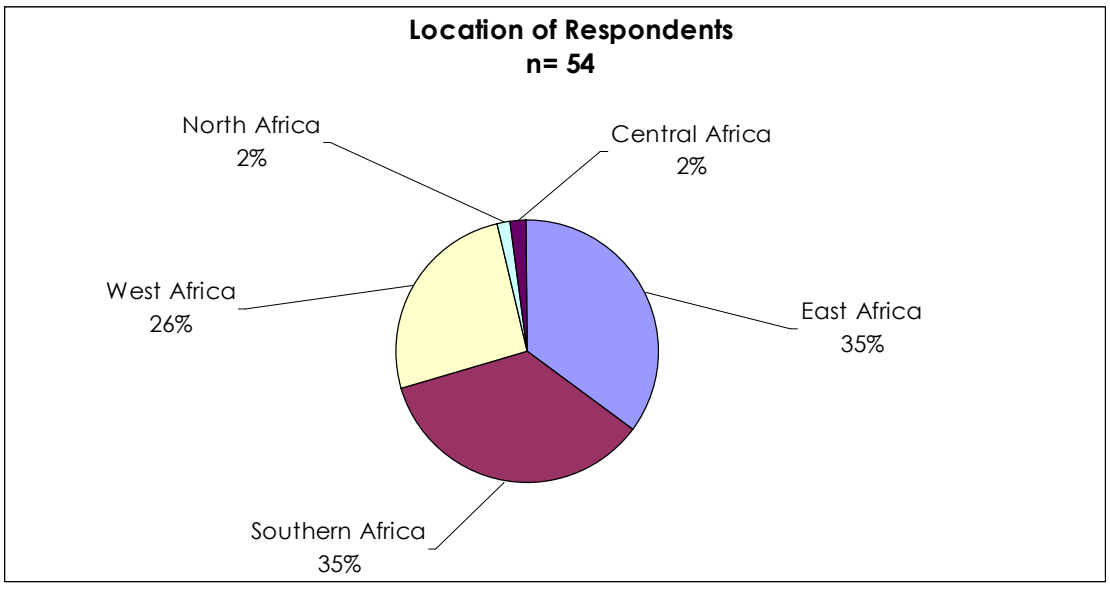
2. Connectivity in African Tertiary Institutions

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

2.1 Location of Respondents

Respondents were targeted from across Africa. This report represents an analysis of 54 respondents from 27 countries. The largest group of respondents came from Southern Africa (35%) and Eastern Africa (35%). North Africa and Central Africa had one respondent each. In comparison, participation in ATICS 2004 was led by West Africa (37%), Southern Africa (27%), and East Africa (19%). The following chart shows the distribution of the respondents in the five Africa regions.

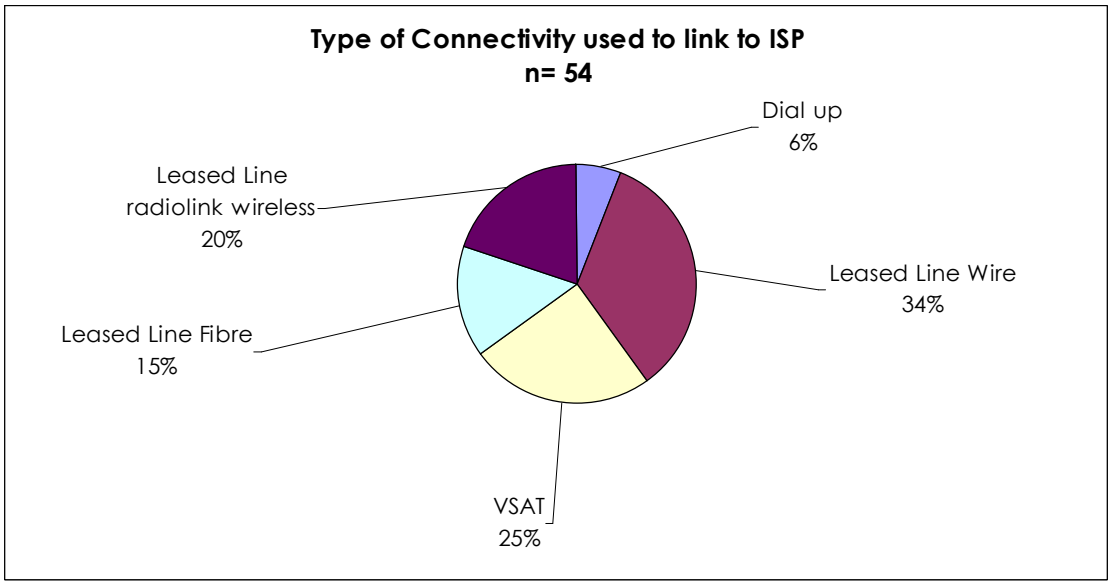
Chart 1 Location of Respondents



2.2 Type of Connectivity at African Tertiary Institutions

On the type of connectivity used by the institutions to link to the Internet Service Provider (ISP), the responses of the institutions were as depicted by the following pie chart:

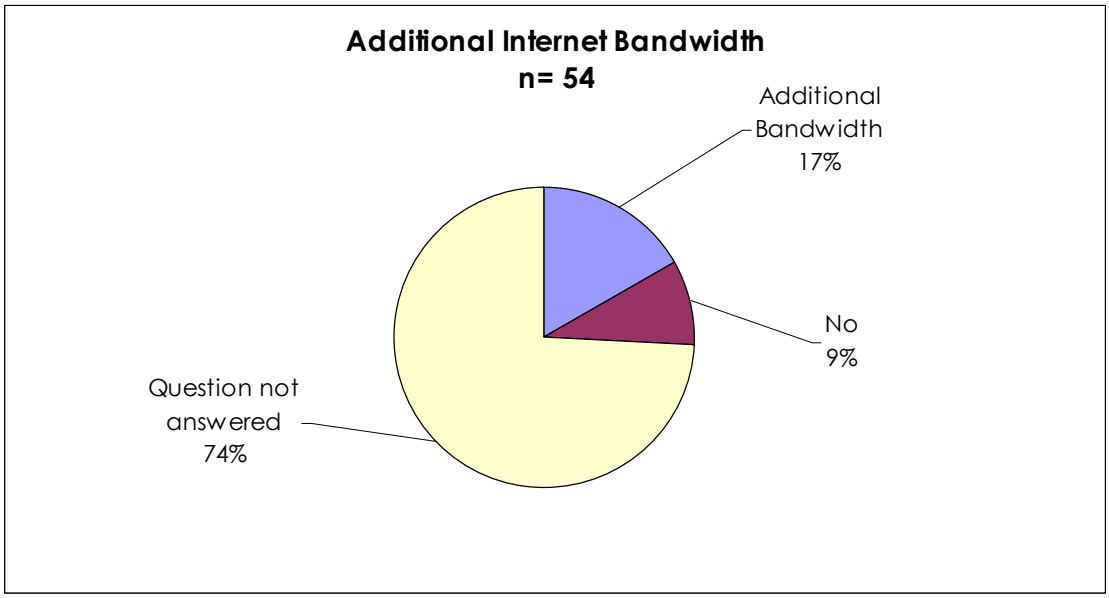
Chart 2 Type of connection used by institutions to link to ISPs



From the above chart it is evident that the majority of the sampled higher education institutions use terrestrial based leased lines for connectivity purposes with satellite (VSAT) coming in second place. In particular 69% (64% in 2004) use terrestrial leased lines (wire, fibre or radio link) for connections to their ISPs, while 25% (29% in 2004) use VSAT. On a downside note, 6% (7% in 2004) of the institutions still rely on dial-up connections.

Some higher education institutions have additional bandwidth links to enhance their internet connectivity. Nine of the 54 institutions (17%) have additional bandwidth links which they use for internet access, research and development, in case their main connection is down and also as back-up.

Chart 2.1 Additional Bandwidth

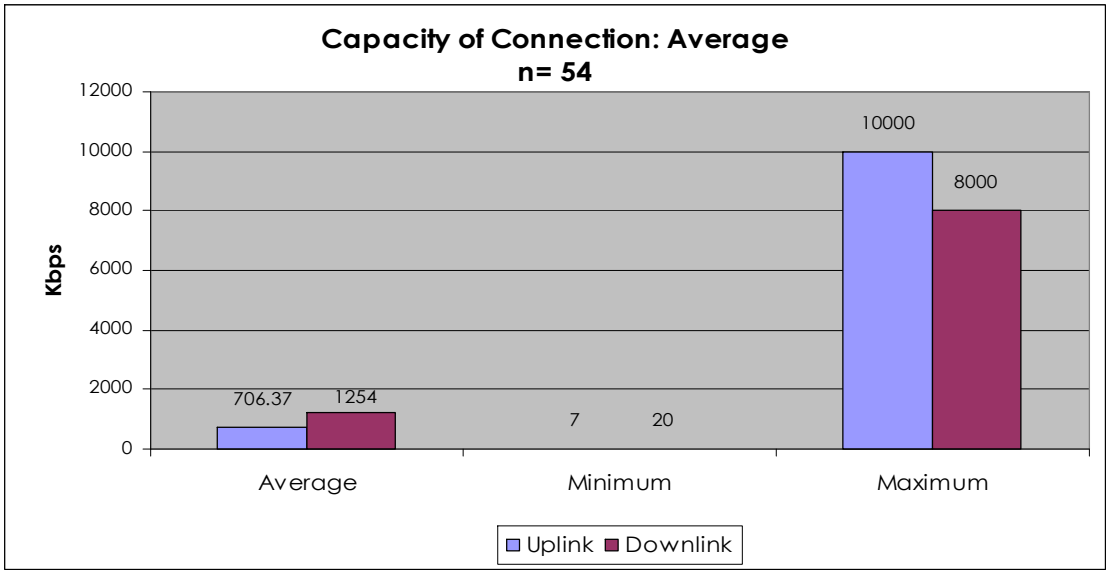


As shown in the chart above, the majority of respondents did not indicate whether they have additional Internet bandwidth sources or not. This could mean that they don't have other additional Internet bandwidth sources. The additional bandwidth sources included DSL Broadband, Leased line wire, dial-up connections and VSAT.

2.3 Capacity of Connection in African Tertiary Institutions

The participants of the survey were asked to indicate the capacity of their connections. The average, maximum and minimum capacities of the connection from the 54 institutions were as represented in Chart 3.

Chart 3 Capacity of Connection



The chart shows that the average bandwidth reported for the uplink and downlink is 706 and 1254 Kbps respectively. Highly notable is the wide gap between the lowest bandwidth capacity of 7/20 Kbps and the highest capacity of 10000/8000 Kbps. The maximum capacity of connection were recorded at Makerere University, Uganda (uplink) and Al Akhawayn University, Morocco (downlink), while the lowest uplink and downlink were from Mount Meru University in Tanzania

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		
Al Akhawayn University	Morocco	**16000**
Makerere University	Uganda	**15000**
Eduardo Mondlane University	Mozambique	**8500**
University of Botswana	Botswana	**7000**
University of Jos	Nigeria	**6000**
National University of Science and Technology	Zimbabwe	**5512**
Bayero University	Nigeria	**4548**
Botswana Institute of Administration and Commerce	Botswana	**4000**
University of Djibouti	Djibouti	**4000**
University du Sahel	Senegal	**4000**

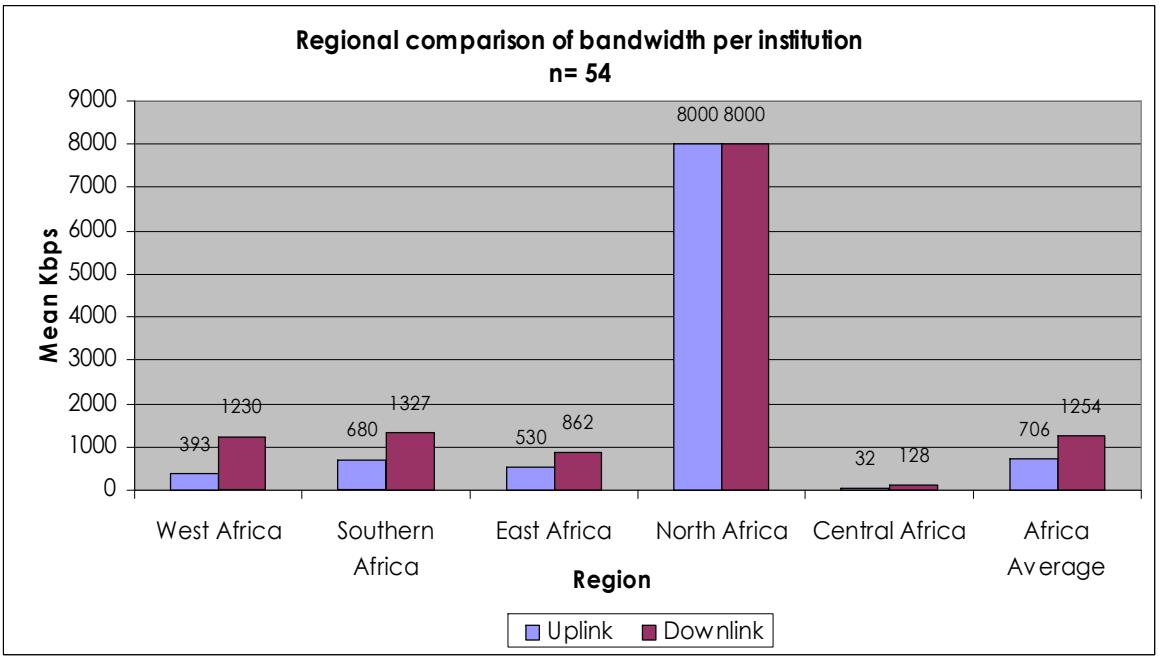
Chinhoyi University of Technology	Zimbabwe	**4000**
Institutions with Lowest Bandwidth Capacity: Bottom Ten		
Copperbelt University	Zambia	**192**
Malawi	Malawi	**192**
East Africa University	Somalia	**192**
Somali Institue of Management and Administration Devlopment	Somalia	**192**
Universite du Burundi	Burundi	**160**
Kamuzu School of Nursing	Malawi	**128**
Universite du Yaounde	Cameroon	**96**
Ecole Africaine des Metiers de l'Architecture et de l'Urbanisme(EAMAU)	Togo	**64**
Njala University	Sierra Leone	**50**
Mount Meru University	Tanzania	**27**

More Southern African institutions feature in the top ten institutions with the highest bandwidth capacity. A North African institution leads all the top ten institutions.

2.3.1 Regional Comparison of Bandwidth Capacity per Institution

When regional averages where 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 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.

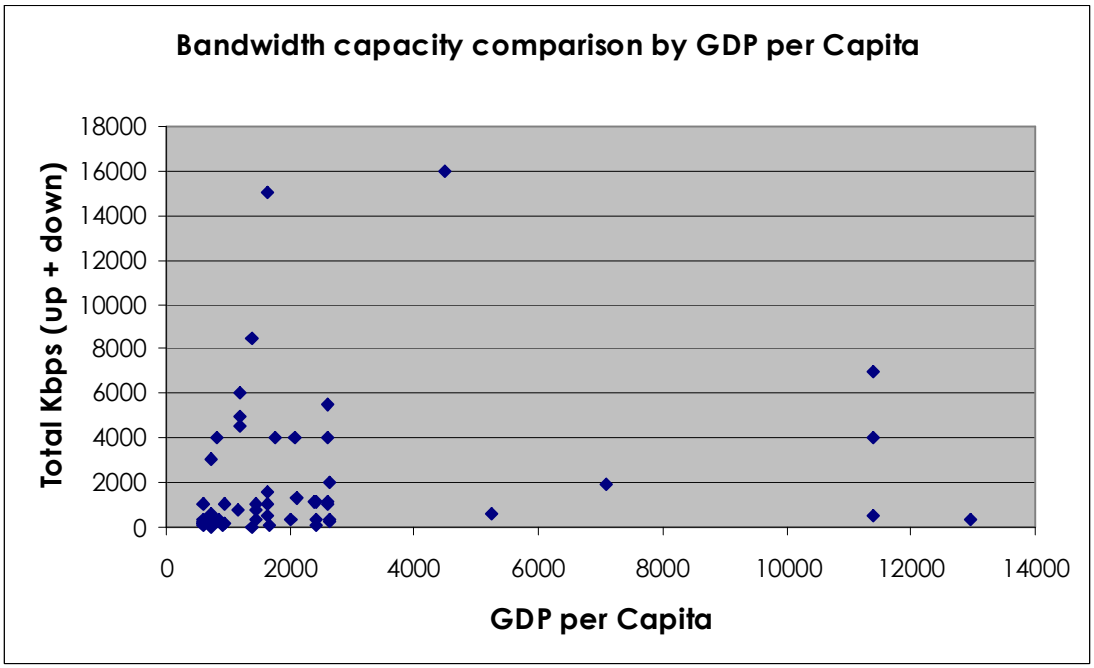
Chart 4 Regional Comparison of Bandwidth Capacity



As seen in the chart above, institutions in North Africa are ahead of those in the other regions in having the highest average bandwidth capacity of 8000 Kbps both uplink and downlink. They are followed by those in Southern Africa, which shows a significant lower average of 680/1327 Kbps.

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

Chart 5 Bandwidth capacities by GDP per Capita

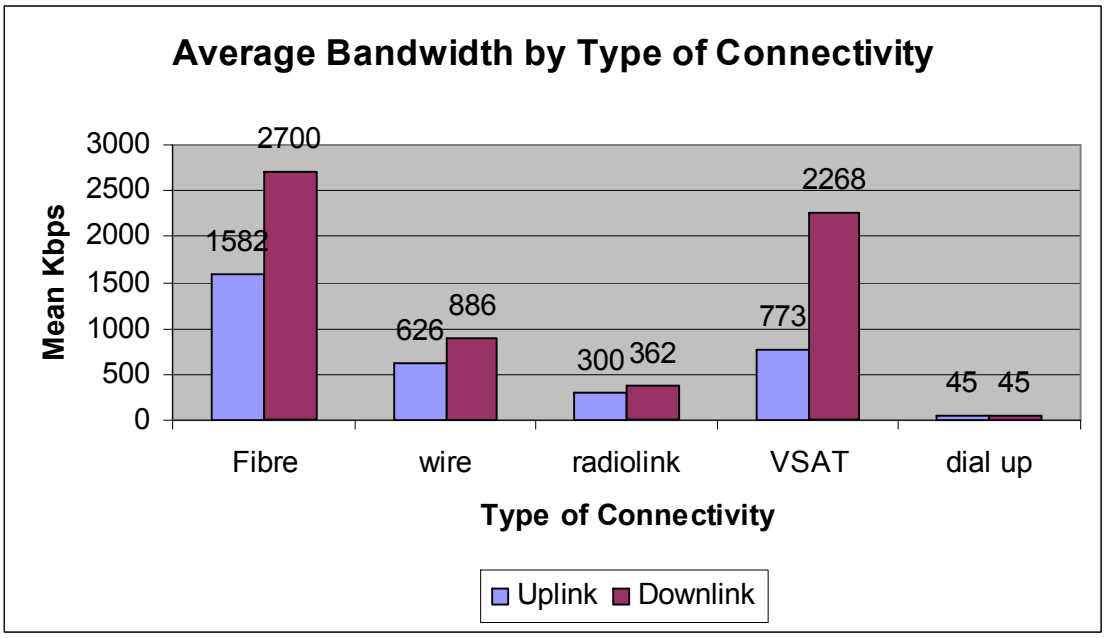


The chart above indicates that the majority of institutions in countries with lower GDP per capita – less than 4000USD – have lower bandwidth capacity, i.e., below 4000 Kbps. However, there are significant deviations. These are possibly caused by regulatory impacts on bandwidth availability, together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

2.3.3 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 1582/2700 Kbps (down from 2066/2178 kbps in 2004) ; while radio link connections have the lowest capacity of 300/362 Kbps (higher compared to 147/330 kbps in 2004). However, of the four institutions that use dial-up, three institutions either did not understand the question or do not know about speed of a dial-up connection as their answers were unrealistic (e.g. dial-up connection of 2000kbps), the calculation is therefore based on the one institution that provided a realistic answer. Chart 6 below presents the average bandwidth capacity by type of connectivity.

Chart 6 Average Bandwidth Capacities by Type of Connectivity

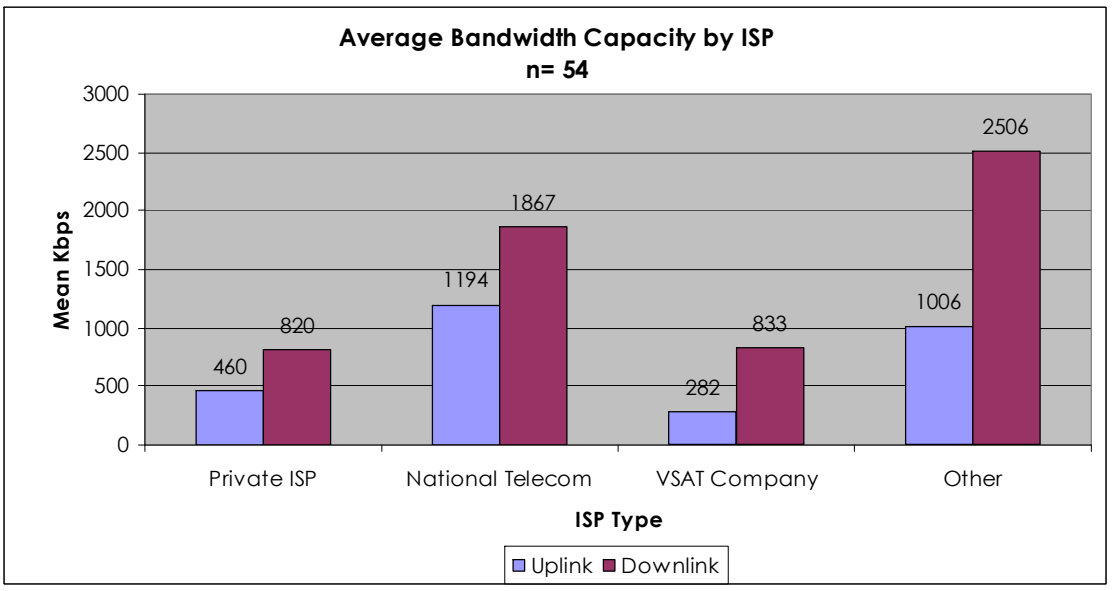


N.B Wire is any from of leased line that uses copper wire connectivity.

2.3.4 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



N.B Other represents donor initiatives and academic networks.

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 VSAT and private ISPs.

From the Chart, donor initiatives (e.g., UNDP, Leland Initiative) and academic and research networks (e.g., TENET, KENET, EU MedConnect – see below) have the largest average bandwidth capacity *(see Appendix 2 for summary profiles of national academic networks in Africa)*. About 15 institutions from the survey (28%) are members of national research and education networks.

The existing NRENs in Africa are: (see Appendix 2)

- *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
- *MAREN* is the Malawi NREN. It has two founder members: the University of Malawi and Mzuzu University. Two other institutions are in the process of joining: National College of Information Technology (NACIT), a tertiary institution; and the Department of Agricultural Research, a research institution. Currently, MAREN falls within the framework of MALICO, the Malawi Library and Information Consortium.
- *The Mozambique Research and Education Network, MoRENet,* is the planned nationwide data network that will interconnect Academic and

Research institutions, developing activities with non-profit purposes. The network, which is intended to be a framework for fast and efficient exchange of research data among its members, has as its main philosophy to take advantage and make use of the already deployed fiber infrastructure in the country. The long term goal of MoRENet is to instigate the growth of the infrastructure and stimulate research projects in the country.

- *Research and Education Network for Uganda (RENU)* is an umbrella organisation bringing together Universities and Research Organisations in Uganda. RENU is motived by the benefits and synergies that will arise out of working together to generate a human resource that will lift Uganda out of under-development; and conduct research and outreach activities that support national development initiatives.
- *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 Rwanda Education Network (RwEdNet)* is the recently formed education and research network for Rwanda.
- The Tanzania Education Network (TENET) whose primary function is to facilitate application of Information and Communication Technology (ICT) in knowledge creation, access and reduction of the cost of each institution acquiring separate band width.

- *Zimbabwe Academic and Research Network*, ZARNet is a non-profit making ISP, whose main goal is to promote Information and Communication Technology and to facilitate Internet and e-mail connectivity to the academic and research institutions, schools, non-governmental organisations (NGOs) and other disadvantaged communities throughout Zimbabwe. ZARNet has now expanded to provide its services to government ministries and institutions.

N.B Please refer to the recent IDRC study report (PAREN 2005) for additional information on academic and research networking in Africa.

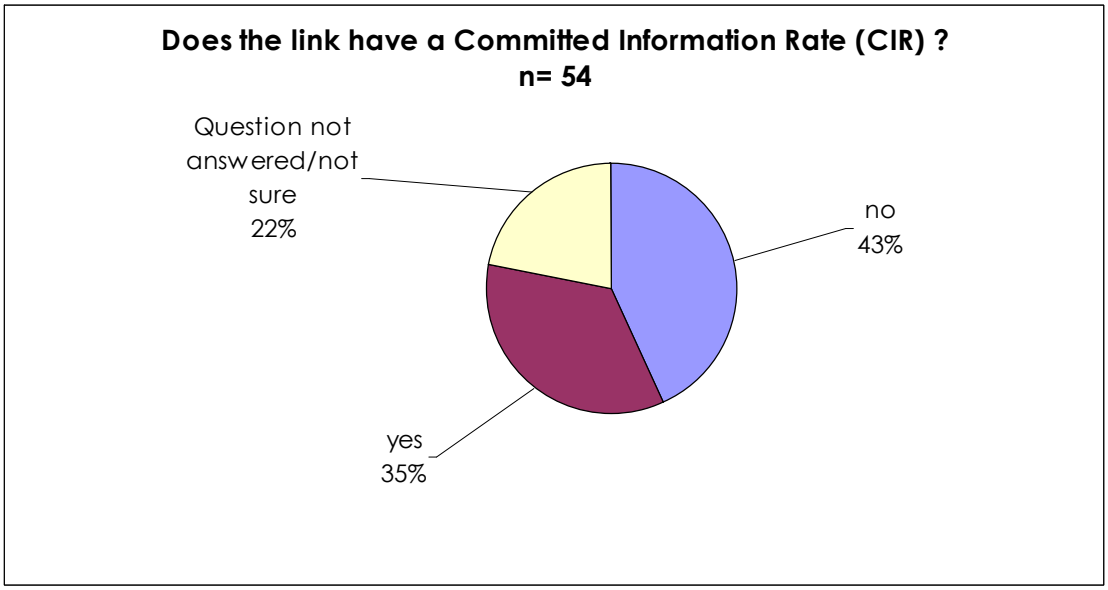
The Tertiary Education Network of South Africa (TENET) and the North African RENs connected via EU MedConnect obtain their bandwidth from international undersea fibre, which accounts for their larger bandwidth capacity. Donor initiatives such as the USAID Leland Initiative offer subsidized bandwidth through VSAT. All other institutions ultimately obtain 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.

An association of national research and education networks, the UbuntuNet Alliance (UA) was formed in August 2005 to ensure that researchers, tertiary educators and students have sufficient bandwidth to work effectively. Currently the Alliance comprises MAREN (Malawi), MoRENet (Mozambique), KENET (Kenya), RWEDnet (Rwanda), and TENET, South Africa. The Alliance is expected to expand rapidly over the next year as new national research and education networks are formed. The activities of the UA have so far been funded by the Canadian International Development Research Centre (IDRC), Open Society Institute (OSI) based in Budapest, Hungary, and and OSI Southern Africa (OSISA). In addition IDRC and SIDA have each pledged $1million to the UA for infrastructure building projects. More recently the Association of African Universities is supporting a process for encouraging the establishment of NRENs and regional RENs.

2.3.5 Institutions with Committed Information Rates

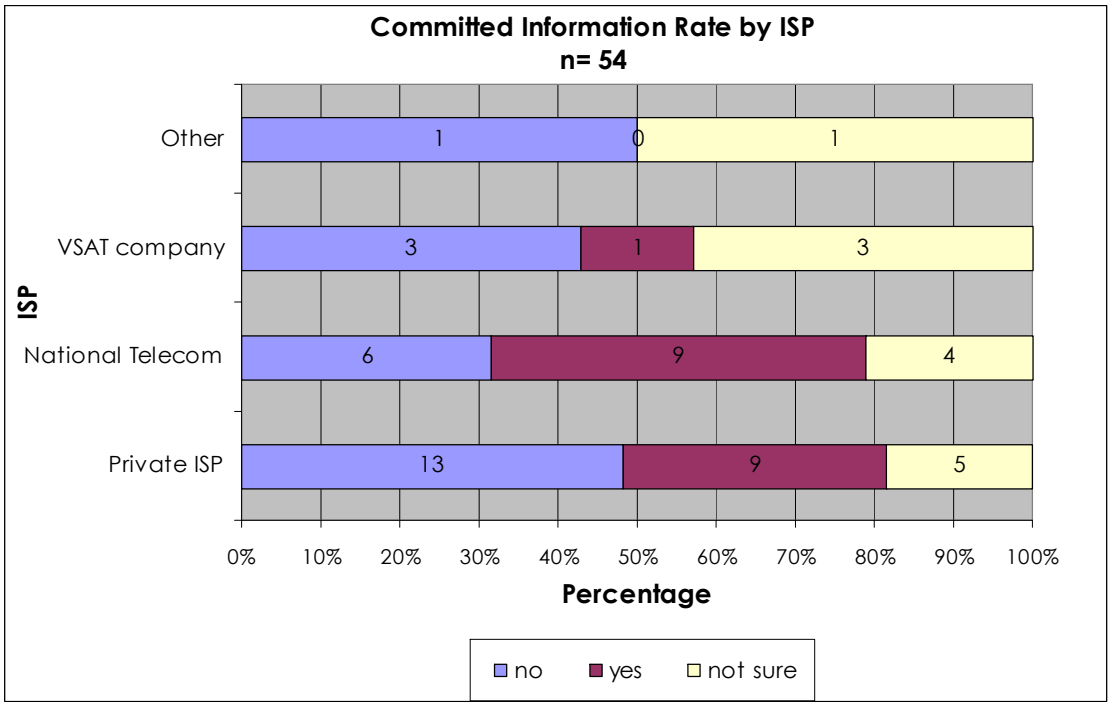
A committed information rate is one of the most critical characteristics to consider when purchasing bandwidth. It essentially indicates the capacity of bandwidth that the Internet service Provider will guarantee to deliver. Without a CIR, customers will be grouped with a pool of clients and there is 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.

Chart 8 Percentages of Respondents with a Committed Information Rate



The majority of the respondents (65%) 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, National Telecom and private ISPs were more likely to provide CIR than other Internet service providers (see Chart 8.1).

Chart 8.1 Committed Information Rate Provided by ISP

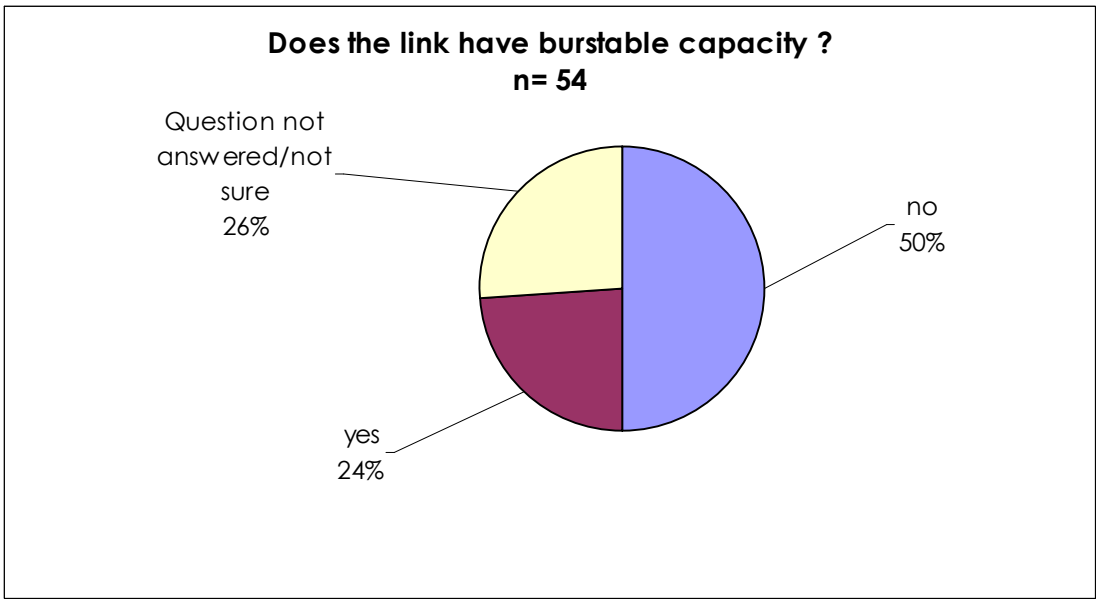


National Telecom and Private ISPs provide more CIR than VSAT and Other initiatives like donor initiatives and academic networks.

2.3.6 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 available for use by a single member when needed.

Chart 9 Percentage of Respondents with Burstable Capacity



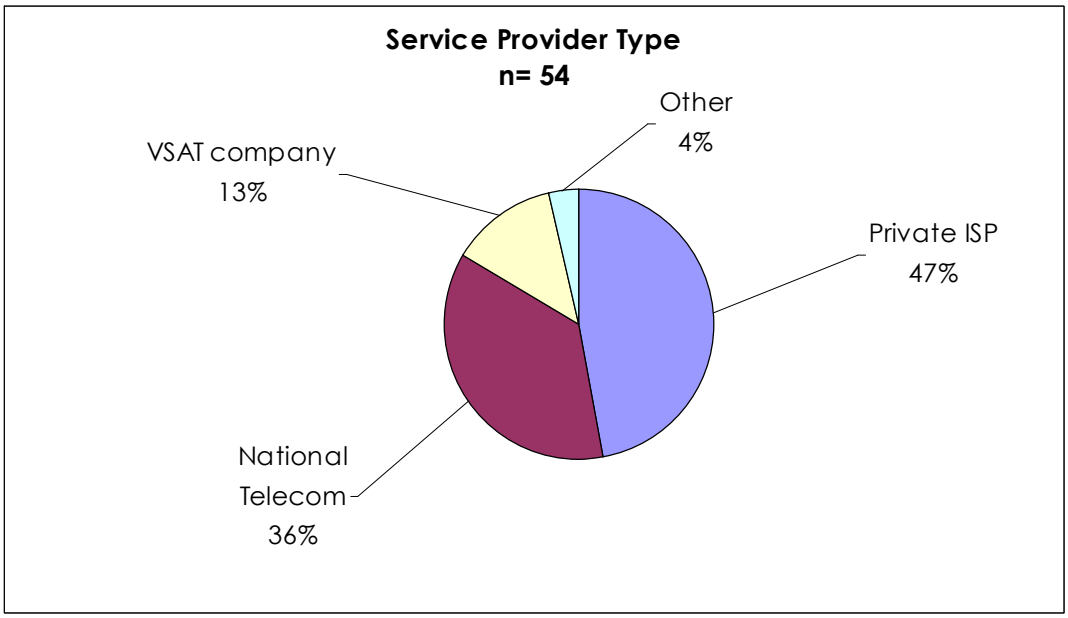
As expected, less than a quarter of the institutions have access to burstable capacity. The majority of the respondents reported that they did not have burstable capacity, as indicated by the 50% who said no to the question. Some respondents did not answer the question, as they were not sure what the question meant, which would likely indicate that these institutions did not have burstable capacity.

Bandwidth provision and costs

3.1 Type of Internet Service Providers in African Tertiary Institutions

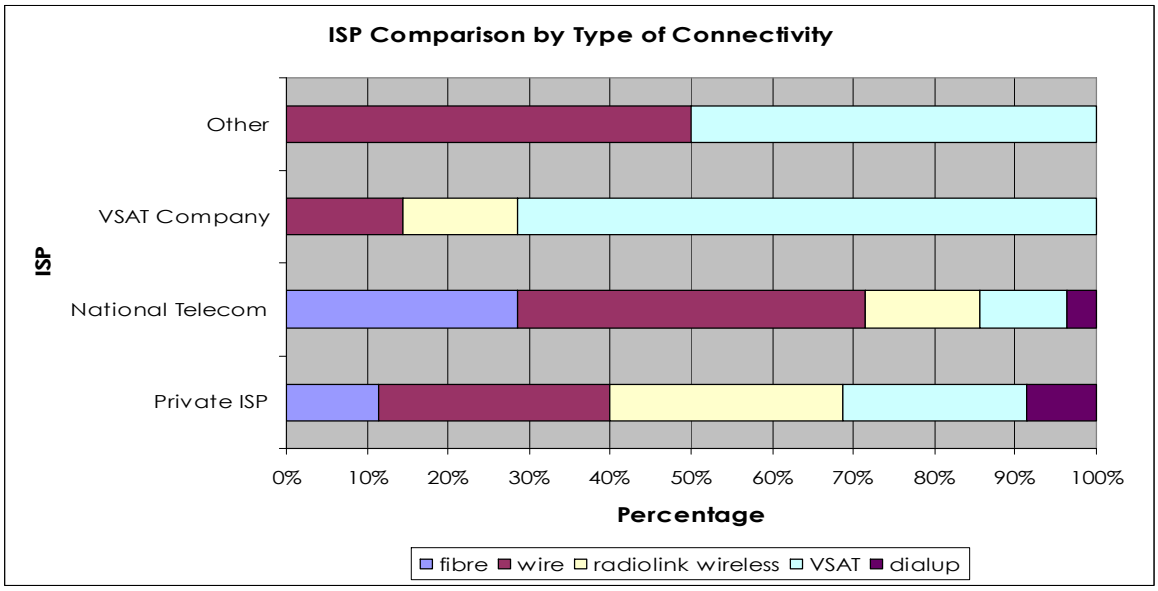
Private ISPs remain the most common service providers, closely followed by the National Telecom. This is because deregulation and monopolization in this field by African governments is often inconsistent. In Zimbabwe, for example, the National Telecom (TelOne) is now competing with a number of other Private ISPs.

Chart 10 Type of Internet Service Providers



Although most countries ultimately obtain their bandwidth via VSAT, only 13% of the respondents mentioned a VSAT company as their ISP. Most of the respondents (47%) listed Private ISP as their service provider. In Zimbabwe, for example, there is a notable proliferation in the number of Private ISPs such as Mweb, Africaonline and Telnet. Other service providers indicated as "other" in the chart, are donor initiatives, such as the UNDP initiative 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 Kenya Education Network (KENET).

Chart 10.1 Internet Service Providers and Type of Connectivity



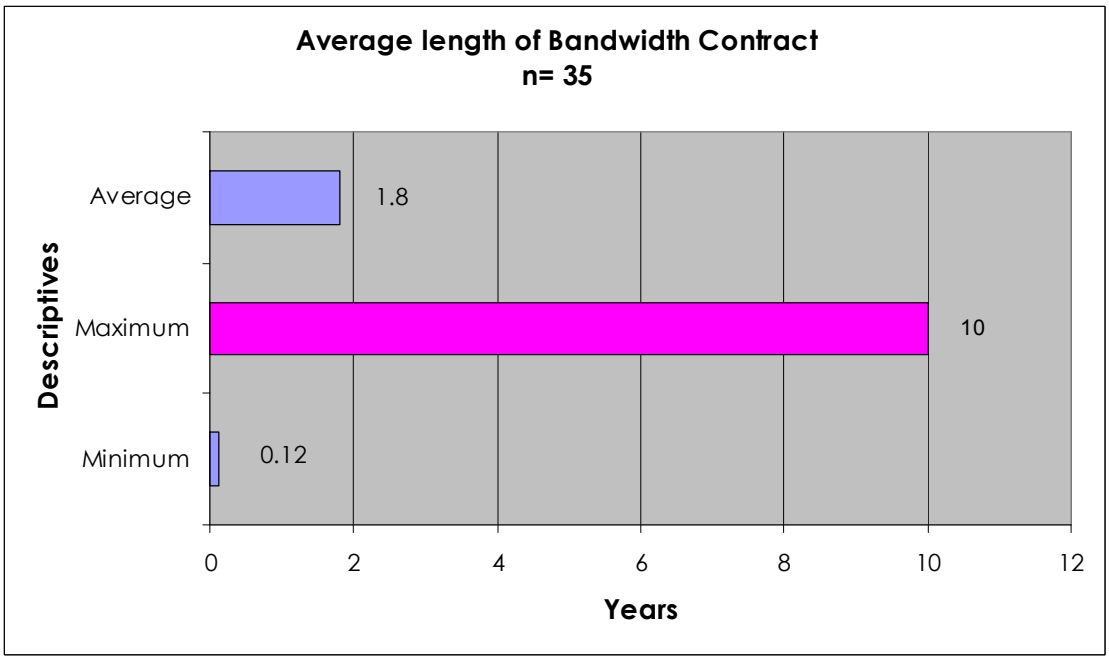
Donor initiatives and academic networks provide their connectivity through wire and VSAT. VSAT companies naturally provide their connectivity through VSAT, while National Telecoms tend to use wire connectivity, followed closely by fibre. Private ISPs use radio link wireless and wire for their connections, with VSAT closely following the two.

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

3.1.1 Length of Bandwidth Contracts

Contract arrangements between ISPs and tertiary institutions were briefly explored in the survey. The length (duration) of bandwidth contracts was analysed as shown in chart 11, which shows 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



The maximum bandwidth contract was recorded at Kamuzu College of Nursing (Lilongwe campus) in Malawi, and the minimum of monthly contract was reported at Gondar University in Ethiopia. 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

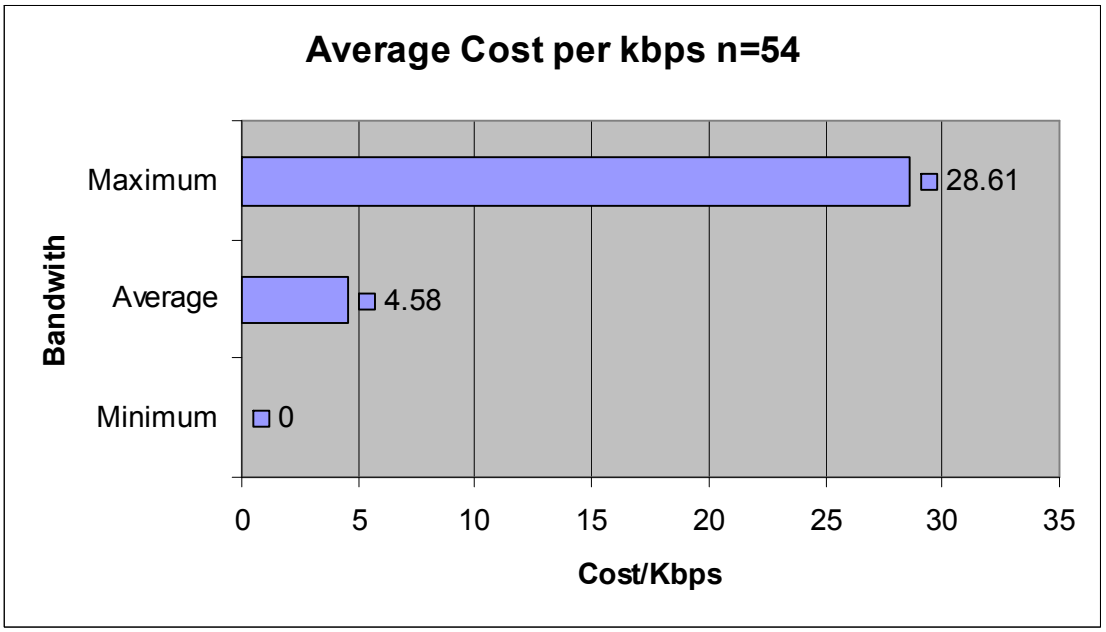
are continuously being reduced and it is usually not in the best interest of the institution to commit to long term fixed price contracts.

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 discussions 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) they were paying per month. The analysts added the uplink and downlink kbps together and multiplied leased line capacities by two in order to provide a basis of comparison with asymmetric bandwidth sources such as VSATs. The results are presented in chart 12.

Chart 12 Average Cost of Bandwidth/Month



With some institutions like University du Sahel in Senegal paying as little as US$0.05 and the Africa University of Zimbabwe paying the highest cost of US$28.61, there is truly a wide range of bandwidth costs in Africa. The average cost per Kbps is US$4.58 (down from $5.46 in 2004). Table 3 ranks the institutions by bandwidth cost.

Table 3 Rankings: Bandwidth Cost

		Cost/Kbps/Month USD ($)
Institutions with Cheapest Bandwidth: Top Ten		
University du Sahel	Senegal	**0.05**
Gondar University	Ethiopia	**0.19**
Njala University	Sierra Leone	**0.22**
Institute of of Admin and Commerce	Botswana	**0.24**
Chinhoyi University of Technology	Zimbabwe	**0.29**
Puntland State University	Somalia	**0.29**
Open University of Sudan	Sudan	**0.34**
Mzuzu University	Malawi	**0.43**
University of Port harcourt	Nigeria	**0.47**
Republic of Djibouti	Uiversity of Djibouti	**0.50**
Institutions with Most Expensive Bandwidth: Top Ten		
Africa University	Zimbabwe	**28.61**
Universite de Yaounde 1	Cameroon	**16.78**
University of Gambia	Gambia	**15.26**
University of Asmara	Eritria	**10.17**
Sokoine University of Agriculture	Tanzania	**7.63**
University of Swaziland	Swaziland	**7.43**
University of Botswana	Botswana	**6.98**
Botswana College of Agriculture	Botswana	**6.78**
Universite du Burundi	Burundi	**6.10**

More Southern African countries are found in the top 10. There are four Southern African institutions, 1 North African, and four Western Africa countries.

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. 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 IDRC funded 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

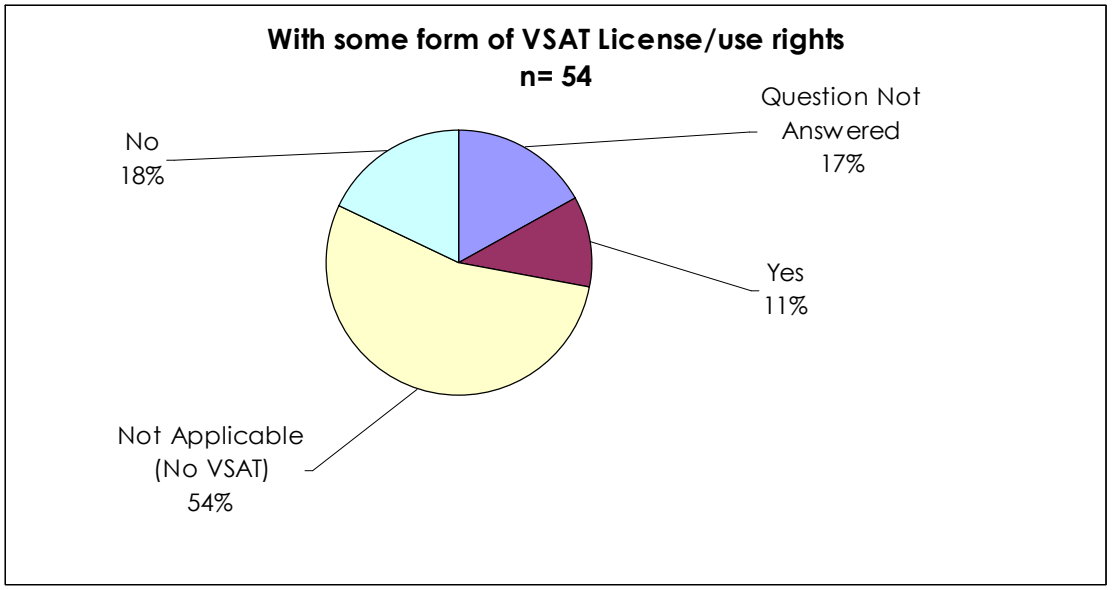
Key
C Competitive or Fully Liberalized,
P Partially Competitive
M Monopoly
D Duopoly
FEL Free Educational License
NLR No Licenses Required
NA Not Allowed
RO Receive-Only Licenses (VSAT receive signals but cannot send out)

Country	ITU (2002)	GVF (2003)	ATICS (2004)	ATICS (2004) Free Educational Licenses	ATICS (2006) Free Educational Licenses
Benin		M			
Botswana	C	C			
Burundi	C	C			
Cameroon	C	C	C	FEL	
Djibouti					
Eritrea					
Ethiopia					
Gambia	M	M	NA		
Ghana	P	P		FEL	FEL
Kenya	M	M		FEL	
Lesotho	C	C			
Madagascar	C	C			
Malawi	P	P			FEL
Mauritius					
Morocco		P			
Mozambique	C	C	C	NLR	FEL
Namibia	P	M			
Nigeria	C	C	C	FEL	
Senegal					
Sierra Leone	P	P			
Somalia					
Sudan					
Swaziland	C	C			
Tanzania		P			
Togo	C	C	M		
Uganda	P	P			
Zambia	C	C			
Zimbabwe	C	P			

Sources; Global VSAT Forum 2003, ITU 2002, ATICS 2004, ATICS 2006

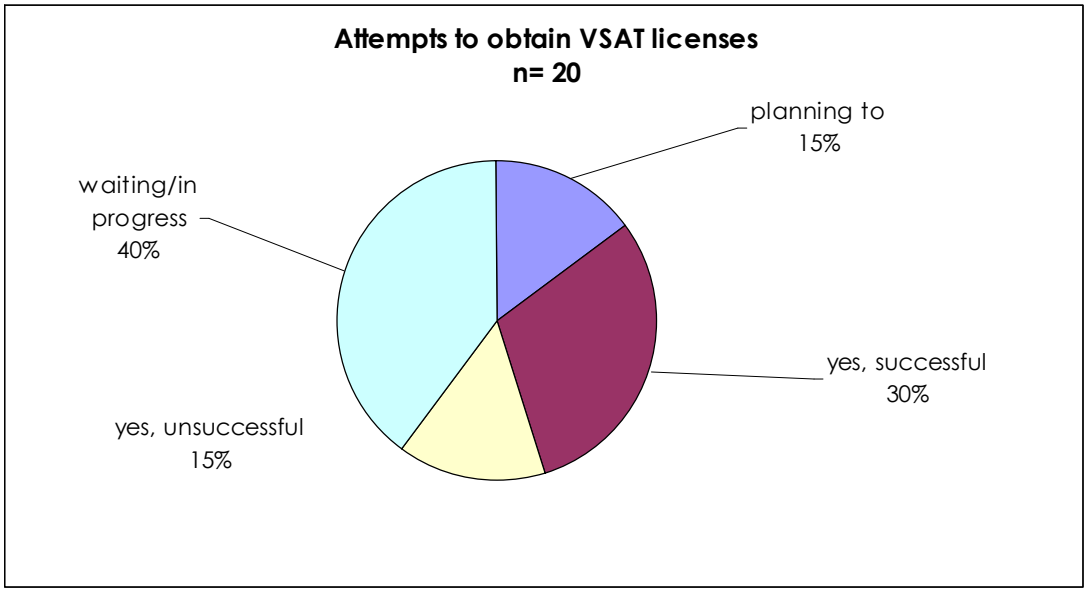
Considering this background, ATICS explored VSAT licensing within African tertiary institutions. Chart 13 indicates the percentage of respondents with VSAT licenses.

Chart 13 Percentage of respondents with VSAT licenses



The results show that 11% of the respondents indicated they had VSAT licenses while 18% indicated that they don't have VSAT license. Chart 13.1 presents the data on institutions, which attempted to obtain VSAT licenses.

Chart 13.1 Institutions which Attempted to Obtain VSAT Licenses



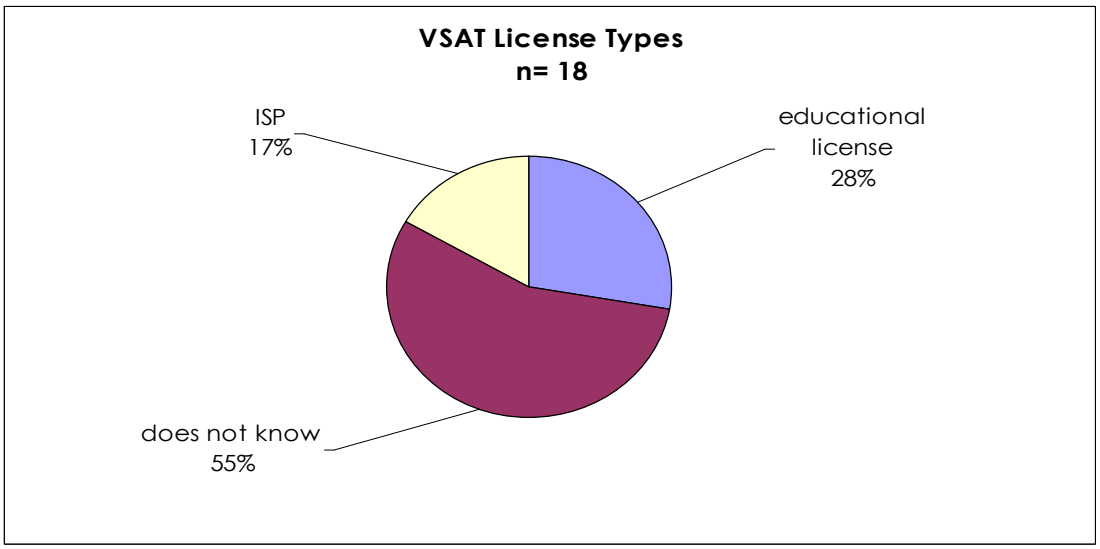
Institutions experienced a mixed response to their attempts to obtain a VSAT license. About 15% of the respondents were unable to obtain VSAT licenses,

possibly due to prohibitive restrictions on VSATs in their countries. Altogether 70% had not been able to obtain a proper VSAT licence, although 40% were still waiting for a reply, indicating a need to encourage institutions to follow-up their licenses applications with the relevant authorities in their countries.

4.1 *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.

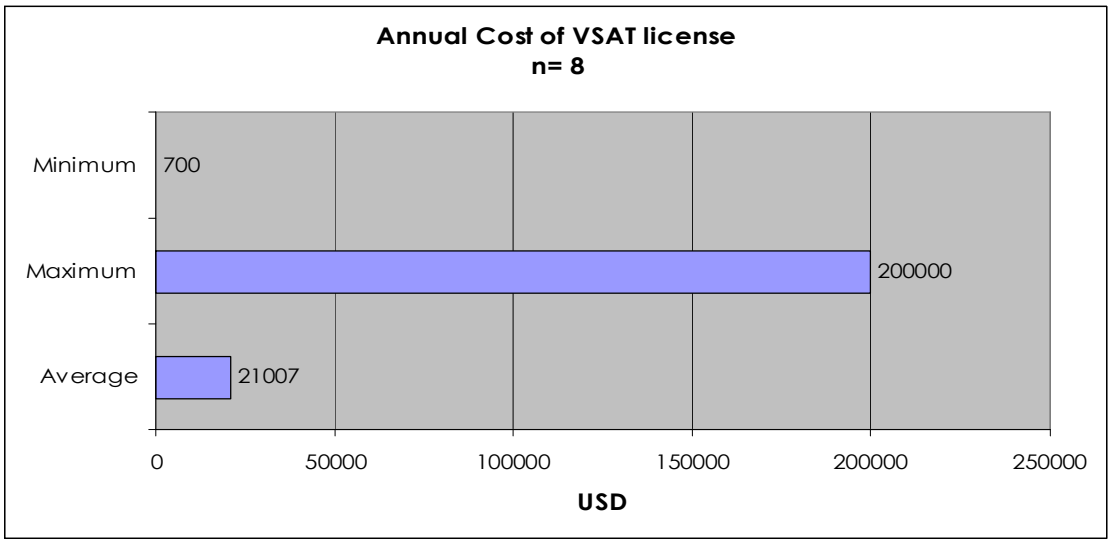
Chart 14 VSAT License Types from Sampled Institutions



AS evident above from the chart above, most of the respondents who are aware of this information (28%) have educational licenses which are non-commercial. This follows recent trends towards educational exemptions, such as the recent institution of VSAT license exemption for educational use in Kenya.

4.2 Cost of Non-Free VSAT Licenses

Chart 15 Cost of Non-free VSAT Licenses

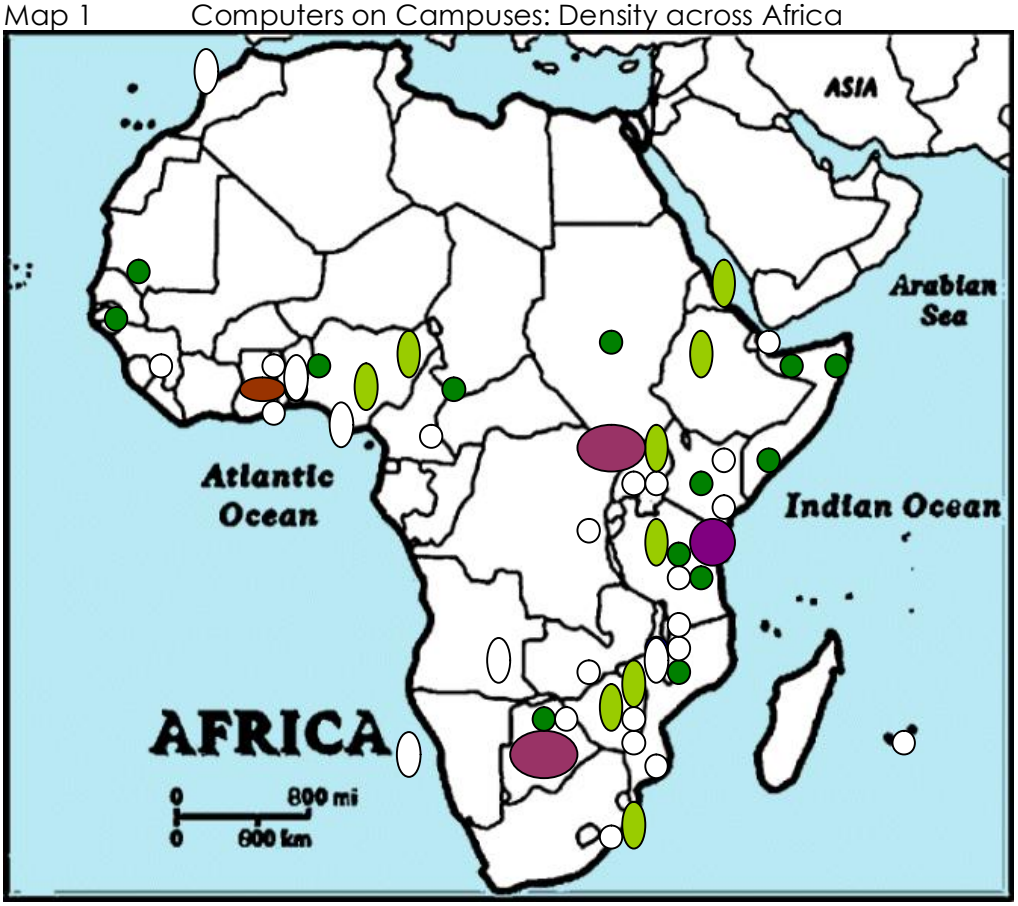


The high average cost of a VSAT license is US$21007 per year, mainly as a result of the extremely high cost of a license in Zimbabwe. It is nevertheless apparent that there is a huge range in the license fess being paid by institutions, with some institutions required to pay as much as US$200,000 (Zimbabwe) compared to some paying as little as US$700 (Zambia). 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 license and what impact that has.

ICT Infrastructure at Surveyed institutions

5.1 Bandwidth and Networked Computers

Map 1 Computers on Campuses: Density across Africa

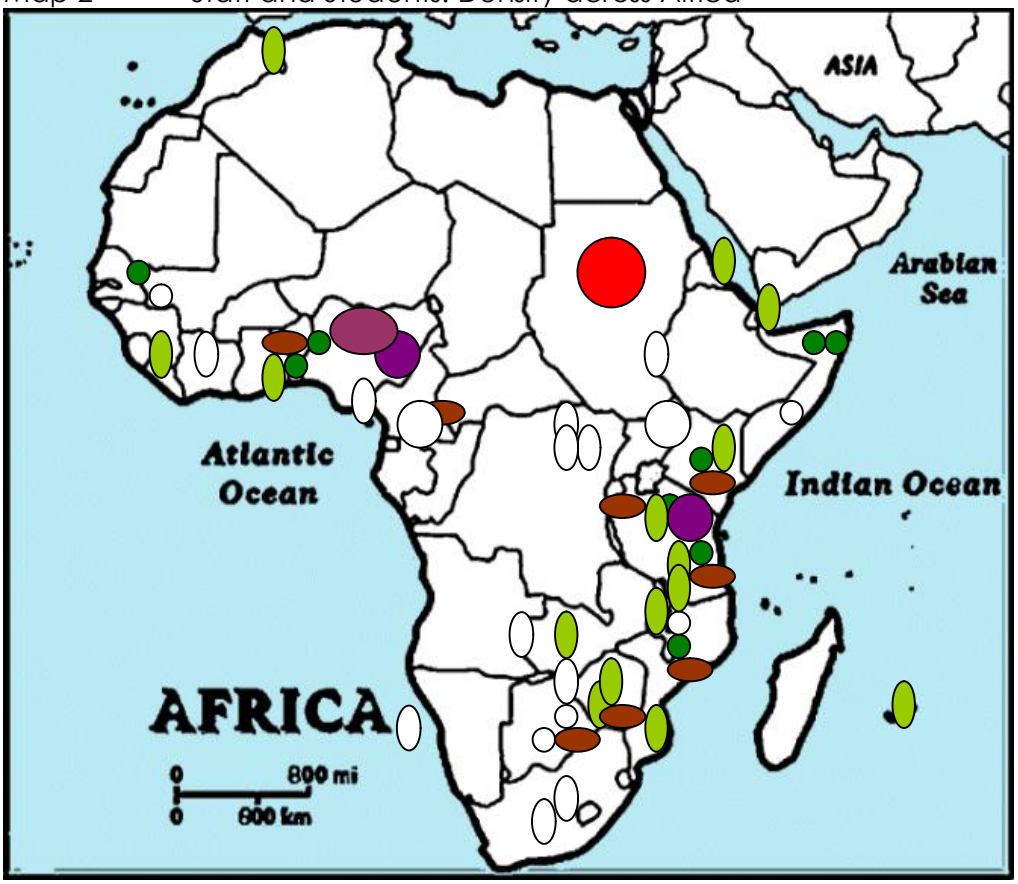


Key

	1 to 100
	100 to 500
	500 to 1000
	1000 to 1500
	1500 to 2000
	2000 to 2500
	2500 to 3000
	3000 to 3500
	3500 to 4000

The survey incorporated a series of questions about campus infrastructure, including the number of computers that were networked or connected to the Internet. It appears that the greatest density of computers is in Southern and Eastern Africa. The density of users (students and staff across African institutions) is presented in Map 2.

Map 2 Staff and Students: Density across Africa

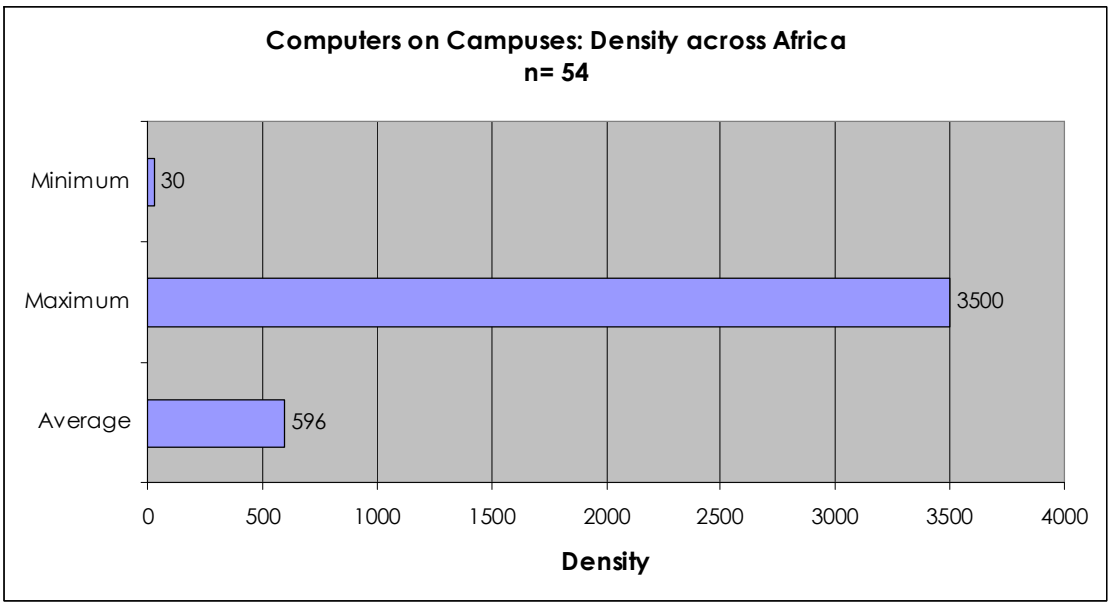


Key

	1 <> 500
	500 <> 1000
	1000 <> 5000
	5000 <> 10000
	10000 <> 20000
	20000 <> 30000
	30000 <> 40000
	40000 <> 50000
	> 50000

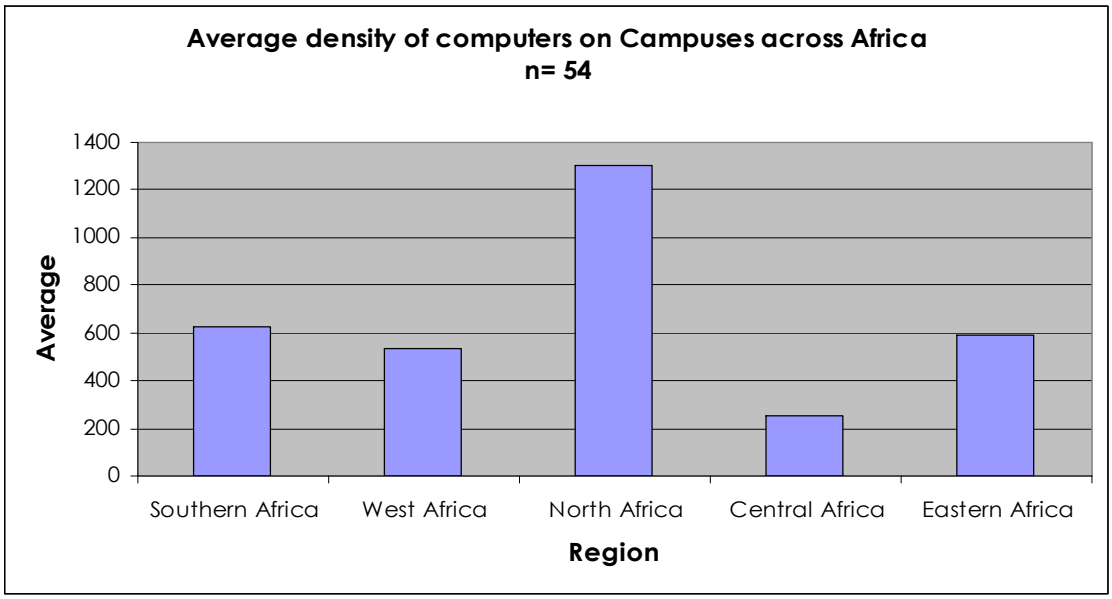
Western and Eastern African countries appear to have the greatest density of staff and students in African tertiary institutions. Appendix 3 shows the number of computers on campuses and the staff and students in the 54 surveyed African tertiary institutions. Chart 16 shows the average, minimum and maximum computers on campuses in the five African regions.

Chart 16 Computers on Campuses: Density across Africa



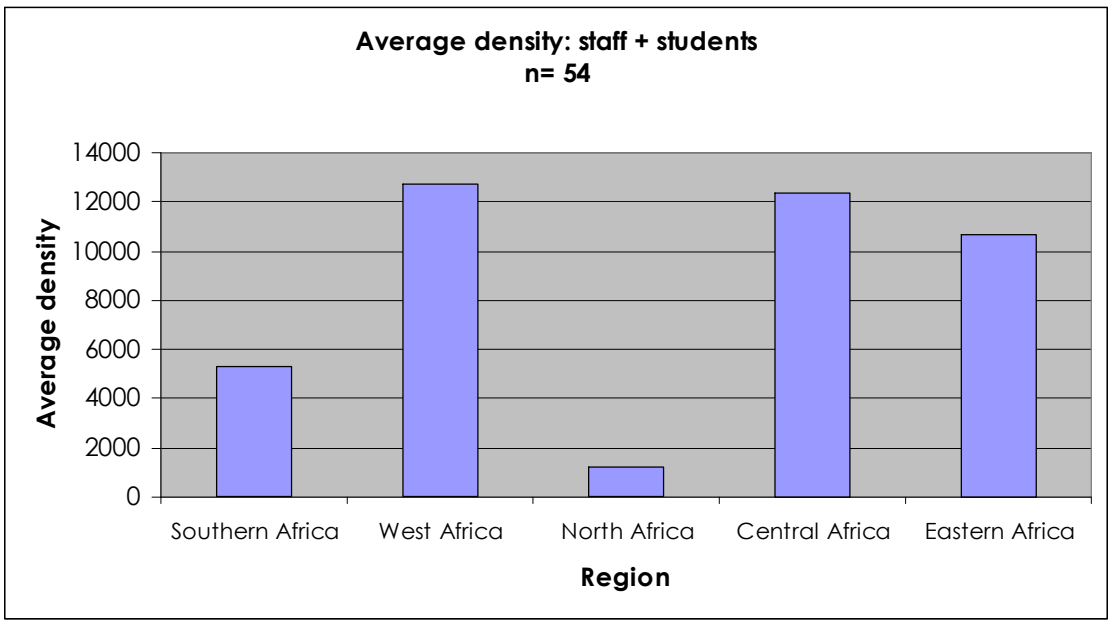
The maximum density of computers (3500) is reported in Botswana and Uganda, while the minimum is reported in Western Africa (Benin Republic). Chart 17 below shows the average computer densities in the five African regions.

Chart 17 Average computer density across campuses in Africa



It appears that countries in North Africa have the greatest average computer density, followed by Southern Africa, Eastern Africa, Western Africa and Central Africa at the bottom. The density of users (staff and students across African institutions) is presented in Chart 18 below.

Chart 18 Average density: staff and students

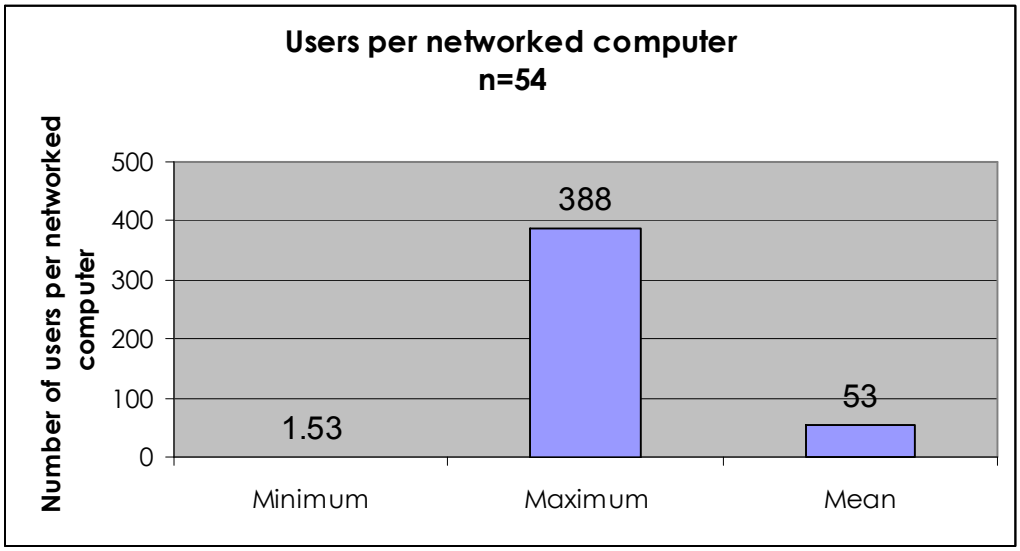


West Africa appears to have the greatest average of density of staff and students in African tertiary institutions. However, Open University of Sudan (Sudan) with a total of 90 000 computer users leads all the African institutions and Swiss Management Academy (Kenya) with 63 is at the bottom. Chart 24 below shows the density of computers on campuses across Africa.

5.1.1 Average Number of Users per Networked Computer

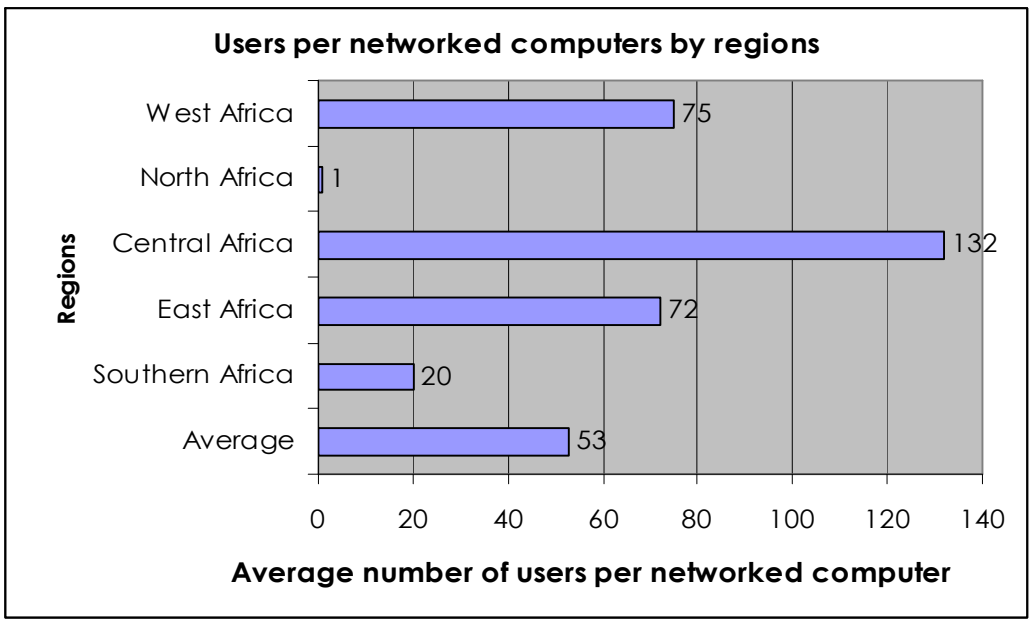
Users are defined as the total number of students and staff, as provided by the sampled institutions.

Chart 19 Average Number of Users per Networked Computer



The results shown in the chart above indicate the huge differences in levels of computer access among the institutions. The highest number of users per computer is 388, the lowest is 1.53 and the mean is 53.

Chart 20 Average Number of Users per Networked Computer by Region

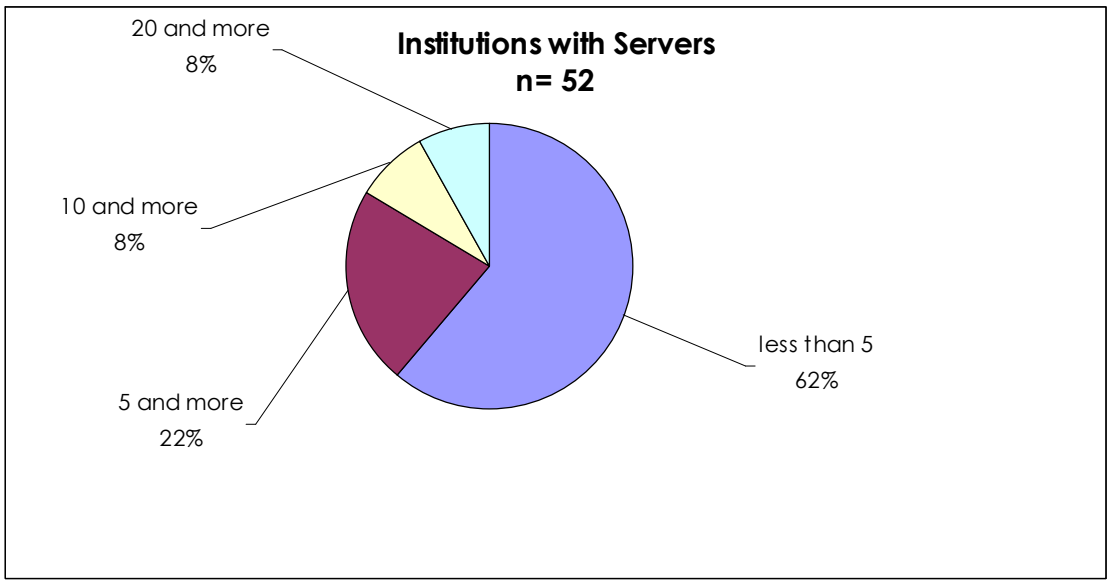


Central African institutions appear to have the least number of networked computers for their campus populations compared to Southern and Northern African institutions which have smaller numbers of users per networked computers. It is important to note, however, that 20 users (southern Africa average) per networked computer means 20 users have access to the Internet through one computer, a high ratio compared to the average students per networked computer ratio of USA institutions. The numbers of computers are increasing with fewer and fewer people per computer.

5.2 Servers in Sampled Institutions

In the sample, the minimum number of servers is 1 and the maximum is 50

Chart 21 Servers in Surveyed Institutions

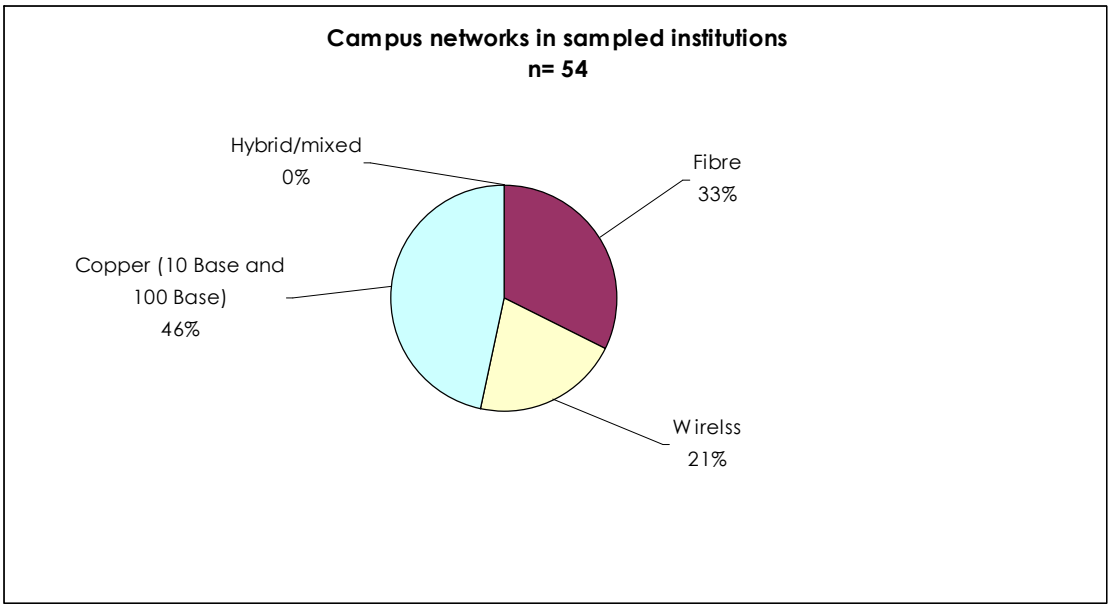


All respondents have servers have at their campuses, with 30 of them having between 1 and 5 servers. This is because most of the institutions have leased line connectivity, which would require at least some server capacity.

5.3 Campus Networks

5.3.1 Campus Networks in Sampled Institutions

Chart 22 Campus Networks in Sampled Institutions



Almost all of the respondents (94%) indicated that they have campus networks. The largest proportion (46%) of the respondents reported they used copper (10 Base and 100 BaseT) for their campus backbones. 33% use fibre, while 21% reported they use wireless. None of the respondents indicated that they use a hybrid/mixed backbone for their campus network.

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 67%. This is extremely high, given that this should be measured over 24 hours a day every day of the month.

Chart 23 Percentage of Time Link is at Maximum Capacity

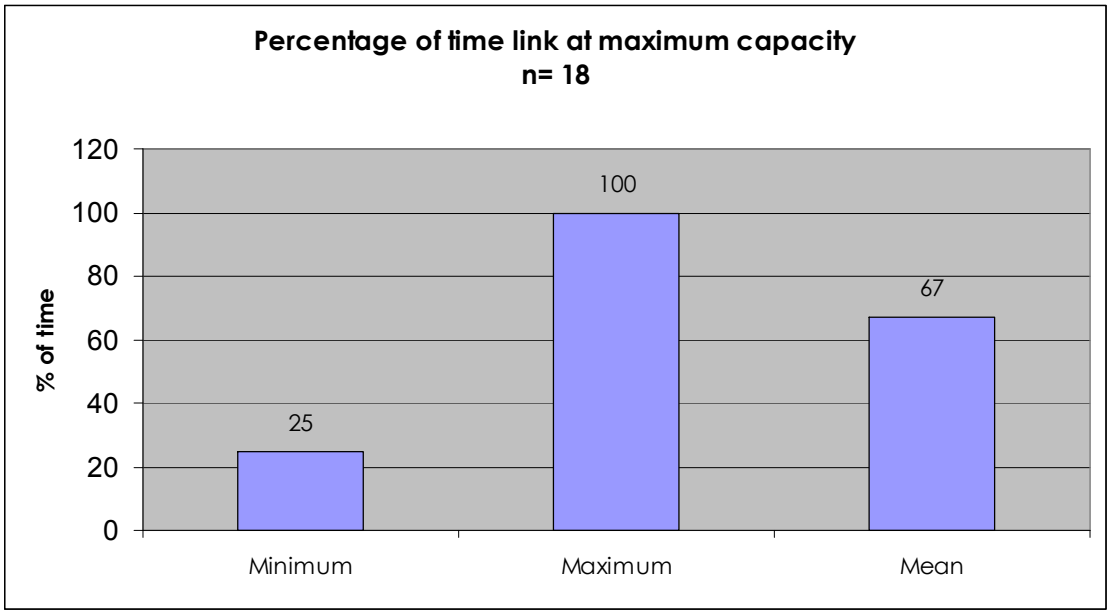
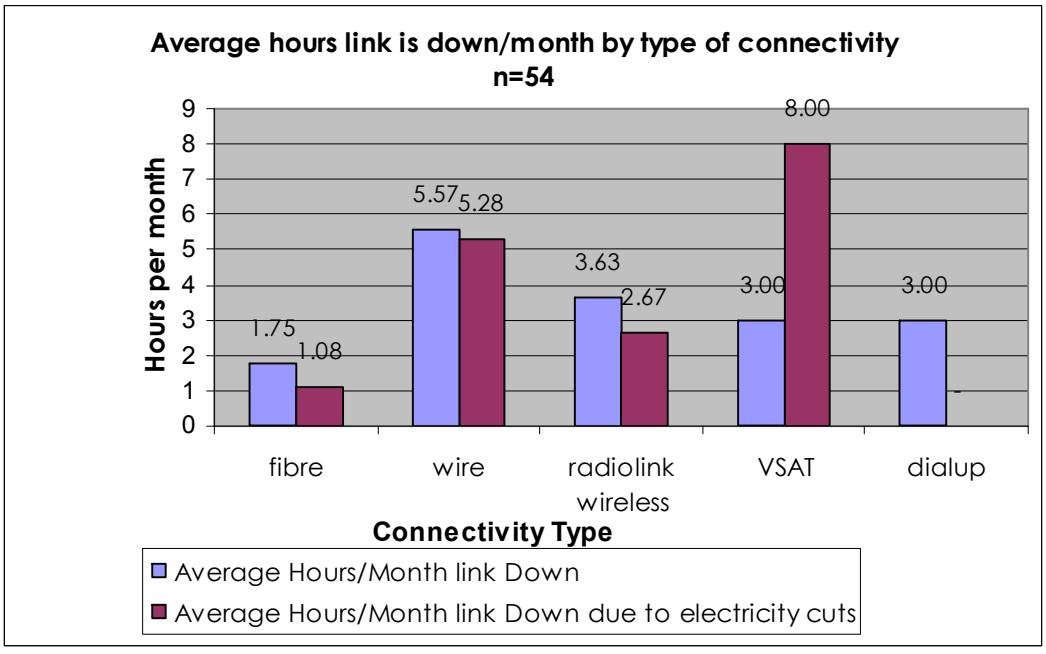


Chart 24 Average Number of Hours Link is Down: Comparison by type of connectivity



The results indicate that wired connections have a higher rate of failure, with 5.57 hours per month, than other links, with fibre having the lowest rate of failure of 1.75 hours per month. It appears that, where electricity cuts are a problem, VSAT and wire are affected most with 8 and 5.28 hours per month respectively. The implications of these findings are that VSAT and wire appear to be a more

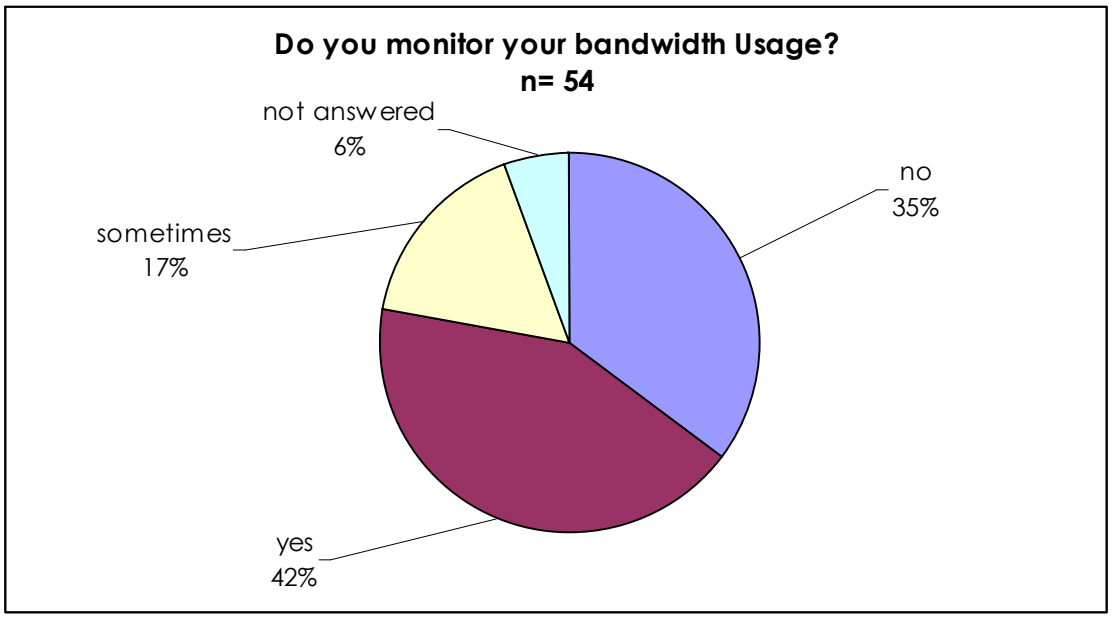
difficult technical solution for many institutions, and additional support is likely to be needed when implementing these solutions.

Bandwidth Monitoring and Management

6.1 Monitoring Bandwidth Usage

Respondents were asked whether they monitored their bandwidth usage. The responses are represented in chart 25

Chart 25 Percentage of Institutions Monitoring Bandwidth Usage

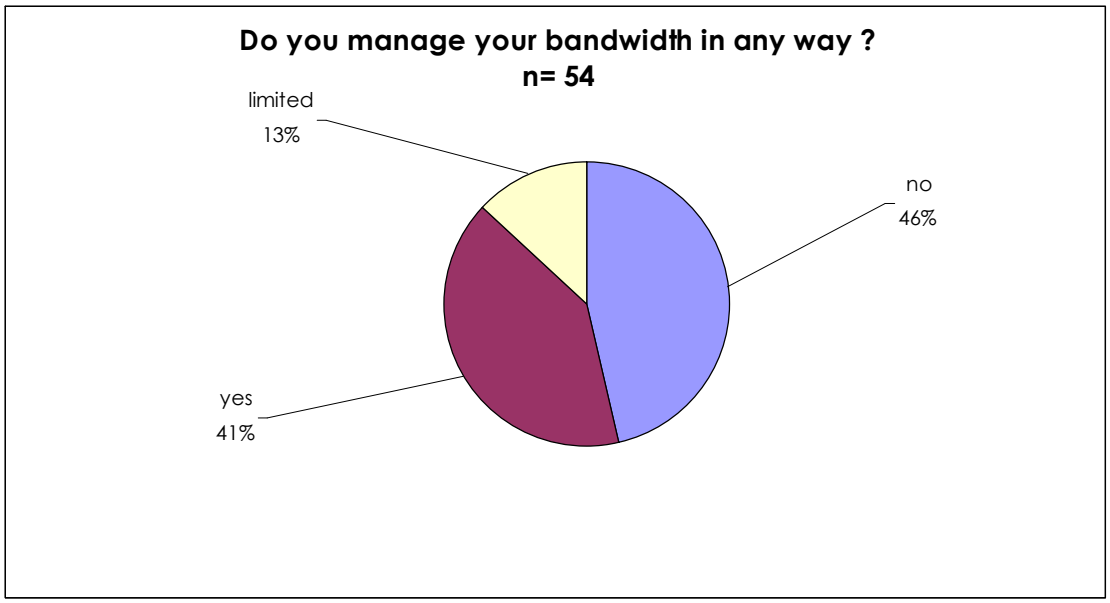


A minority (42%) of the respondents monitor their bandwidth usage, though most of them could not produce basic figures such as average bandwidth used.

6.2 Bandwidth Management

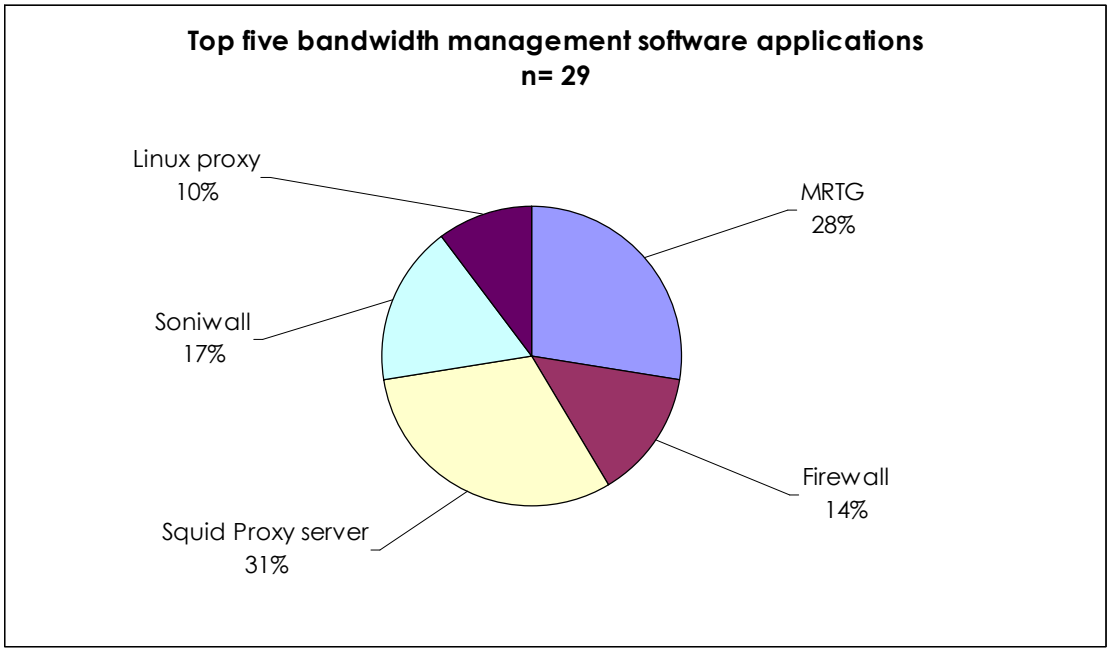
Bandwidth management is an essential service that promotes efficiency and maximum utilisation of bandwidth. Without good bandwidth management, the available bandwidth is quickly used up in non-productive traffic including music files, viruses and photographs. Compromised PCs running as rogue spam relays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

Chart 26 Do you manage your Bandwidth in any way?



Unfortunately, the majority of the respondents (59%) reported that they practiced little or no bandwidth management, 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 quality and quantity of their bandwidth for educational purposes.

Chart 27 Software used in bandwidth Management



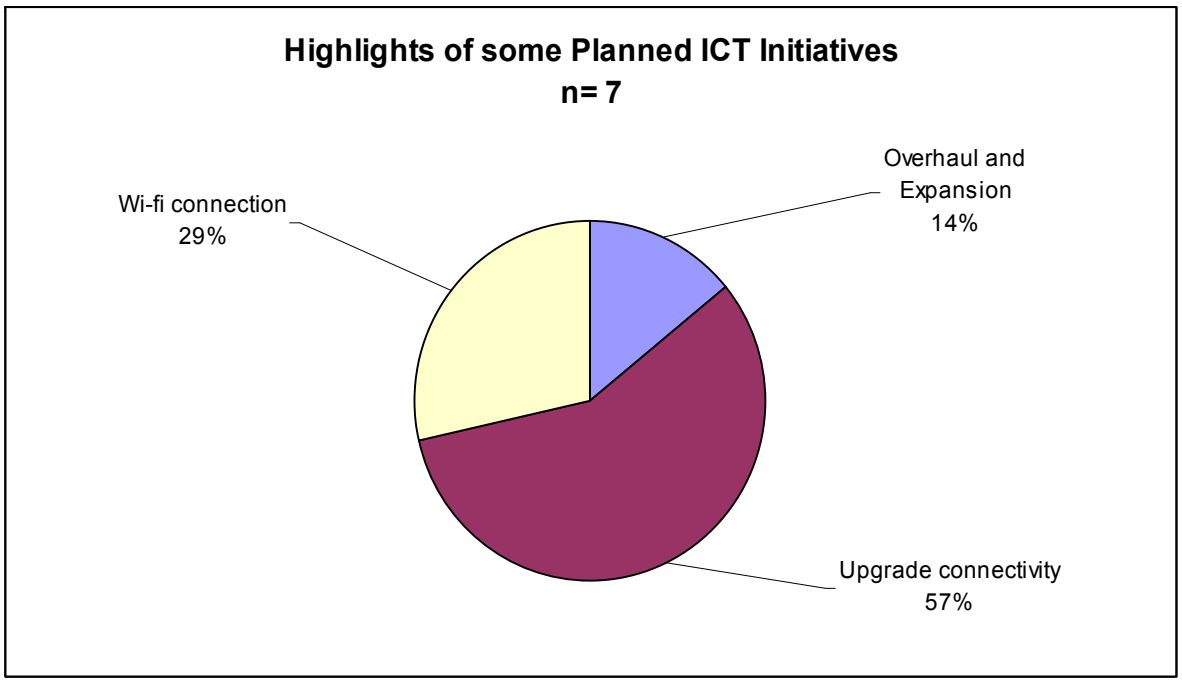
Of the 29 respondents that answered this question, 31% use Squid Proxy server in bandwidth management. They said they prefer this because it has access control lists. Multi Router Traffic Grapher (MRTG) is not strictly a graphing tools that is commonly used to help monitor the traffic load on network links, however it was only used by 28% of the respondents.

ICT Projects and Bandwidth Consortia

7.1 ICT Initiatives and E-Learning

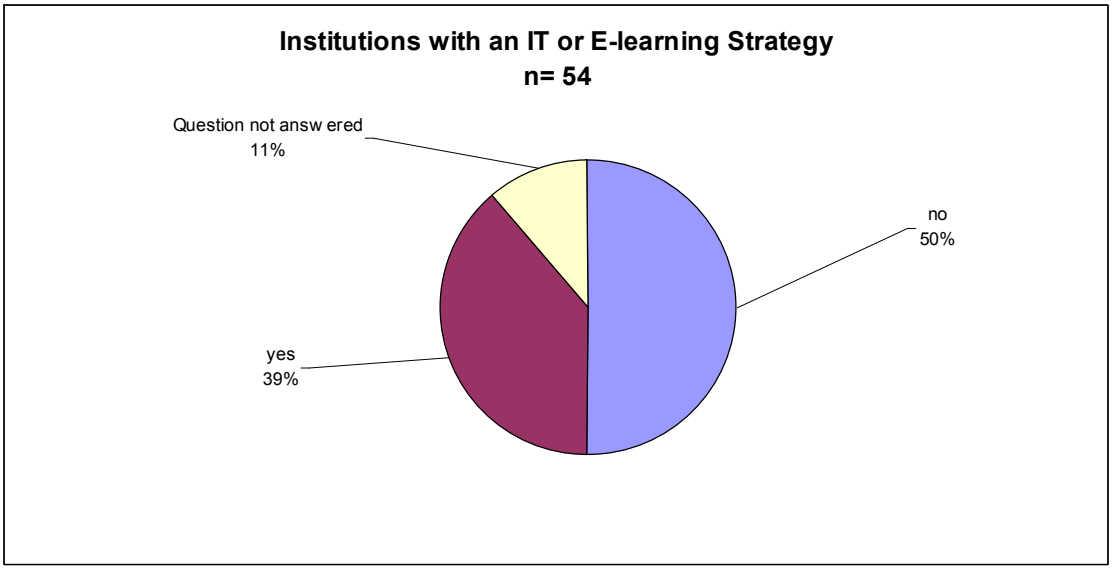
Many of the tertiary institutions surveyed are planning to implement various ICT initiatives, and some of them are using e-learning to complement the conventional methods of learning in institutions. Respondents were asked to list five planned ICT initiatives. Chart 28 shows responses for the first initiatives listed.

Chart 28 Highlights of some Planned ICT Initiatives.



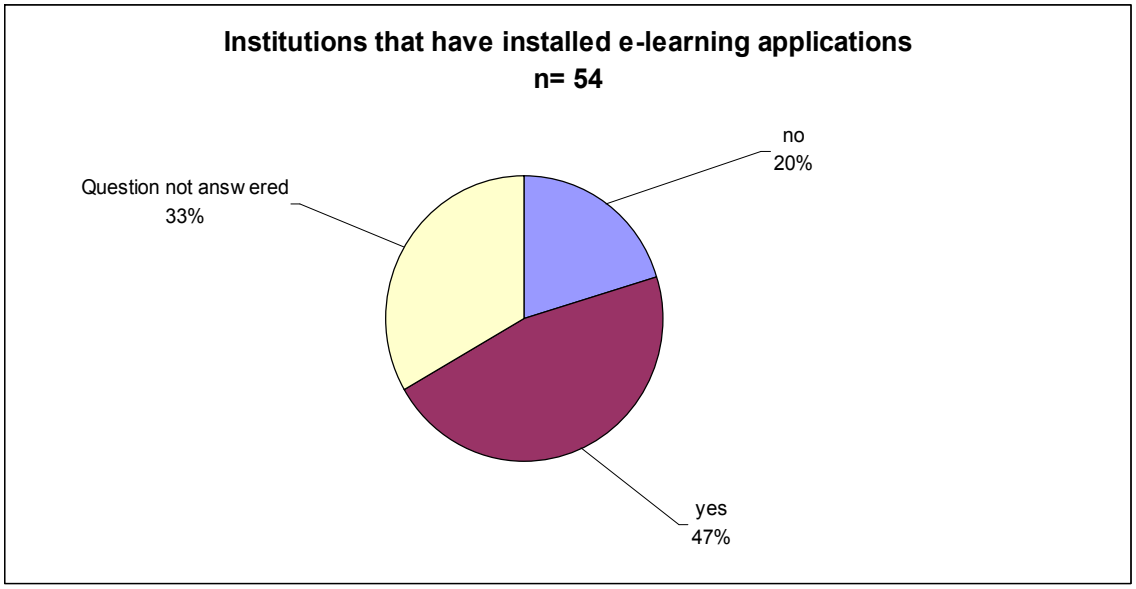
The majority listed upgrading connectivity as the first initiative they were planning to implement. Others said that they were planning to introduce Wi-Fi connections or overhauling and expanding their campus networks so as to extend internet access to all students.

Chart 29 E-Learning/IT Strategy in surveyed Institutions



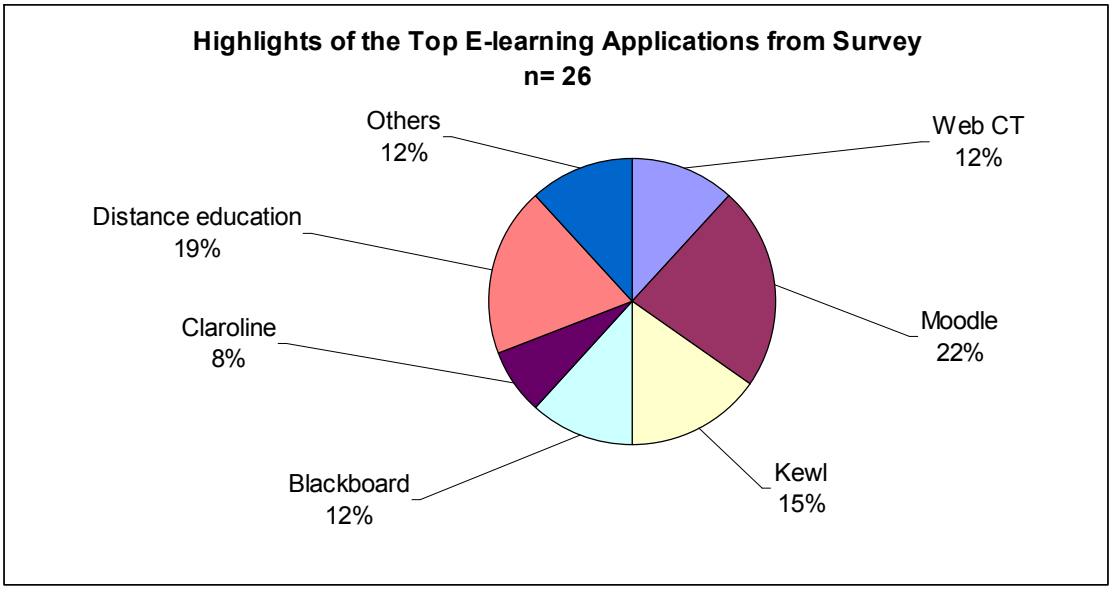
Half of the respondents, 50% do not have a written e-learning/IT strategy, while 39% have written one, and 11% did not answer the question.

Chart 30 Institutions with E-learning Applications



Only 47% of the respondents have installed e-learning applications, while 20% have not yet installed such applications, and the remaining 33% did not answer the question. Respondents that said they had installed e-learning projects were asked to list three e-learning projects that they have installed. Chart 31 below shows the response for the first e-learning project listed.

Chart 31 Highlights of the Top E-learning Applications from Survey



Moodle appears to be the major application of e-learning in the surveyed institutions. Other applications listed are:

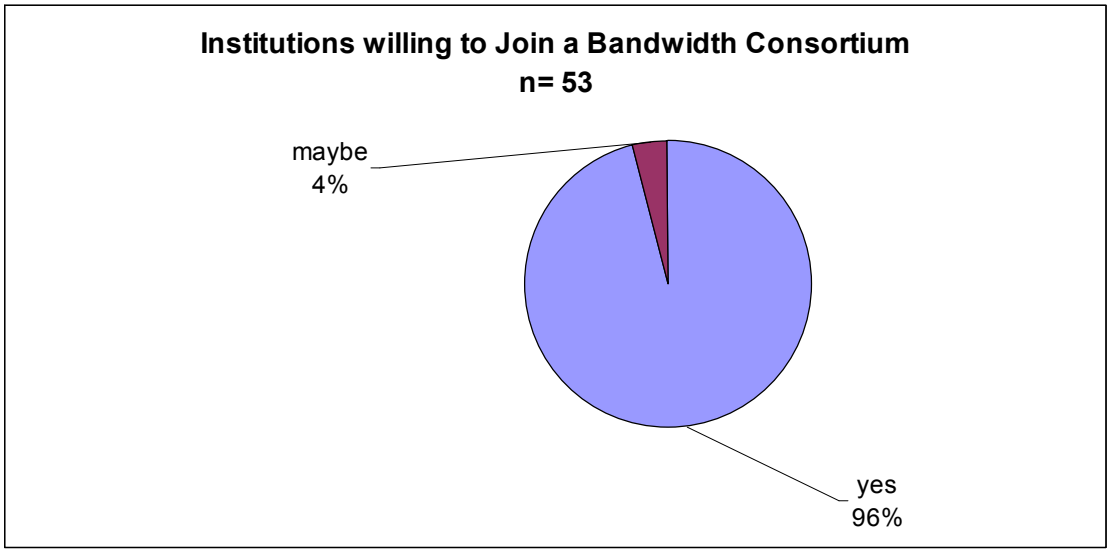
- Blackboard is a Web-based server software platform that offers course management. It is open for customization and is also scalable allowing for integration with student information systems.
- Distance Education (individual applications not specified).
- Web CT. Web CT Campus Edition is a course management system that enables the delivery of online education. It is scalable and integrates with existing campus infrastructure, enabling campus-wide deployment.
- Claroline is open Source software and a course management system, which allows teachers or educational institutions to create and administer courses through the web.
- Kewl, Knowledge Environment for Web-based Learning, is an Open Source learning management system originally developed for the Microsoft Windows platform but now ported to open source.

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

7.2 Joining a Bandwidth Consortium

The respondents were asked if they were willing to join a bandwidth consortium. Chart 32 below presents the response.

Chart 32 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 4% indicating a lower possibility of their inclusion in such an initiative. The fact that the majority are willing to join a bandwidth consortium is clear evidence that these tertiary institutions will be receptive to any projects and consortium aimed at improving their 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 university consortium 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.

Bandwidth pricing is volume-sensitive and centralized buying would result in a much lower per-bit cost than when organizations negotiate individually. In addition the group 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.

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 Infracom, obtaining bandwidth through fibre will increase and is envisaged to eventually surpass satellite bandwidth, especially as fibre has much higher capacity and quality. The biggest challenge with fibre is that monopoly-pricing is 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 8 countries along the West Coast of Africa. Already, TENET South Africa is utilizing this link to provide its 26 institutions with international connectivity. East African Submarine System (EASSY) is a planned East African fibre link. Infracom is a South African government initiative which plans to establish a fibre backbone to link Southern Africa with Europe. In the next 3-4 years, this should see most 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 and most immediate 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, restricting

trivial use such as downloading mp3s, 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 the regulatory environment for improving both access to satellite and to improved national backbones is, perhaps, the most difficult issue to address, particularly by small 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.

8.1.5 Educate tertiary institutions on connectivity issues

There is a high need to educate personnel from African tertiary institutions on bandwidth and connectivity issues. This is particularly important as most respondents largely senior administrators and key technology people within the institutions did not appear to be knowledgeable about the major issues such as bandwidth monitoring, management, committed information rate and burstable capacity. Workshops should be organized to sensitize the people on these issues.

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 and the possibility of bandwidth buying consortia which most of the respondents are willing to join. A range of options is available. At one end, a relatively simple buying consortium can be created very similar to what the AVU/PHEA initiative 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. There is also need to sensitize African institutions on how effectively monitor and manage their bandwidth.

8.2.1 Comparison of 2004 and 2006 ATICS Survey results

In the 2004 ATICS Report the majority of the respondents were from West Africa (37%), followed by Southern Africa with 27%, whereas in the 2006 survey the majority were from Southern and Eastern Africa (35%). In both surveys the lowest number of respondents was from Central Africa.

Leased line wire continue to be the one used for connectivity purposes in both surveys, 32% in 2004 and 34% in 2006 survey use leased line wire. In both surveys over 6% of the sampled institutions still rely on dial-up connections for their internet connectivity. It also emerged from the surveys that a significant number of institutions have additional bandwidth sources, 28% of the surveyed institutions in 2004 had at least one additional bandwidth source, while 17% in the 2006 survey also have additional bandwidth sources. The maximum capacity of connection for 2006 is 10/8Mbps uplink and downlink and is higher than the 7Mbps for both uplink and downlink of the 2004 survey. The minimum for 2006 is 7/20 Kbps which is lower than 28Kbps for the 2004 survey.

In both surveys when the regional comparison of bandwidth per institution for the mean Kbps were calculated, institutions in North Africa are ahead of those in other regions, followed by those in Southern Africa. In the 2006 survey the mean is 8Mbps for both uplink and downlink while in 2004 it was 4, 3/4,4Mbps. The two surveys also revealed that the majority of institutions in countries with lower GDP per capita – less than 3000USD – have lower bandwidth capacity, i.e., 4000Kbps.

On the downside, from the 2004 and 2006 surveys the majority of the sampled institutions do not have a Committed Information rate (CIR), 42% in 2004 and 43% in 2006. Moreover, half of the institutions have links which do not have burstable capacity, 50% in 2004 and 50% in 2006.

In 2004 National Telecom Operators were the most common type of ISP (34%), whereas in 2006 Private ISPs were now the most common ISP (47%). In 2004 Private ISPs had 28% and in 2006 National Telecom followed Private ISPs (36%). The majority of the respondents, 97% had local servers in the 2004 survey, while all the respondents in the 2006 survey have servers, with 38% having 5 or more servers. More than 90% of the respondents had campus networks in both surveys and the largest proportion in both surveys used copper (10 Base and 100BaseT) for their campus backbones.

The largest proportion of the respondents monitors their bandwidth usage, 51% in 2004 and 42% in 2006. However most of them do not manage their bandwidth, 54% in 2004 and 46% in 2006. It also became clear that many institutions in Africa are planning to upgrade and improve connectivity at their campuses, 40% in 2004, and 57% in 2006. Clearly nearly all the sampled institutions in the two surveys are willing to join a bandwidth consortium, 84% in 2004 and 96% in 2006.

To a large extent the ATICS 2004 results and 2006 survey results are very similar and the message is clear that there is dire need to come up with initiatives to improve the bandwidth capacity and connectivity in African tertiary institutions.

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

Table 5
Total of 54 tertiary institutions were surveyed. Here is the list of institutions and their contact details

Country	University	Respondent	Occupation
Benin	Institut de Mathemathiques et de SciencesPhysiques	J Hounsou	**IT Officer**
Botswana	Botswana Institute of administration and Commerce	William	
Botswana	Botswana College of Agriculture	Chibanda Mwale	**Assistant Manager IT**
Botswana	University of Botswana	Mrs Lilian Maswabi	**IT User Support Manager**
Burundi	Universite du Burundi	Apollinaire Yengayenge	**IT Manager**
Cameroon	University of Yaounde` I	Gabriel	
Cameroon	University of Yaounde` II	Roger Tsafack Nanfosso	**Director of EPM program**
Cameroon	Universite du Dschang	Marie Louise Avana Tientcheu	**IT**
Eritrea	University of Asmara	Samuel	
Ethiopia	Gondar University	Abraham Dargie	**Director – ICT Resource Services**
Gambia	University of Gambia	A Remien	**Network Administrator (US Pearce Corp)**
Ghana	Central University College	John Haizel Commeh	**Administrator**
Ghana	Kwameh Nkrumah University of Science and Technology	Dr. Kwame Osei	
Ghana	University for Development Studies	John Kaburise	**Vice-Chancellor**
Kenya	Daystar University	Paul	
Kenya	Egerton University	He1y	
Kenya	Swiss Management Academy	Kangogo Leonard	
Lesotho	National University of Lesotho	Lefuma	
Malawi		Dr Harry	

Malawi	Bunda College of Agriculture	Noel	
Malawi	Mzuzu University	Paxton Zozie	**Assistant Librarian**
Malawi	Kamuzu College of Nursing -Lilogwe campus	Kondwani	
Mauritius	University of Technology, Mauritius	Rishi Heerasing	**Lecturer**
Morocco	Al Akhawayn University	Touria	
Mozambique	Universidade Catolica de Mozambique	Dirk	
Mozambique	Eduardo Mondhlane University	Americo Mushanga	**IT Director**
Namibia	Polytechnic of Namibia	Calvin	
Nigeria	Bayero University	Ado	
Nigeria	University of Port Harcourt	Ebi Bio	
Nigeria	University of Jos		
Republic of Djibouti	University of Djibouti	Djama Mohamed	
Senegal	University du Sahel	El Hadji Sall	**President**
Sierra Leone	Njala University	A.N.T	
Somalia	Somali Institue of Management and Administration Devlopment	Moh'ed Farah	
Somalia	East Africa University		
Somalia	Puntland State University	Romano Salama	
Sudan	Open University of Sudan	Mohammed El Bashir	**Head IT and Systems Dept.**
Swaziland	University of Swaziland	Thembela Thwala	**ICT Director**
Tanzania	Dar es Salaam Institute of Technology	Joseph Yongolo	
Tanzania	Mount Meru University	Donald	
Tanzania	Bugando University College of Health Sciences	Saphina	
Tanzania	University of Dar es Salaam	Prof. Beda Mutagahwya	**Director Computer Centre**
Togo	Ecole Africaine des Metiers de l'Architecture et de l'Urbanisme(EAMAU)	Dr KOUADIO	**General Manager**
Uganda	Kampala International University	Mbaziira	
Uganda	Uganda Christian University	Isaac	

Uganda	Makerere University	Frank	
Uganda	Makerere University	Kyeyune	**Maintenance Manager**
Zambia	Copperbelt University	Bonny Khunga	**Computer Centre Manager**
Zambia	University of Zambia	Dr. Hudwell Mwacalimba	**University Librarian**
Zimbabwe	Chinhoyi University of Technology	Peter Muderei	**Technical Support Officer**
Zimbabwe	Africa University	Wisdom Machata	**Network Engineer**
Zimbabwe	National University of Science and technology	T	
Zimbabwe	**Midlands State University**	**Owen**	

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

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

Table 6 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 www.tenet.ac.za	2000	Secure internet and information technology services for South African Universities and Technikons	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 services delivery. 6. Managing Telkom (ISP) performance during installation.
TENET Tanzania	Proposal stage	Improve connectivity	Consortium arrangement for bulk buying of bandwidth		
Kenet Kenya www.kenet.org	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 Communications Limited	1. Network Services (network management e.g. filtering, caching, access and security) 2. General Internet services (domain registration, web solutions, internet infrastructure, content integration) 3. Training 4. E-mail
NuNet Nigeria http://www.widernet.org/nigeriaconsult/nuc.htm		1. More bandwidth 2. Reduce access costs	Consortium arrangement	Advisory and technical support as well some infrastructure (PCs) to the network from University of Lowa Advisory support from USA IT academics	1. Training service 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		Reducing access costs	Consortium	Funded by the	Network services

Research Network				government	Helpdesk Multicast IPv6 Training VOIP Videoconferencing Contract negotiation
Egyptian National Scientific and Technical Information Network (ENSTINET) http://www.sti.sci.eg/	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 USAID Scientific 2. L'Institutute National d'Information Scientific et Technique (INIST) 3. the British Council 4. IDRC Canada	Internet services (dial up, email, leased lines, web hosting, cybercafé) Information services (database search, document delivery, library services) Database development Videoconferencing Training (Microsoft windows, macromedia applications, Microsoft applications)
Tunisia National Research Network		Improve bandwidth Universities	PTN Type	EUMD provides external link Gvt funds the operations	IP services Billing
Zimbabwe Academic and Research Network www,zarnet.ac.zw	**1997**	Facilitate Internet and e-mail connectivity to the academic and research institutions, schools, non-governmental organisations (NGOs)			

Appendix 3 Computers on Campuses and the staff and students

Table 7

Country	Institution	Computers on Campus	Staff and students
Gambia	University of Gambia	33	
Zimbabwe	Midlands State University	700	**12800**
Sudan	Open University of Sudan	40	**90700**
Uganda	Makerere University	3500	**40000**
Cameroon	Universite' de Yaounde I	1500	**30800**
Nigeria	Bayero University	900	**27670**
Nigeria	University of Port Harcourt	540	**41000**
Ghana	Kwameh Nkrumah University of Science and Technology	1974	**20351**
Nigeria	University of Joos	1500	**26000**
Tanzania	University of Dar es Salaam	2013	**15292**
Botswana	University of Botswana	3500	**18700**
Burundi	Universite du Burundi	250	**12350**
Cameroon	University of Dschang	200	**10350**
Cameroon	Universite de Yaounde II	100	**9750**
Kenya	Egerton University	500	**11200**
Zambia	University of Zambia	1500	**9931**
Uganda	Makerere University	420	**9782**
Mozambique	Eduardo Mondlane University	1230	**11160**
Ghana	University for Development Studies	120	**5438**
Lesotho	The National University of Lesotho	-500	**7471**
Ethiopia	Gondar University	810	**7350**
Zimbabwe	National University of Science and technology	750	**5215**
Namibia	Polytechnic of Namibia	1200	**6900**
Swaziland	University of Swaziland	680	**6000**
Uganda	Uganda Christian University	375	**6000**
Uganda	Kampala International University	600	**7540**
Zambia	Copperbelt University	310	**3760**
Ghana	Central University College	300	**3070**
Tanzania	Sokoine University of Agriculture	650	**2780**

Malawi	Malawi	300	**3060**
Mozambique	Universidade Catolica de Mozambique	300	**3045**
Sierra Leone	Njala University	100	**2370**
Eritrea	University of Asmara	784	**2888**
Mauritius	University of Technology,Mauritius	250	**3545**
Republic of Djibouti	University of Djibouti	375	**2602**
Kenya	Daystar University	350	**2572**
Tanzania	Dar es Salaam Institute of Technology	500	**1605**
Zimbabwe	Africa University	500	**1750**
Zimbabwe	Chinhoyi University of Technology	360	**1950**
Morocco	Al Akhawayn University	1300	**1200**
Malawi	Bunda College of Agriculture	300	**2000**
Botswana	Zimbabwe	0	**965**
Somalia	Somali Institue of Management and Administration Devlopment	70	**984**
Malawi	Mzuzu University	200	**820**
Senegal	University du Sahel	100	**550**
Botswana	Botswana Institute of administration and Commerce	300	**670**
Tanzania	Mount Meru University	50	**486**
Malawi	Kamuzu College of Nursing -Lilogwe campus	58	**369**
Togo	Ecole Africaine des Metiers de l'Architecture et de l'Urbanisme(EAMAU)	42	**322**
Somalia	East Africa University	50	**456**
Somalia	Puntland State University	37	**332**
Tanzania	Bugando University College of Health Sciences	70	**101**
Benin Republic	Institut de Mathemathiques et de SciencesPhysiques	30	**100**
Kenya	**Swiss Management Academy**	**50**	**63**

Appendix 4 Survey Questionnaire

INTERNET CONNECTIVITY SURVEY FOR HIGHER EDUCATION INSTITUTIONS IN AFRICA

From: **Africa Tertiary Institutions Connectivity Survey Team**

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To: Selected University/higher-ed/research institutions

The International Development Research Centre (IDRC) is supporting a second assessment of Internet connectivity needs in Higher Education and research institutions across Africa. In 2004, the Africa Tertiary Institutions Connectivity Survey was a success with responses obtained from 83 tertiary institutions from 40 African countries.

IDRC has found it useful to support a second survey of Internet connectivity needs in African tertiary institutions. This is after the realization that there are likely to be changes in the Internet connectivity needs of the institutions since 2004 and it is important to update information collected in 2004 for future referencing and policy making. Moreover this update will provide critical information to interested development agencies who are also stakeholders in facilitating initiatives aimed at increasing connectivity in tertiary institutions.

The 2004 survey indicated 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.

If your institution might be interested in participating in these initiatives please fill out this questionnaire. Once the questionnaire is completed the IDRC team will then facilitate your organisation's participation in the initiatives.

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 February 14th 2006.

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):	
2a: If Supply was unlimited, what would you project to be the actual consumption (growth of demand) for bandwidth, over the next 5 years, considering projected development projects and human resource development?	
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:	
17a: If Supply was unlimited, what would you project to be the actual consumption (growth of demand) for bandwidth, over the next 5 years, considering projected development projects and human resource development.	
Uplink (Kbps):	
Downlink (Kbps):	
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: % of time link 100% utilized:	Ave	Max
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:		

Appendix 5 References

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About the Authors

Karanja Gakio
Karanja Gakio 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. Subsequently, 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 VoIP network, growing coverage from 2 to over 60 countries and was instrumental in successful project management throughout the organization. He holds undergraduate and graduate degrees from University of Notre Dame and Massachusetts Institute of Technology. Karanja is currently CEO of Cyberplex Africa based in Botswana.

Gracian Chimwaza
Gracian Chimwaza is a highly experienced ICT Trainer who has traveled throughout Africa. He is Executive Director of ITOCA (Information Training & Outreach Centre) with offices in Harare and Pretoria.. He helped setup the sales and marketing division of Africa Online (one of Africa's pioneering ISPs) from 1997 to 1999. Gracian is a member of the HINARI-AGORA management team and has been an invited speaker at international, regional and national-level conferences and policy meetings that address information literacy, access and capacity building in Africa. He holds an MBA from Thames Valley University in the UK.

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Sailas Nyareza completed his B.Sc. in Library and Information Science at the National University of Science and Technology (NUST) in Zimbabwe. He currently works as a Project Assistant with the Information Training and Outreach Centre for Africa (ITOCA). His research interests include ICT for development, knowledge management and ICT training.