Promoting African Research and Education Networking

A Study Sponsored by IDRC

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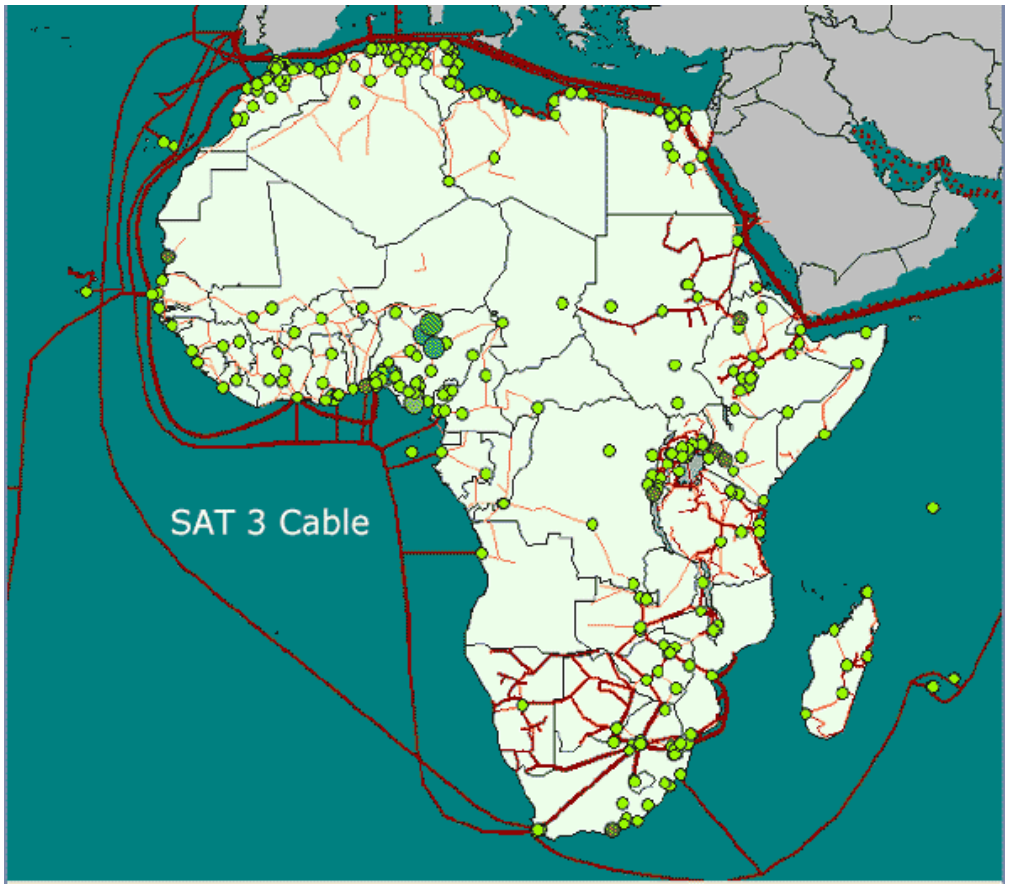
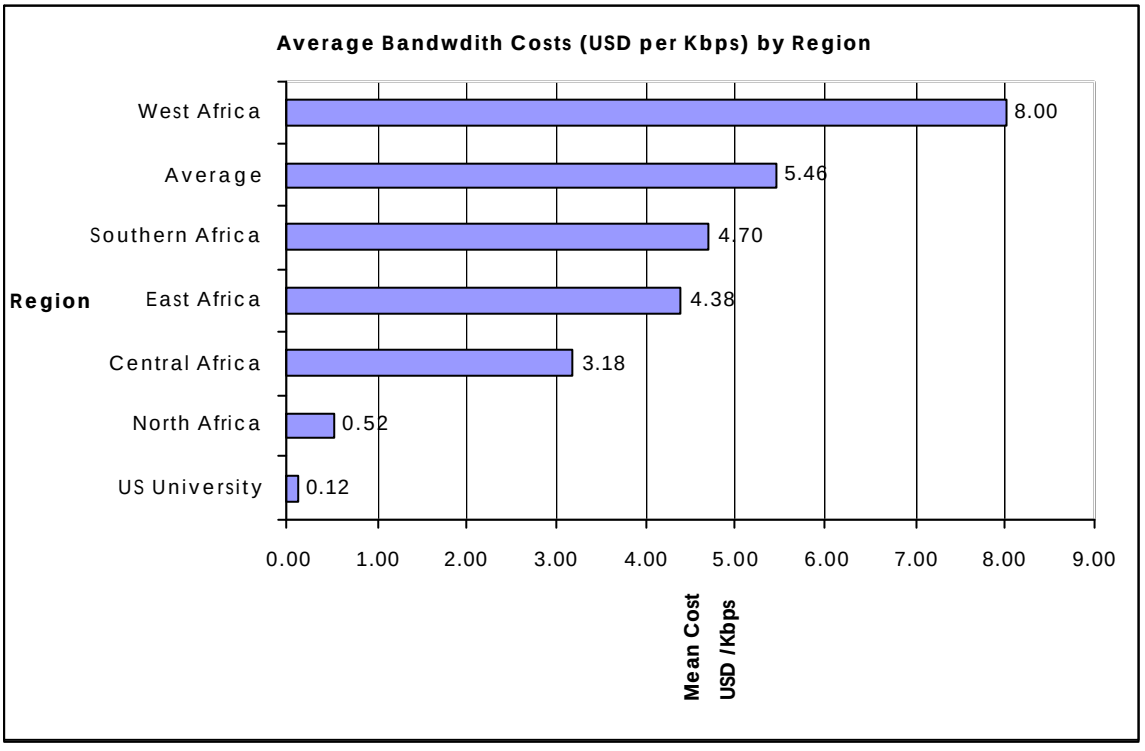


State of Internet Infrastructure *Source: IDRC*

Executive Summary

Internet connectivity in tertiary education institutions in Africa is in general too expensive, poorly managed and inadequate to meet even basic requirements. As the recent ATICS (Africa Tertiary Institutions Connectivity Survey) study for the African Virtual University showed, 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 (ATICS 2005). As a result, what little bandwidth that is available becomes even less useful for research and education purposes.

Average Bandwidth Costs/Kbps by Region (ATICS 2005)



However, initiatives within the continent point the way to a different future. North Africa is the most advanced of all regions in Africa because universities in these countries have just recently become members of the EU MED Connect project, which links them to high-speed undersea fibre networks. The potential for these types of arrangements hold out the possibility to dramatically alter the bandwidth landscape in tertiary institutions in the near future.

These experiences and those around the world argue strongly that there is an imperative to examine the potential to create initiatives to improve bandwidth access for African universities. A range of options is available. At one end relatively simple buying consortia can be created for even small groups of universities. On the other end the potential exists to create a continental 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.

The International Development Research Centre (IDRC) commissioned this work because it became aware of many parallel initiatives that would benefit greatly from working together both in terms of sharing information and in developing a common vision. The economies of scale for bandwidth purchasing are straightforward – the more bandwidth gets purchased the less expensive it becomes. Only through united action can these economies of scale be taken advantage of.

This is not by any means a new concept. Most of the organizations in this report understand this principle and several excellent reports have already addressed this issue (Bandits, ATICS). In addition many donor organizations have taken the issue of improved connectivity very seriously and many of their efforts are reflected in the success of the described networks. It is hoped that this effort will build upon these other initiatives and assist the community to address the many constraints to improved connectivity. These include political and

regulatory barriers, the challenges of working cross regionally, the challenges of providing equal opportunities to Francophone and Anglophone and Lusophone institutions, to name but a few.

The vision that motivates all of us in overcoming these obstacles is that of a fully connected African research and education system. Imagine the impact of providing all students and researchers' access to broadband level connectivity at their individual desktop! Today, African universities and researchers are often working in a silo model, insulated from regional actors and drivers of funding and requirements. Through establishing low cost high quality networks a platform for generative discourse can be created leading to improved policy advice, more effective cross pollination of best practices and lessons learned as well as encouraging an affinity towards cost sharing and partnership engagement models. Other benefits would include:

- An increase in African research material on the Internet - content that is directly relevant to the socio-economic development of African environments.
- Improved educational standards of African universities. By accessing the same research materials, students will be able to make meaningful contribution to their areas of research.
- Literature searches truly at the fingertips of the researchers. Today, in many cases they have to submit searches via fax or postal mail to a literature search service incurring both a cost and a significant delay in days. This is analogous to the research environment in the developed world 20-25 years ago.
- Enhanced peer review processes (both participation in reviewing and submissions) that need to be facilitated through electronic communications networks
- Increased collaboration and partnerships among individuals and research institutions and enabling regional comparative studies with localized partners.
- Real time collaboration with other international researchers using video conferencing. This aspect is very crucial especially in Medical research centres where critical theatre procedures

can be conducted with the participation of other international experts

- ϖ Enhanced institutional effectiveness,
- ϖ The creation of knowledge networks - crucial in co-coordinating world and Africa wide efforts in combating social ills such as HIV/AIDS and food insecurity
- ϖ Enabling regional centres of competences for local issues,

The proposal to create bandwidth consortia comes at a time when changes in the connectivity landscape in Africa are creating dramatic opportunities for increasing online access. Not only is there increased content that is directly relevant to Africa, but also there is the fact that bandwidth volumes have increased at the same time that significant policy reforms are enabling access to this bandwidth.

This survey was conducted over a period of four months and developed several key observations for improving connectivity to institutions in Africa. The study profiles several planned and existing regional and interregional groupings as well as intercontinental groupings. These are profiled separately from the national consortiums. The focus of the profiles was on:

- The motivation behind the formation of the grouping. This includes the objectives that the group wants to achieve. In most instances, these include the provision of bandwidth to tertiary institutions at relatively lower prices than those in the industrial market.
- The dates when the establishment was set up
- Membership of the organization and the requirements for becoming a member.
- The quantity and quality of bandwidth being made available to member institutions.
- Existing Network topology.
- Description of the nature of the organization, paying attention to organization and staffing structures.
- How the organisations are financing their operations. Given the exorbitant costs of bandwidth in Africa and the existing Internet

infrastructure, financing these organisations is a major challenge.
- Services that are being provided to members by the consortiums and,
- The challenges that are being faced by these networks in the carrying out of their duties, even in their actual establishment.

The profiles indicate a wide range of network structures, management, membership and services provided to members. As expected, networks from Europe, including Asia and Latin America seem to be more advanced than their African counterparts in terms of network infrastructure, bandwidth capacity and membership numbers. However, it is encouraging to note that several regional initiatives and networks are in the making and some national academic networks in North Africa have already fostered beneficial partnerships with European networks e.g. NRENs in Tunisia, Egypt, Morocco and Algeria now have high speed networks as they are linked to EUMEDConnect.

Key observations from the study

Network services

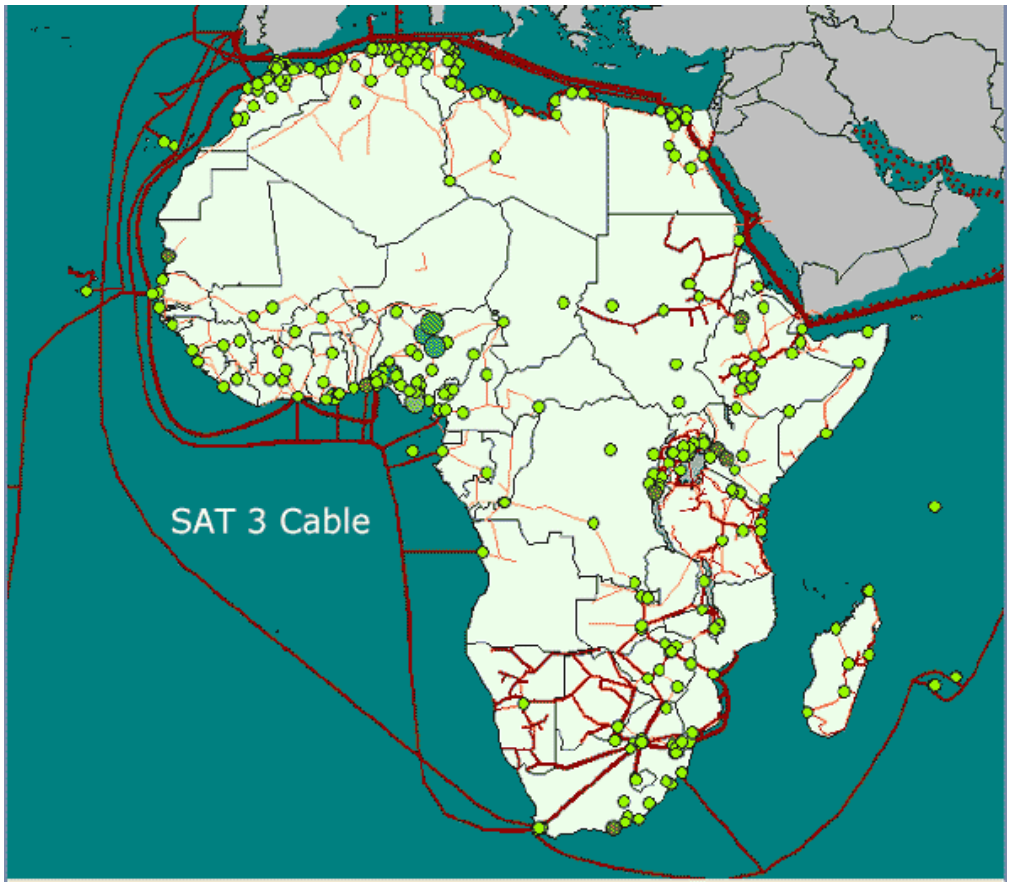
Most of the networks in Africa focus on the provision of basic Internet services, billing and network management. However, more effort is needed to address issues such as bandwidth monitoring and management, negotiating for the deregulation of policies which affect bandwidth provision, and bargaining for better pricing

State of Internet Infrastructure

The state of Internet infrastructure can be briefly explained as follows:

- Existing terrestrial links reflect a historic layering, which started with the Panaftel analogue network of the 1970s and 80s. In many cases, the Panaftel network within a given country

comprises the national transmission backbone today. Many of the links have deteriorated due to lack of funding and maintenance, and have fallen into disrepair, and some sections have been damaged or destroyed during war. In some countries, the analogue network has been upgraded and extended as the incumbent operator has built out its national backbone. The full extent, operational status, or capacity, of national backbone links across all African countries is not at this stage fully known. In South Africa, for example, as the map shows, only half of the institutions (17 out of 33) are at locations, which were, at least at one time, connected to the Panaftel network.



Source: IDRC, 2005

- All of Africa is currently covered by satellite bandwidth. By December 2003, thirteen satellite operators had 51 satellites deployed with coverage over Africa. These satellites have pointed

39 Ku-band frequency beams and 30 C-band beams throughout the continent. There are a number of planned regional connectivity projects include East Africa Digital Transmission project, COMTEL, Intelcom II, COM 7 and the submarine cable systems SEAMEWE II, SEAMEWE III, Sat-3/WASC and EASSy which surround the northern, western and eastern parts of Africa

- The overall supply pattern of bandwidth leaves a considerable gap in the market that can be filled by satellite-based suppliers in the short to medium term, particularly in areas (the interior, Eastern and central Africa) not yet reached by regional fibre projects, and in those countries which do not have national transmission backbones which reach hinterland locations (like Nigeria, Angola and DRC).

Bandwidth Cost Models

The costing structure of any African network will be influenced by the choices of networking made, since terrestrial-based and VSAT-based networks have very different cost structures. Given the bandwidth situation already existing in Africa, it appears that both VSAT and terrestrial networks will have to be used to cover all institutions. This situation complicates the generation of a uniform pricing model for the network. For a regional network, costs would need to be allocatedon a per site basis. However on a terrestrially delivered multiple site network this may be difficult to calculate without the correct tools in place. The simplest way to do this is to group sites that are connected back to the point of delivery, divide their bandwidth allocation by their costs and charge accordingly. It is easier if all the sites have the same bandwidth allocation

A satellite-delivered network is actually easier to cost out. The service is directly delivered and can therefore be costed directly according to the service provided. Once a determination was made for the bandwidths required, the vendor would calculate the price of services supplied and charge accordingly. The bandwidth volume has a dramatic effect on bandwidth pricing and savings of over 50% are

possible if institutions band together to purchase their bandwidth in larger volumes.

Governance

All national and regional academic and research networks have some form of an o*versight body*, usually represented by the board, an *advisory body*- usually represented by an advisory committee or board of trustees, and *executive management*- usually represented by secretariat managers and *operations*- represented by technical staff. Models of governance and management found in the profiled networks included the:

- *Reciprocity Model*: The majority of existing networks are set up as reciprocity networks, with members expecting mutual and equal benefits after making equal investments e.g. KENET (Kenya), CEENET (Central and Eastern Europe)
- *Donor Centred Model*: Some networks are funded by a single organization that takes the dominant role in management and governance e.g. DANTE for TIEN (Asia), ALICE (Latin America) and EUMEDCONNECT (Mediterranean and North Africa)
- *Special-Member Model*: Finally, there are networks where two or three parties make a greater investment in the project than the rest of the members. Those members with 'extra' amounts of investment then form a special group of members with certain privileges, as defined in their AUP e.g. CUDI in Mexico

Staffing patterns observed from the study include:

Full Operational Staffing: The organization sets up a complete operations structure, with both administrative and technical support offices e.g. APAN (Asia Pacific).

Decision Focused Staffing: This pattern consists of a single decision-making group that has the responsibility of outsourcing the requisite specialist services. Under this model, members are often tasked with maintaining their own link to the network. The group has responsibility over the usage of both the facilities and bandwidth e.g. TIEN, TENET.

Recommendations for Bandwidth Consortia

1. Establishing a Pan African VSAT Consortium

Due to the limited availability of international fibre gateways and national backbones, the establishment of regional or continental consortia for bandwidth purchasing is likely to focus on the purchase of satellite bandwidth but may also need to consider emerging international or national backbones in the near future. Given the fact that terrestrial infrastructure is still disjointed and sparse across much of Africa, the only immediate way to deploy a world-class educational network within an initial 12-month period is to implement a satellite-based network. The hardware for these types of networks is available at relatively low cost. It is also of higher quality and is more easily available. Because of the dramatic cost savings, which result from volume purchasing, a number of separate VSAT consortia could be created, if following that strategy proves to be more politically expedient.

There are essentially three ways in which a VSAT consortium could evolve:

*Creation of several regional and/or research-focused networks***:** For example, East, Southern and West African tertiary institutions could each create their own VSAT consortium. This way, each network would be able to deliver significant value because critical volumes would be obtained. Additionally, other specialty networks (i.e., for medical research, such as MIMCom, or language-focused networks [French West African]) could also be established.

Organic growth of existing established network: The obvious example of this is the initiative being taken by the AVU in sourcing bandwidth for the five universities participating in the Partnership for Higher Education. Over time, other institutions could join the consortium, and it could become the dominant bandwidth provider.

Establishment of an independent entity focused on bandwidth provision: African educational institutions and committed donors could decide to follow the example of most other networks in the

world and create an independent organization that is focused on providing the lowest cost bandwidth to its members.

2. Governance structure of Pan Africa VSAT Consortium

The study recommends that any Pan African VSAT consortium adopt the following governance structures:

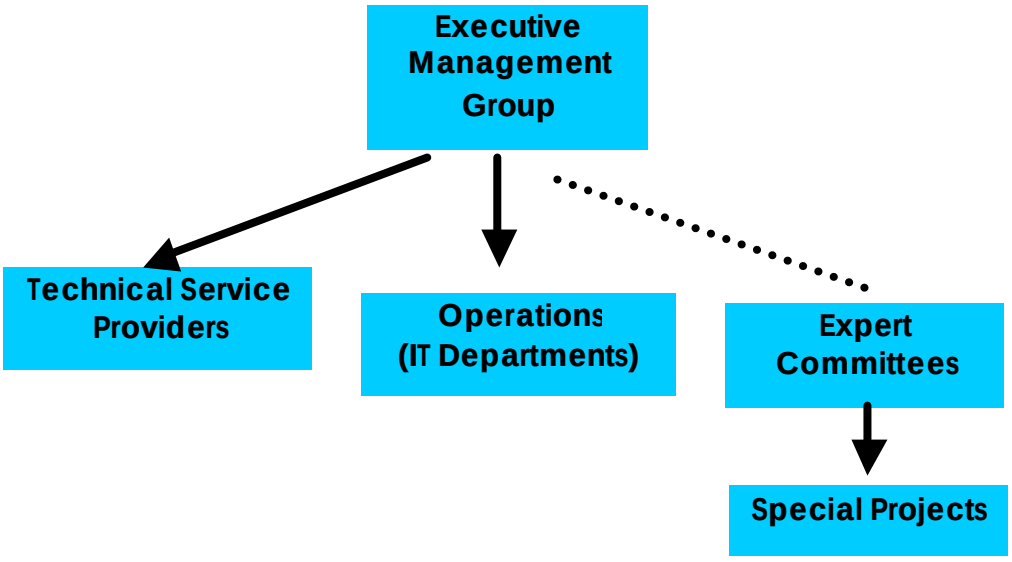
*Independent Board of Directors***:** This body would serve the primary oversight functions of a board: strategic direction and fiscal responsibility. Ideally, its members would represent a broad range of stakeholders, including representatives from governments, education institutions and the private sector, but it must be seen as being independent and acting in the best interests of the membership. The selection of the board would be the responsibility of the Membership Advisory Group and the funding agencies.

*Membership Advisory Group***:** This would comprise a group of not more than nine elected representatives of the educational institutions making up the membership of the consortium. The primary responsibility of this advisory group would be to work with the donors in selecting an appropriate board of directors and providing feedback as needed from the membership.

*Donor Advisory Group***:** This is envisioned as a group of donor representatives who would ensure that the strategic interests of the project are being met. The primary role of this group would be to select the board of directors and to ensure that funding is channelled to the consortium as needed.

3. Staffing structure for a Pan African VSAT Consortium

The staffing of the consortium organization should be minimized in order to ensure efficiency. Ideally, the technical management of the network (i.e., the management of the Network Operations Centre [NOC]) would be handled by the VSAT company supplying the bandwidth.



4. Network Configuration for a Pan African VSAT Consortium

The recommended network configuration would be a meshed network with a central hub in either the US or Europe. The network should not be over-complicated. Whilst the geographical spread is wide, if similar terminals – with only a few permutations on the hardware – were deployed from a central African store, it should not be too difficult to achieve a large number of deployed sites per month.

5. Funding and Sustainability Strategy

In order to achieve sustainability, the consortia will have to pursue a strategy of a gradual reduction of bandwidth subsidy over the course of 5 to 10 years. The example of TENET SA is instructive: the organization provided subsidies on increasing quantities of bandwidth over three years. At the end of this period, member institutions were covering all of their own bandwidth costs. The consortium will need to be a legal body that will sign the bandwidth contracts with the VSAT supplier in order to obtain the volume discounts desired.

However the consortium must then enter into binding contracts with each of the educational institutions for the provision of their bandwidth. It is expected that some member institutions will default on their payment obligations, and strategies must be in place to handle this eventuality. There are four primary mitigation strategies:

- Member institutions must prepay their bandwidth fees. If payment is not received on time, services will be immediately cut off. Usually, this creates a crisis within the institution, and funds are immediately prioritised for bandwidth.
- If member institutions create a history of non-payment, the amount of bandwidth they could purchase would be reduced.
- Estimates of expected default rates could be made and a "self insurance" fund created to cover the expected shortfall. Such a fund would be built into consortium charges
- Insurance companies are invited to provide insurance against default.

6. Regulatory Strategy

An important role of the consortium will be to negotiate with governments to allow the use of satellite and/or to eliminate license fees and monopoly pricing for educational bandwidth. A well-conceived diplomatic strategy would have to be pursued in order to accomplish this. Precedents, both within and outside of Africa, indicate that this is possible. EUMEDCONNECT, for example, was able to assist universities in North Africa in lobbying their governments for educational waiver on fees and pricing. Also, the Partnership for Higher Education has not had much difficulty in doing the same for the sub-Saharan countries in which they operate

7. Location of Consortium

From a technical standpoint, it would be best for the consortia headquarters to be located near the central hub – i.e., in the US or Europe. However, politically, it would best if the headquarters were located within Africa in a country with; good relations with rest of Africa, technical infrastructure advanced enough to meet the needs of an international office, facilities for easy travel to and from

headquarters, politically stable and where highly qualified staff are willing to be locate there.

8. Partnerships with Private Sectors

Strong partnerships will need to be forged with the various private-sector service providers. They will include:

- The satellite operator
- The satellite equipment suppliers
- The networking equipment suppliers

Any bandwidth consortium would have high visibility, a large number of sites, significant bandwidth and important political value. Given these characteristics, and the fact that most private-sector players have some sort of social responsibility program, favourable terms could be negotiated for their services.

9. Partnership with Regional Academic Networks in Other Continents

International networks such as Geant and Internet2 have already indicated their interest in assisting with linking their networks to similar emerging African networks. These could provide relatively low-cost upstream connectivity for African institutions. Also, it would be important to foster south-south knowledge exchange by ensuring that African networks are linked to their counterparts in Asia and Latin America

10. Recognition of Evolution of Bandwidth Sourcing

The consortium will have to actively monitor the bandwidth landscape in Africa and, as terrestrial options become more attractive, be able to quickly shift connections for certain institutions to the most competitive option. This will mean that, over time, the consortium will evolve from providing bandwidth via VSAT only to providing bandwidth via terrestrial sources as well.